



**India Meteorological Department
Mausam Bhawan, Lodi Road
New Delhi-110003**

NOTICE INVITING TENDER (NIT)

Tender Enquiry No. **DGM-HQ 32011(66)1/2021- CPU**

Dated: 18.10.2021

1. Director General of Meteorology (DGM), India Meteorological Department (IMD), Ministry of Earth Sciences (MoES), Government of India, on behalf of President of India invites, ONLINE tenders in two bid system i.e. (i) Technical bid & (ii) Price bid (Separately) from eligible and qualified **Indian Bidders** for procurement of following Goods/Articles/Services.
2. Name of Goods/Articles/Services : 01 No. **Procurement of Customize Rainfall Information System-II.**
3. Specification and Quantity : As per "RFP" Section under tender enquiry document
4. Tender schedule is as follows:

1.	PRE BID Conference	01.11 .2021 / 1100 Hrs. Place- Mausam Bhawan, Lodi Road New Delhi, Tel- 01143824460
2.	Closing date and time for submission of tender	01.12 .2021 / 1700 Hrs.
3.	Tender Opening date & time (Technical Bid)	03.12 .2021/ 1200 Hrs.
4.	Place of Tender Opening	Central Purchase Unit, O/o DGM, IMD, Lodi Road ,New Delhi.

5. **Earnest Money Deposit (EMD):** As per office memorandum No.F.9/4/2020-PPO dated 12/11/2020 of Ministry of Finance, Department of Expenditure PPD, No EMD is required for the tenders. The firm has to submit a signed Bid Security Declaration as per **Annexure -6** of tender document on their company letter head failing which their bid will be declared as unresponsive.
6. All prospective bidders are requested to attend the Pre Bid meeting as per venue, date and time indicated in the Para 4 above. The prospective bidders can send their queries preferably 5 days in advance before scheduled pre-bid meeting, on email: cpu.imd@imd.gov.in.

7. The bidder shall download the Tender Enquiry Document from <https://eprocure.gov.in/eprocure/app> and <https://internal.imd.gov.in/pages/tenders.php> Bidder shall upload their tender ONLINE through <https://eprocure.gov.in/eprocure/app> along with scanned copies of EMD documents as mentioned in Para 5 above. Manual bids are NOT accepted

8. In the event of the tender opening date being declared as holiday for the purchase organization, the tender will be opened on the next working day. The venue and time of tender opening will remain the same.

9. Purchaser : The President of India
Through Director General of Meteorology,
India Meteorological Department,
Lodi Road, New Delhi-110003

10. Consignee: Head (Hydromet Divn),
India Meteorological Department,
Lodi Road, New Delhi-110003

11. Inspecting Authority: Head (Hydromet Divn),
India Meteorological Department,
Lodi Road, New Delhi-110003.

12. Inspection officer: Authorized Representative of Inspecting Authority

Head, Central Purchase Unit (CPU)
O/o Director General of Meteorology,
India Meteorological Department,
Lodi Road, New Delhi-110003.
Email- cpu.imd@imd.gov.in



भारत मौसम विज्ञान विभाग
लोदी रोड, नई दिल्ली -110003

निविदा आमंत्रित करने की सूचना (एन आई टी)

निविदा जाँच सं. DGM-HQ 32011(66)1/2021- CPU

दिनांक: 18.10.2021

1. भारत के राष्ट्रपति की ओर से भारत मौसम विज्ञान विभाग (IMD), पृथ्वी विज्ञान मंत्रालय (MoES), दो बिड प्रणाली में ऑनलाइन निविदाएं अर्थात (एक) तकनीकी बिड और (दो) दर बिड में निम्नलिखित सामान / सेवाओं की खरीद के लिए पात्र और योग्य भारतीय बोलीदाताओं से टेंडर आमंत्रित करते हैं :
2. **सामान/ वस्तुएँ/ सेवाओं का नाम:** 01 No.Procurement of Customize Rainfall Information System-II.
3. **विनिर्देशन और मात्रा** : विनिर्देशन आर एफ पी के अनुसार ।
4. निविदा अनुसूची इस प्रकार है:

1	प्री बिड कांफ्रेंस	दिनांक बजे	01.11.2021 / 1100
		स्थान- मौसम भवन लोदी रोड नई दिल्ली Tel- 011 42364460	
2.	निविदा जमा करने की अंतिम तिथि व समय	दिनांक	01.12.2021 / 1700बजे
3.	निविदा खोलने की तिथि व समय (तकनीकी बिड)	दिनांक	03.12.2021/ 1200बजे
4.	निविदा खोलने का स्थान	केंद्रीय क्रय एकक, मौविमनि का कार्यालय भा.मौ.वि.वि , लोदी रोड, नई दिल्ली	

5. **EMD:** वित्त मंत्रालय, व्यय विभाग पीपीडी के कार्यालय ज्ञापन संख्या एफ.9/4/2020-पीपीओ दिनांक 12/11/2020 के अनुसार, निविदाओं के लिए किसी ईएमडी की आवश्यकता नहीं है। फर्म को अपनी कंपनी के लेटर हेड पर निविदा दस्तावेज के अनुबंध-6 के अनुसार एक हस्ताक्षरित बोली सुरक्षा घोषणा प्रस्तुत करनी होगी, ऐसा न करने पर उनकी बोली को अनुत्तरदायी घोषित कर दिया जाएगा।

6. सभी संभावित बोलीदाताओं से अनुरोध है कि वे उपरोक्त पैरा 4 में उल्लिखित स्थल, तिथि और समय के अनुसार बोली पूर्व बैठक में भाग लें। संभावित बोलीदाता अपने प्रश्नों को अधिमानतः 5 दिन पहले निर्धारित प्री-बिड मीटिंग से पहले ई मेल: cpu.imd@imd.gov.in पर भेज सकते हैं।
7. निविदाकर्ता को <https://eprocure.gov.in/eprocure/app> और <https://internal.imd.gov.in/pages/tenders.php> से निविदा पूछताछ दस्तावेज डाउनलोड करना होगा। <https://eprocure.gov.in/eprocure/app> ईएमडी दस्तावेजों की स्कैन की गई प्रतियों के साथ जैसा कि ऊपर पैरा 5 में उल्लेख किया गया है। मैनुअल बोलियां स्वीकार नहीं की जाती हैं।
8. यदि निविदा खोलने की तारीख के दिन क्रय संगठन का अवकाश घोषित होता है तो निविदा अगले कार्य दिवस को खोली जाएगी। निविदा खोलने का स्थान और तारीख वही रहेंगे।
9. क्रयकर्ता: भारत के महामहिम राष्ट्रपति
भा.मौ.वि.वि.के माध्यम से
भारत मौसम विज्ञान विभाग,
लोदी रोड, नई दिल्ली-110003
10. परेषिति: प्रमुख (Hydromet Divn)
भारत मौसम विज्ञान विभाग
लोदी रोड, नई दिल्ली-110003
11. जाँच प्राधिकारी: प्रमुख (Hydromet Divn)
भारत मौसम विज्ञान विभाग
लोदी रोड, नई दिल्ली-110003
12. जाँच अधिकारी: जाँच प्राधिकारी का प्राधिकृत प्रतिनिधि

प्रमुख, केंद्रीय क्रय एकक (कें.क्र.ए) ,
मौसम विज्ञान के महानिदेशक का कार्यालय,
लोदी रोड, नई दिल्ली- 110003
Email- cpu.imd@imd.gov.in



**TENDER DOCUMENT
FOR
PROCUREMENT OF
CUSTOMIZE RAINFALL INFORMATION SYSTEM-II.**

**Government of India
Ministry of Earth Sciences
India Meteorological Department
Lodi Road New Delhi-110003**

Tender Enquiry No. **DGM-HQ 32011(66)1/2021- CPU**

Dated: 18.10.2021

SECTION – I

INSTRUCTIONS TO BIDDERS

1. Introduction:

The India Meteorological Department (IMD) has issued this Tender Enquiry document for purchase of goods/stores/articles and related services as mentioned in "Request for Proposal (TENDER DOCUMENT)" which also indicates, inter alia, the required stores, delivery schedule, terms and conditions and place of delivery etc.

This section ("General Instructions to Bidders") provides the relevant information as well as instructions to assist -the prospective bidders in preparation and submission of tenders.

Bidders shall have to agree/accept all the terms and conditions of tender including payment terms etc.

Acceptance shall be unconditional and bidders shall have no claim and right in future on their terms, if any.

Bidders are allowed to quote in **Indian Rupees Only**.

2. Language of Tender:

The tender submitted by the bidder and all subsequent correspondence and documents relating to the tender exchanged between the bidder and IMD, shall be written in the English language.

3. Tendering Expense:

The bidder shall bear all the costs and expenditure incurred and/or to be incurred by them in preparation, and in uploading their tender including attending the pre-bid conference and or arranging demonstration of Product/Services or Presentations that may be deemed necessary by IMD.

4. Pre-Bid Conference:

- a) Pre-bid conference shall be held as per Notice Inviting Tender (NIT) schedule so as to provide an opportunity to the bidders to interact with India Meteorological Department (IMD) with regard to various tender provisions/clauses, before the bids are submitted.
- b) Request for clarification during pre-bid, if any, may be sent by email at ddgmhydrology@gmail.com latest by five working days before the commencement of pre-bid meeting. Pre-Bid minutes shall be uploaded on e-procurement portal (eprocure.gov.in/eprocure) and IMD website (<http://www.imd.gov.in/pages/tenders.php>).
- c) Bidders are requested to attend or may depute their authorized representative for pre-bid meeting.
- d) In case, due to the points/doubts raised by the prospective bidders, tender needs to be modified, the same will be considered for modification.
- e) No change will be permissible after notification of pre-bid minutes
- f) No reply in this regard shall be sent to individual bidders.
- g) Conditional tenders shall not be accepted on any ground and shall be rejected straightway. If any clarification is required, the same should be obtained on or before pre-bid meeting. No correspondence will be entertained after pre-bid meeting.
- h) Regular visit of website: Prospective Bidders are advised to see e-Procurement portal <http://eprocure.gov.in/eprocure> or IMD website

(<https://www.mausam.imd.gov.in>) on regular basis for any change in NIT schedule, amendment / corrigendum in Tender Document including technical requirement and pre-bid minutes etc.

5. Regular inspection of website:

Prospective bidders are advised to visit Central Public Procurement (CPP) portal eprocure.gov.in/eprocure and or IMD website (<https://www.mausam.imd.gov.in>) on regular basis for any change in NIT schedule like amendment / corrigendum in Tender Document including technical requirement and pre-bid minutes etc.

6. Amendments to Tender enquiry (TE) documents:

At any time, prior to the deadline for submission of tender, IMD may, for any reason deemed fit by it, modify the Tender Enquiry document by issuing suitable amendment(s) to it. The amendment will be uploaded on CPP portal eprocure.gov.in/eprocure only.

In order to provide reasonable time to the prospective bidders to take necessary action in preparing their tenders as per the amendment, IMD may, at its discretion extend the deadline for the submission of tenders and other allied time frames, which are linked with that deadline.

7. Documents Comprising the Tender:

The tender is to be submitted in Two Bid System. The "**Techno - Commercial Bid**" and "**Price Bid**" prepared by the bidder shall comprise the followings:

(A) Techno - Commercial Tender (Un-priced Tender)

The following documents are to be furnished by the bidder along with Technical Bid (Techno-Commercial Bid) as per the eligibility conditions applicable. Bidder shall upload following documents on CPP Portal eprocure.gov.in/eprocure

- a) Company profile and Infrastructure
- b) All the documents asked for Eligibility Criteria.
- c) Copy of Tender document in each page duly signed and stamped.
- d) Compliance sheet as per Annexure-3 and the supporting documents.
- e) Checklist section (as per Annexure-4) properly filled and signed.
- f) Submission of Tender Acceptance form as per format given in Annexure-5.
- g) Any deviations to the Terms and Conditions including Financial shall clearly be brought out in the Technical proposal with specific reasons

- h) The Technical bid file in PDF format, NOT containing the above documents or containing the financial bid (with price quote details) in explicit/implicit form will lead to rejection of the bid.
- i) Registration certificate of bidding firm with any state and central government body of India. Credential/document shall be attached.
- j) Checklist section (as per Annexure-4) properly filled, signed and stamped.
- k) Scanned copy of Earnest Money Deposit (EMD) in the form of Fixed Deposit Receipt/ Bank Guarantee (FDR/BG).
- l) Original EMD in physical form shall be submitted to Central Purchase Unit, Office of DGM, IMD, on or before opening of tender.
- m) Documentary evidence for fulfillment of Eligibility /Qualification criteria.
- n) Certificate issued by competent authority from Ministry of MSME/ National Small Industries Corporation shall be uploaded on eprocure.gov.in/eprocure(CPP Portal) and original shall be submitted in Central purchase Unit of IMD on or before opening of tenders.
- o) Tender terms & Conditions Acceptance Form (as per Annexure-5) duly signed and stamped.
- p) Technical Bid duly signed and stamped on all pages.
- q) List of deliverable (un-priced/without price) shall be submitted with details of make and model being offered etc. All should be similar to the items in price bid.
- r) *The above documents must be signed (all pages), stamped and scanned& shall be attached in the beginning of technical bid.*
- s) *Successful Bidders are required to sign Non disclosure agreement with IMD*

(B) Price Bid

Price bid documents are to be furnished by the bidder as per following:

- a) All pages of the price bid should be page numbered, indexed and signed with company/firm's seal by authorized signatory.
- b) Price Bid shall be quoted as per price schedule format (Chapter-4).
- c) Costing of each and every item, sub items offered in bidder's technical bid, shall be done with all breakup prices.
- d) The bidder shall indicate on the Price Schedule specifying all components (main units and sub units etc. of each item) of prices shown therein including the unit prices and total tender prices of the goods (Hardware & Software), services,

packing, inland transportation/freight/insurance to the sites, GST or any other duties and taxes applicable against the requirement.

- e) Successful bidder shall bear all the taxes (GST/IGST/SGST/Income-tax/WCT/or any other taxes) levied by the state / central government in force in India, as per the rates prevailing at the time of undertaking the job in accordance with the Income-tax Act.
- f) Comprehensive Annual Maintenance Contract (CAMC) shall be only for the maintenance of stores (all equipment and software supplied by bidder only) therefore prospective bidders are advised to quote CAMC charges accordingly and specifically for 36 months after the expiry of 24 months of warranty period. The charges are to be quoted for each year, on annual basis. Minimum amount cannot be less than 6 % of the capital cost.
- g) The reasonability of cost including the CAMC charges shall be a criterion in short listing the Bidders. Justification of CAMC charges with breakup need to be submitted along with the bid.
- h) In case any charges not mentioned in the price bid, it will be treated as all the charges are free of cost for that item.
- i) Bidder shall quote prices on F.O.R basis.
- j) If there is a discrepancy between the amount expressed in words and figures, the amount in words shall prevail.
- k) The rates are to be quoted by the Bidders in Indian Currency and payment shall be made to successful Bidders in Indian currency only.
- l) The Bidder shall bear all the Income-tax liability as per rates prevailing at the time of undertaking the job in accordance with the Income-tax Act in force in India.
- m) Percentage (%) of taxes etc. if any to be claimed shall be indicated in the Price bid, otherwise it will be presumed that rates are inclusive of all taxes and no plea would be accepted in this regard after opening of the Tender bids.
- n) Any firm in India (Agent/ Authorized Supplier /Dealer/ Subsidiary/ Integrators/ Distributors/ Stockist etc. of their foreign principal) quoting prices in foreign-currency and payment (in foreign currency) has to go to his foreign principal, then bidding firm in India must have enlistment with . Indian firm shall not be paid in foreign currency.

Price bid shall summarily be rejected in case of any deviation from the un-priced bid given with the technical bid of the bidder.

Price bids shall not be accepted if CAMC charges are quoted in percentage.

8. **Signing and Submission of Tender:**

- a) The Bidder has to quote for all items mentioned in Scope of the Services, as per Price-bid format given in Annexure-2
- b) No deviations in terms & conditions of the tender document will be accepted in any case.
- c) Uploading of bids on e-Procurement portal is an essential requirement. Bids not submitted through e-Procurement portal will not be considered for tender evaluation. The bids submitted by fax/ E-mail / manually etc. shall not be considered. No correspondence will be entertained on this matter.
- d) All the documents attached to the tender for considering offer are supposed to be complete in all respects. Therefore, it is important that all tender documents (scanned copies in PDF format) are duly filled in, duly signed-in and duly stamped, in all respects before uploading.
- e) IMD will not be responsible for any delay on the part of the bidder in obtaining the terms and conditions of the tender notice or submission of the online bids.
- f) Without EMD unless exempted, bid will be treated as cancelled.

Properly signed and stamped tender on the company letterhead shall be uploaded online through CPP Portal, eprocure.gov.in/eprocure. **Hard copy of bids shall not be considered and accepted for submission of tender document.** The tender shall not contain any over writing. Only PDF format of the tender shall be uploaded on CPP portal and will be treated as final version of the bid.

Note: One set of hard copy of the complete techno-commercial bid document which was uploaded during submission of tender is to be submitted before opening of the bid. If any discrepancy is noted between the softcopy uploaded and the hard copy of the tecno-commercial document, the soft copy will be considered as the final version for tender evaluation.

9. **Alteration and Withdrawal of Tender :**

- a) The bidder after uploading its tender on CPP portal is permitted to alter / modify its tenderso long as such alterations / modifications are received duly signed, sealed and marked like the original tender, within the deadline for submission of tenders.
- b) No tender should be withdrawn after the deadline for submission of tender and before expiry of the tender validity period. If a Bidder withdraws the tender during this period, it will result in forfeiture of the EMD furnished by the Bidder.

- c) Any discrepancy noticed in the hard copy and the soft copy of the bid submitted online by the bidder, the uploaded soft copy will be treated as final version of the bid for evaluation.

10. Opening of Tenders:

IMD will open the tenders at the specified date and time and at the specified place as indicated in the NIT. In case the specified date of tender opening falls on / is subsequently declared a holiday or closed day for IMD, the tenders will be opened at the appointed time and place on the next working day.

Authorized representatives of the bidders, may attend the tender opening process, provided they carry letter of authority from the respective bidders.

- a) The Technical Bids are to be opened at the prescribed date and time. These bids shall be scrutinized and evaluated by the competent committee/ authority with reference to parameters prescribed in the TE document. During the Technical Bids opening, the tender opening official(s) will read the salient features of the tenders like delivery period, Earnest Money Deposit and any other special features of the tenders, as deemed fit by the tender opening official(s).
- b) Thereafter, in the second stage, the Price Bids of technically qualified bidders only shall be opened for further scrutiny and evaluation on a date notified after evaluation of the techno commercial tender.

11. Scrutiny and Evaluation for acceptance of tender

(A) Scrutiny of bids:

The tenders will be scrutinized to determine whether they are complete in all respects and meet the essential important requirements, conditions etc. as prescribed in the TE document.

The tenders are liable to be treated as non - responsive and will be summarily rejected if following are not essentially provided along with techno-commercial bids.

- a) Registration certificate of bidding firm with any state and central government body of India. (Credentials/documents shall be attached).
- b) Tender should be signed, stamped and complete in all respects. All documents shall also be digitally signed.
- c) Properly signed and stamped checklist (Annexure-4) and fully completed compliance statement (Annexure 3) is to be enclosed.
- d) Tender Acceptance Form (Annexure-5) to be duly signed and stamped. (i.e. all the terms & conditions of tender document are acceptable).

- e) Tender validity is shorter than the required period.
- f) Required EMD to be provided unless exempted.
- g) Bidders' consent to provide the required performance security.
- h) Copy of agreement of bidding firm from India with its foreign principal, if any, along with the precise relationship between them and nature of services which would be available from bidding firm in India, also to be attached with the tender.
- i) Proof of MSME on the date of tender submission for exemption of EMD.

(B) Technical Evaluation:

- a) After the tender acceptance, tenders shall be evaluated to assess the technical suitability of the bid with respect to the terms and conditions of the RFP, by the committee constituted by competent authority.
- b) If during the preliminary examination, IMD finds any minor deviations/irregularity and/or non-conformity regarding technical evaluation in a tender, IMD may waive the same provided it does not constitute any material deviation and has no financial impact and, also, does not prejudice or affect the ranking order of the bidders.
- c) Wherever necessary, IMD will convey its observation on such 'minor' issues to the bidder seeking their response by a specified date. If the bidder does not respond by the specified date or provides evasive/incomplete reply without clarifying the exact point in clear terms, that tender will be liable to be ignored for further processing.
- d) Technical presentation in the presence of the committee shall be held in IMD. The committee will seek proof of capabilities claimed in the compliance matrix provided by the respective bidder. IMD will seek clarifications on the design, performance and other technical points during the presentation. All points will be recorded.
- e) Compliance statement in the form of 'Complied' or 'Not Complied' shall be given against each term and specification mentioned in the tender document. The compliance statement should contain the signature of the authorized person and the seal of the company. Any deviation should be mentioned / explained by the Bidder in Compliance Statement. The compliance statements should be supported by authentic documentation. Deviations in lower side will not be accepted.
- f) No enquiry shall be made by the Bidder(s) during the course of evaluation of the tender, after opening of bid, till final decision is conveyed to the successful Bidder(s).
- g) The names of technically short listed Bidders will be announced to only those Bidders whose bids will qualify for opening of the Price/Financial/Commercial Bids.

(C) Financial evaluation:

- a) After Technical Evaluation, the Price Bids of only the technically qualified bidders shall be opened for further scrutiny and evaluation on a date notified after completion of evaluation of the techno commercial tender.
- b) IMD shall evaluate the technically qualified financial bids for deciding lowest bidder (L-1) on the basis of landing costs of the store including all applicable taxes/levies/duties etc.
- c) The cost of Warranty/Extended Warranty and CAMC charges etc will be added to evaluate financial bid for deciding lowest bidder L-1. Charges towards Insurance, Freight and transportation of goods up to delivery at sites etc applicable from time to time for taking purchase decision shall also be added. These should be clearly indicated by the bidder.
- d) IF ANY CHARGES ARE NOT INDICATED SPECIFICALLY AND SEPARATELY IN THE BID, SAME WILL BE TREATED AS INCLUSIVE.
- e) The Financial Bids of only those Bidders short-listed from the Technical Bids by TEC will be opened in the presence of their representatives on a specified date and time to be intimated to the respective Bidders, and the same will be evaluated by a duly constituted Finance Evaluation Committee (FEC).
- f) There will be NO NEGOTIATION regarding the financial bid.
- g) No enquiry shall be made by the Bidder(s) during the course of evaluation of the tender, after opening of bid, till final decision is conveyed to the successful Bidder(s). However, the Committee/its authorized representative and office of IMD can make any enquiry/seek clarification from the Bidders, which the Bidders must furnish within the stipulated time else bid of such defaulting Bidders will be rejected.
- h) If there is a discrepancy between the unit price and total price, The Unit Price shall prevail.

12. Inspection, Testing and Factory acceptance test (FAT):

- a) IMD reserves the right to evaluate the Software development at the various stages of the development cycle and its confirmation to the SLA before the final acceptance. The developed software needs to have all the functional requirements as per the Technical document subsequent to the installation and commissioning.
- b) SAT shall be undertaken by IMD for the applications developed installed and commissioned. Additionally, the Web audit of the Web site and hosting of the mobile app on the (IOS & android) Play-stores will only be acceptable.

- c) Goods accepted by IMD/consignee and/or its inspector at initial inspection shall in no way dilute purchaser's/ consignee's right to reject the same later, if found deficient in terms of the clauses of the contract.
- d) During SAT, cost of travel, per diem charges and charges for boarding/lodging for IMD personnel (Maximum 5 persons) will be borne by IMD, Government of India.

CHAPTER-2

Conditions of Contract (CoC)

Bidder shall have to agree/accept all the terms and conditions of tenders including payment terms etc. Acceptance shall be unconditional and bidder shall have no claim and right in future on their terms if any.

NOTE: Whenever there is any conflict between the provisions in the GCC regards to specific Para under "List of requirements/ technical specifications", the provision contained in the "List of requirements/ technical specifications" shall prevail and have an over-riding effect.

Any Special instructions as per "List of requirements/ technical specifications" section will also apply for this purchase.

The conditions (like qualification criteria, delivery schedule, mode of delivery & sites of delivery etc.) mentioned in "List of requirements/ technical specifications section" etc. will also apply for this purchase.

1. Tender Validity:

The tenders shall remain valid for acceptance for a period of 180 days (one hundred eighty days) after the date of tender opening prescribed in the TE document.

1.1 The tenders shall remain valid for acceptance for a period of 180 days (one hundred eighty days) after the date of tender opening prescribed in the Tender Enquiry (TE) document.

1.2 Purchaser's Right to accept any tender and to reject any or all tenders.

1.3 The purchaser reserves the right to accept in part or in full any tender or reject any tender without assigning any reason or to cancel the tendering process and reject all tenders at any

2. Purchaser's Right to accept any tender and to reject any or all tenders:

IMD reserves the right to accept in part or in full any tender or reject any tender without assigning any reason or to cancel the tendering process and reject all tenders at any time, prior to award of contract, without incurring any liability whatsoever to the affected bidder or bidders.

3. Tender Fee:

No tender fee is charged on the downloaded and e-tenders.

4. Price preference:

- a) Price preference shall be given to Micro and Small Industries registered as per requirement of tender document with National Small Industries Corporation or any other government agencies as per the latest guidelines/orders from Government of India.
- b) The bidders shall have to upload and submit the copy of valid registration certificate. Micro and small Enterprises are exempted from submitting fees/cost towards tender document and submission of earnest money deposit (EMD), also known as security deposit.
- c) Micro and small Enterprises are not exempted for performance security or Bank Guarantee (BG) and have to furnish performance security if contract is awarded to them. There is no relaxation in this regard.

5. Qualification criteria for Bidders:

- a. Prime Bidder should have an average turnover of 1.0 Crore per annum during the last three years and must have experience in design, development, hosting of GIS based, dynamic website in server environment and application softwares.
- b. Prime bidder must have completed at least three similar nature of work (GIGW Compliance, CMS, GIS based, Database oriented Dynamic website duly audited by CERT (Computer Emergency Response Team) -In empaneled vendors) during last five years.
- c. Prime Bidder has to provide a completion certificate from such client and; at least (02) two completion certificate preferably from Central / State Government agencies /PSU
- d. Prime bidder must have a valid ISO 9001:2015 or 90001:2008 certificate.
- e. If the quote is from a foreign firm it should be through an Indian partner who meets the above experience criteria.
- f. The Bidder must provide the details on technical manpower as per Annexure-1.
- g. The registration number, GST and PAN numbers of the firm should be submitted, failing which Bidder's bid-offer would become invalid & same shall be rejected.

- h. The Bidder should submit the details of agreements entered into with various Manufacturers/Partners/Sub-contractors for executing the work as per RFP and their experience to meet the qualification & experience criteria. The Manufacturer Authorisation form duly filled-up as per Annexure-8.
- i. A self-certificate stating that the Bidder is not presently blacklisted and hasn't been black listed by any institution of the Central/State Government in the past three years should be submitted.
- j. The Bidder is requested to furnish documents to establish their eligibility for each of the above clauses. Relevant portions, in the documents submitted in pursuance of eligibility criteria mentioned above, should be highlighted. If tender were not accompanied by all the above documents mentioned, the same would be rejected. Undertaking for subsequent submission of any of the above document will not be entertained. However, IMD reserves the right to seek a fresh set of documents or seek clarifications on the already submitted documents. All documents should be submitted electronically in PDF format. Upon verification, evaluation / assessment, if in case any information furnished by the Bidder is found to be false / incorrect, their bid shall be summarily rejected and no correspondence on the same shall be entertained.
- k. The prime bidder /and its constituents, in case of joint venture should be from the country which do not share the land border with the Republic of India.
- l. THE BID SUBMITTED BY ANY BIDDER NOT FULFILLING THE ELIGIBILITY CONDITIONS / CRITERIA DETAILED ABOVE, WILL NOT BE CONSIDERED.

6. Contact Details:

The complete name and address of the Indian bidding firm along with permanent income tax account number (PAN) as allotted by the Indian Income Tax authority must be submitted.

7. Earnest Money Deposit (EMD):

- a) The bidder shall furnish along with its tender, earnest money for an amount as shown in the tender notice.
- b) The bidders who are registered as Micro and small Enterprises specified by Ministry of Micro, Small & Medium Enterprises (MSME) only for the specific item and services being procured under this tender are exempted from EMD.

- c) The EMD shall be furnished in Fixed Deposit Receipt (FDR) or Bank Guarantee (BG) (as per Annexure-6) from any Nationalized bank in India.
- d) The earnest money shall be valid for period of sixty (60) days beyond the validity period of the tender.

8. Refund of EMD:

- a) EMD of the unsuccessful bidders will be returned to them without any interest, after expiry of the tender validity period.
- b) EMD of the successful bidder will be returned without any interest, after receipt of Performance Bank Guarantee (PBG) from the successful bidder.
- c) Successful bidder shall submit pre-receipt for obtaining back their security.
- d) Application of request for refund of EMD is given at Annexure-7

9. Forfeit of EMD:

- a) Earnest money of a bidder will be forfeited, if the bidder withdraws or amends its tender or impairs or derogates from the tender in any respect within the period of validity of its tender or if it comes to notice that the information/documents furnished in its tender is incorrect, false, misleading or forged without prejudice to other rights of IMD.
- b) The successful bidder's earnest money will be forfeited without prejudice to other rights of Purchaser if supplier fails to furnish the required performance security within the specified period.
- c) Firm shall have to extend the validity of EMD if extension of tender validity is agreed on the request of purchaser in exceptional cases.

10. Performance Security:

A. Submission

Successful bidder shall submit performance security as per Annexure-10, within thirty (30) days from date of dispatch of supply order/award of contract by IMD or within twentyone (21) days from the receipt of supply order by Successful bidder whichever is earlier.

- a) IMD may consider annulment/cancellation of supply order/ award of contract if performance security not received in stipulated time.
- b) There is no relaxation/exemption in submitting of performance security.
- c) Successful bidder shall furnish performance security to the purchaser for an amount equal to three percent (3%) of the total value of the order excluding CAMC charges,

valid up to sixty (60) days beyond the warranty period. The format of bank guarantee to be submitted as performance security is given in Annexure-10.

- d) Post warranty, the bidder has to submit performance security to the purchaser for an amount equal to ten percent (10%) of the CAMC value, valid up to sixty (60) days beyond the CAMC period ordered.
- e) Performance Security has to be submitted irrespective of its registration in NSIC etc.
- f) Performance security is not relaxed to any bidder.
- g) Performance Security shall be in any one of the articles namely FDR or PBG drawn / issued by a Nationalized bank in the prescribed form, in favour of “DDO, India Meteorological Department, New Delhi”. If the Security Deposit is not paid within time specified, the Earnest Money Deposit of the Bidder shall be forfeited. No interest will be payable for “Performance Security”.
- h) In the event of any amendment issued to the contract, Successful bidder shall, within twenty-one (21) days of issue of the amendment, furnish the corresponding amendment to the Performance Security (as necessary), rendering the same valid in all respects in terms of the contract, as amended.
- i) The purchaser may consider annulment/cancellation of supply order/ award of contract if performance security not received in stipulated time.
- j) Performance Security shall be furnished by foreign supplier (participated directly in the tender) including indigenous components to be taken by their representative.
- k) Bank Guarantee issued from the foreign banks must be authenticated by State Bank of India (SBI) or any other Nationalized Bank of India.
- l) Firms, registered with NSIC/ MSME, quoting on behalf of their foreign principal shall be responsible for furnishing performance security for the entire project tenure.
- m) Performance Security has to be submitted irrespective of its registration NSIC etc. Performance security is not relaxed to any supplier/service provider. Submission of Performance Security is must for all suppliers/service providers.
- n) It shall be in any one of the forms namely Fixed Deposit Receipt or Bank Guarantee drawn/issued by a commercial bank doing Government business in the prescribed form in favour of the purchaser. In the event of any amendment issued to the contract, the supplier shall, within twenty-one (21) days of issue of the amendment, furnish the corresponding amendment to the Performance Security (as necessary), rendering the same valid in all respects in terms of the contract, as amended. Foreign Bidder may submit in the form of Bank Guarantee. Bank Guarantee issued

from the foreign banks must be authenticated by STATE BANK OF INDIA or any other Nationalized Bank of India.

- o) The purchaser will release the Performance Security without any interest to the supplier/ service provider on completion of the supplier's all contractual obligations including the warranty obligations & after receipt of performance security for CAMC (if applicable).
- p) In the event of non-providing the services, the Performance Security shall be forfeited to the extent the services are not provided. Further, if the purchaser has to get the services from any other Bidder because of failure to provide in full or part by the successful Bidder, the difference in payment may be made from such amount. Also, the amount retained towards "Performance Security" is subject to forfeiture if it is found at any point of time during the period of contract that the services offered by the supplier are not in conformity to the accepted specifications mentioned in RFP by the purchaser.
- q) In case the Bidder backs out of the contract in mid stream without explicit consent of the IMD, the PBG will stand forfeited.

B. Refund

On completion of the Project, the Performance Bank Guarantee without any interest accrued shall be released after ascertaining that satisfactory support that has been provided during CAMC period. In case, it is found that appropriate satisfactory support has not been provided by the Bidder, IMD will ensure that the prescribed penalty as per clause 6.14, 6.15& 6.5 in Chapter 3 for the default in service has been realized or shall be recovered from the Bidder out of already due payments.

11. Force Majeure:

- a) Force Majeure means an event beyond the control of Successful bidder and not involving Successful bidder's fault or negligence and which is not foreseeable. Such events may include, but are not restricted to, acts of IMD either in its sovereign or contractual capacity, wars or revolutions, hostility, acts of public enemy, civil commotion, sabotage, fires, floods, explosions, epidemics, quarantine restrictions, strikes, lockdown, lockouts, and freight embargoes.
- b) If there is delay in performance or other failures by Successful bidder to perform its obligation under its contract due to event of a Force Majeure, Successful bidder shall not be held responsible for such delays/failures.

- c) If a Force Majeure situation arises, Successful bidder shall promptly notify IMD in writing of such conditions and the cause thereof within twenty one days of occurrence of such event.
- d) Unless otherwise directed by IMD in writing, Successful bidder shall continue to perform its obligations under the contract as far as reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.
- e) If the performance in whole or in part or any obligation under this contract is prevented or delayed by any reason of Force Majeure for a period exceeding sixty days, either party may at its option terminate the contract without any financial repercussion on either side.
- f) There may be a Force Majeure situation affecting the purchase organization only. In such a situation the purchase organization shall take up with Successful bidder on similar lines as above for further necessary action.

12. Warranty

- a) Entire website system including all the hardware, software, applications, Mobile APPS, etc. shall be under warranty for 24 months from the date of acceptance & commissioning of the system.
- b) The warranty shall be on-site warranty for 24 months. The quoted rate shall deemed to include the same.
- c) Successful bidder shall be bound to furnish a clear written warranty.
- d) Successful bidder shall provide warranty certificate from the OEM for the goods along with date of manufacturing of stores/products.
- e) Warranty shall be quoted as per IMD requirements i.e. 24 months after commissioning of the whole system, otherwise the Bid shall be considered as unresponsive.
- f) Other condition, if any, under warranty clause of "List of requirements/ technical specifications" section shall also be applicable.

13. Comprehensive Annual Maintenance Contract (CAMC)

- a) Post warranty, the complete system shall be under comprehensive AMC for 36 months from the date of expiry of 24 months warranty. Upgradation/migration of system if required due to any change in technology, hardware, software, or any other unforeseen reasons, shall be done by the firm during warranty and AMC period.

- b) Bidder should carry out necessary modifications and improvements in application software due to new requirements and in the formats which may come up in course of time during the warranty and CAMC period.
- c) IMD/Consignee reserves the rights to enter into Comprehensive Annual Maintenance contract between Consignee and Successful bidder after the completion of warranty period.
- d) CAMC shall be for the maintenance of the developed application and the platform on which the application is built Prospective bidders are advised to quote accordingly and specifically.
- e) Payment for maintenance contract is made on quarterly basis unless it is specified otherwise in the technical section.

As per IMD requirements, year wise CAMC shall be quoted for 36 months after completion of 24 months warranty period, otherwise the Bid shall be considered as unresponsive.

14. Award Criteria and Tolerance Clause:

- a) The purchase order /supply order shall be awarded to the eligible responsive BIDDER tender, evaluated as the most economical, technically qualified and suitable to the requirements.

15. Modification of contract:

- a) If necessary, during the period of the contract, IMD may amend the contract, by making alterations and modifications within the general scope of contract and issue a written amendment in this regard to Successful bidder at any time.
- b) If Successful bidder doesn't agree to the adjustment made by IMD, Successful bidder shall convey its views to IMD, within fifteen (15) days from the date of Successful bidder's receipt of IMD's amendment / modification of the contract.
- c) The successful Bidder shall sign a contract agreement with IMD as per terms and conditions specified in the RFP. The format of the Agreement will be provided after finalisation of successful Bidder.

16. Income Tax and service tax etc:

- i. Tax deducted at source (TDS) shall be done before making payment to Successful bidder as per existing law in force. The bidder may visit website of Income Tax Department of India for details of Tax Liabilities, Rules, and Procedures etc.
- ii. The bidders shall have to provide their Permanent Income Tax Number (PAN), TAN and GST registration number.

17. Terms and Mode of Payment:

a) Payment towards Supply, installation and commissioning of the systems:-

- I. Payment, as per term mentioned below, shall be made subject to recoveries, if any, by way of liquidated damages /penalty clause /TDS or any other charges as per terms & conditions of contract if not specified elsewhere in the document.
- II. Payment of software and services (design, development, hosting of website and integrated mobile apps) excluding CAMC: 20% on successful CDR (Critical Design Review) meeting and remaining 80% on commissioning of project including security audit, completion of training, commissioning, test and acceptance of the system.
- III. CAMC charges shall be paid for the completed half yearly period, after providing satisfactory service for the period post warranty; however, charges for CAMC shall be considered for deciding the lowest bidder (L-1).

b) Payment towards Comprehensive Annual Maintenance Contract Charges:

- i. IMD will enter into CAMC agreement along with the SLA with Successful bidder at the rates as stipulated in the contract, after warranty period.
- ii. The payment of CAMC will be made after satisfactory completion on quarterly basis as per TENDER DOCUMENT terms and duly certified by IMD.
- iii. Successful bidder shall send its claim for payment in writing, when contractually due, along with relevant documents etc., duly signed with date, to IMDs.

C) Following documents shall be submitted along with the Bills:

- i. Three copies of supplier's invoice showing contract number, goods description, quantity, unit price and total amount.
- ii. Consignee Receipt Certificate in original issued by the authorized representative of IMD.
- iii. Copies of delivery Challan identifying contents of each package.

- iv. Inspection certificate by the nominated Inspection agency, if any. Insurance Certificate.
- v. Final Acceptance Report from consignee.
- vi. Bills/invoices must be submitted separately for stores and services.
- vii. The bidder shall submit particulars of his bank account required for making payments.

(a) Account Number **(b)** Bank Name **(c)** Branch Name **(d)** Address **(e)**IFS code **(f)** MICRNo.**(g)** Telephone No. **(h)** SWIFT code etc.

18. Termination of tender by IMD:

- a) From the time of submission of tender to the time of awarding the contract, if a bidder/firm needs to contact IMD for any reason relating to this tender enquiry and/or its tender, it should do so only in writing.
- b) In case a bidder/firm attempts to influence IMD in IMD's decision on scrutiny, comparison & evaluation of tenders and awarding the contract, the tender shall be liable for rejection in addition to appropriate administrative actions being taken against that bidder, as deemed fit by IMD.
- c) IMD, without prejudice to any other contractual rights and remedies available to it (IMD), may, by written notice of default sent to Successful bidder, terminate the contract in whole or in part, if Successful bidder fails to deliver any or all of the goods or fails to perform any other contractual obligation(s) within the time period specified in the contract, or within any extension thereof granted by IMD.
- d) In the event of IMD terminating the contract in whole or in part, IMD may procure goods and/or services similar to those cancelled, with such terms and conditions and in such manner as it deems fit and Successful bidder shall be liable to pay IMD for the extra expenditure, if any, incurred by IMD for arranging such procurement.
- e) If Successful bidder becomes bankrupt or otherwise insolvent, IMD reserves the right to terminate the contract at any time, by serving written notice to Successful bidder without any compensation, whatsoever, to Successful bidder, subject to further condition that such termination will not prejudice or affect the rights and remedies which have accrued and / or will accrue thereafter to IMD.

19. Arbitration clause:

- a) If dispute or difference of any kind shall arise between IMD and Successful bidder in connection with or relating to the extension of contract, the parties shall make every effort to resolve the same amicably by mutual consultations.

- b) If the parties fail to resolve their dispute or difference by such mutual consultation within twenty-one days of its occurrence, then, unless otherwise provided in the "List of requirements/ technical specifications" section either IMD or Successful bidder may give notice to the other party of its intention to commence arbitration, as hereinafter provided the applicable arbitration procedure will be as per Indian Arbitration and Conciliation Act, 1996.
- c) In the case of a dispute or difference arising between IMD/ Consignee and all bidder/suppliers relating to any matter arising out of or connected with the contract, such dispute or difference shall be referred to the independent arbitrator appointed by the Director General of Meteorology.
- d) The award of the arbitrator shall be final and binding on the parties to the contract.
- e) Each party shall bear its own cost.

20. Venue of Arbitration:

- a) The venue of arbitration shall be the place from where the contract has been issued, i.e., New Delhi.
- b) The contract shall be interpreted in accordance with the laws of India.

21. List of Deliverables:

- a. The bidder shall submit the final list of Deliverables as given for Software items, and all other services which the bidder is going to offer in their technical proposal to meet the requirements under "List of requirement & Technical specifications" of this tender document.
- b) The list of deliverables shall be same as submitted in the price bid.
- c) The price bid shall not be considered if it is not matching with the list of deliverable submitted with technical-commercial bid document.

22. Terms & Conditions of Comprehensive Annual Maintenance Contract (CAMC):

- a) The CAMC includes the installed application at IMD HQ and other sub offices.
- b) The Licenses of the third party tools (VM Ware and windows server licenses, framework) shall be the property of the of IMD
- c) The CAMC clause will be applicable for control center and and at other sites where the application (or part of) has been installed
- d) The CAMC will commence immediately after the expiry of the warranty period.
- e) The comprehensive maintenance contract includes preventive and corrective maintenance and free of cost services till the application is running trouble free as

- per the technical requirements. Any issue arising due to versioning differences between the software components used have to be resolved by the SI/Vendor
- f) Successful bidder should submit a detailed CAMC plan including preventive maintenance schedule.
 - g) The Successful bidder shall provide the details of its call center meant for booking the complaints along with the contact numbers like mobile nos., phone nos., mail address and names etc of its service engineers.
 - h) The Successful bidder's engineers attending to the system are required to make all entries of their work done and corrective measures taken by them with their signatures in the log book kept with the Hydromet Division.
 - i) Overall uptime of the system shall be at least 85 days in a quarter of 90 days.
 - j) If there is a failure of the system for more than the criteria stipulated in (j) above then LD will be applicable at the rate of 0.5% per day (calculated for CAMC value of that station) and part there of subject to maximum of 10% of CAMC charges for that quarter.
 - k) If the total failure duration (CONTINUOUS OR INTERMITTENT) extends beyond one month then the contract may be terminated at the discretion of competent authority of IMD and cost of its repair from alternate source will be recovered from the "Bidder" and performance security may be forfeited.
 - l) The mode of payment will be quarterly and will be made after end of each quarter on the basis of satisfactory performance certificate from the HydrometDivision ,IMD.
 - m) Successful bidder will assist IMD for regular backups of all the software.
 - n) The Successful bidder is also required to restore the existing Software from the Backups whenever required.
 - o) Successful bidder will also be responsible for configuring the networking components.
 - p) CAMC contract will be signed with a validity for 3 years and renewed annually based on satisfactory performance. If required, contract may be extended by IMD. However, IMD reserves the right to terminate the contract at any time by giving three months of notice, if the performance of the system or the services rendered by Successful bidder is not found satisfactory.
 - q) The Successful bidder has to submit an undertaking that it will not use IMD's data for any commercial purpose.
 - r) This contract shall be governed in all respects by Indian Laws.

23. IMD is following and abides with the Public Procurement (Preference to Make in India), Order 2017, DIPP, MoCI Order No. P-45021/2/2017-B.E.II dated 15th June 2017 and subsequent amendments to the order including order even no. dated 16th Sep 2020. Accordingly, preference will be given to the Make in India products while evaluating the bids, however, it is the sole responsibility of the bidder(s) to specify the product quoted by them is of Make in India product along with respective documentary evidence as stipulated in the aforesaid order in the technical bid itself.
24. The Provision of restrictions under Rule 144(xi) of the GFR 2017 [Order No. 6/18/2019-PPD (Public Procurement No. 1&2) dated 23rd Jul 2020] for the bidder from a country sharing land border with India shall also be applicable.

CHAPTER-3

Schedule of requirements, specifications & allied technical details.

Technical Specification

1. Introduction

India Meteorological Department (IMD) is the government agency for national meteorological services of the country and the principal Government agency in all matters relating to meteorology and allied subjects. The Hydromet Division of IMD is responsible to provide rainfall related information for various zones/regions viz., (i) Administrative zones like Districts, States and Country (ii) Meteorological zones like Met. Subdivisions and four climatologically homogeneous regions and (iii) River basins and sub-catchments, to cater various Govt./Semi-Govt./other agencies and stakeholders. Department provides the hydrometeorological support for flood forecasting in the form of sub basin-wise Quantitative Precipitation Forecast (QPF) to Central Water Commission (CWC) for their flood forecasting purposes. The department also analyzes the historical rain-storms for various purposes like providing design storm estimates, depth area duration curves, time distribution, Return Period values, IDF curves, Isopluvial maps etc. to private and Govt./Semi-Govt. organizations. All these activities are being carried out at Hydromet Division, IMD, New Delhi. Hydromet Division is being providing the following major Services;

(i) Real Time Rainfall Monitoring:

Real-time Rainfall statistics at different time scales for various administrative and meteorological/regional zones:

Real time rainfall monitoring plays an important role in preparation and dissemination of rainfall statistics and maps for various administrative & meteorological zones and river basins of the country. Timely information, its spatial as well as temporal distribution is vital for agricultural planning and management of water resources including flood forecasting. Real-time rainfall statistics of various kinds are required by planners, agricultural scientists, irrigation engineers, water management authorities, administrators and agencies concerned with drought and flood. This information is vital for the other stake holders like forecasters, researchers and planners of hydraulic structures as well. Following standard rainfall products are being prepared operationally;

- Daily, Weekly, Monthly, Seasonal and Annual basis

- Presently preparing for 690 districts, 36 meteorological subdivisions, 37 states/UTs, 4 broad regions & for the country as a whole and 61 river basins

(ii) Hydromet Support for Flood Forecast:

IMD's contribution in flood warning through Flood Meteorological Offices (FMOs) is mainly in the form of sub-basin-wise Qualitative and Quantitative Precipitation Forecast (QPF) issued to Flood Forecasting Divisions (FFDs) of Central Water Commission which is used by them in the formulation of flood warning/forecast. During flood season (generally, 1st June to 31st October), these field offices of IMD provides catchment-wise/ Sub-catchment-wise categorical QPF to FFDs of CWC on daily basis for the use in flood forecasting purposes. Synoptic charts, synoptic analogues, climatology, satellite pictures/products, sub-catchment-wise Numerical Weather Prediction (NWP) model rainfall products etc are being utilized for the formulation of sub-basinwise QPF/Hydromet Bulletin. A typical Hydromet Bulletin and QPF bulletin format is given in Annexure-11(a) & 11(b) & 12(a) & (b).

(iii) Design Storm estimates for hydraulic structures:

Design Storm Studies are being conducted to evaluate design storm estimates (rainfall magnitude and time distribution) for various river catchments/ projects in the country, for use as the main input for design engineers in estimating design flood for hydraulic structures, irrigation projects, dams etc. on various rivers. Similarly, in case of minor structures like bridges, culverts, planning of water supply system & drainage systems, railway and road bridge construction etc., IMD provide estimates of short duration rainfall return period values, isopluvial maps, intensity duration frequency (IDF) curve.

During the 12th five year plan period a Customized Rainfall Information System (CRIS) was procured GIS based Customized Rainfall Information System (CRIS) software in the year 2014 to automate the Hydromet Activities at Hydromet Division, IMD, New Delhi. Now, it is proposed to enhance the features, introduce more automation in preparation of all operational products & new products which needs to be generated in the new version. All the hydromet products which will be available in the IMD website will be made as different GIS layers including query analysis tool for the stake holders/users and more no of GIS interactive rainfall products will be generated. Proposed version should support all the product generation and analysis related work with state-of-art technology viz., GIS and other required supporting softwares as detailed in the subsequent paras. The required H/W support will be utilized as per

available H/W facilities in the division and also optimized new procurement. This project proposal will be implemented as a turn-key solution basis.

2. Scope of Work:

- 2.1 Design, Development, Hosting, maintaining the GIS based (tools like zoom-in and zoom-out, fit to screen, pan, search, measure, display mouse/cursor position in terms of latitude, longitude, overly of different layers etc) customized rainfall information system for Daily, Weekly, Monthly, Seasonal and Annual statistics & for districts, states, met sub division, four homogenous regions, river basins, sub-basins and the country maps and Database oriented dynamic website. Security audit certification of the website by certified CERT-In vendor, is also a part of the present scope of work.
- 2.2 Development of Decision Support System(DSS) for issuing QPF for different river basins/sub basins by various FMOs:
 - 2.2.1 A uniform single window platform will be made available for providing simultaneously all dynamical model rainfall forecast products, past 24 hour observed Rainfall analysis (isohyetal) for the jurisdiction of each FMO and synoptic analogue model-based QPF.
 - 2.2.2 Synoptic analogue tool for RMC's/MC's based on last five years data and also a software will be developed to enter the latest synoptic information in respect of each sub-basins to a software which will be used to update the synoptic analogue model every year for each FMOs.
 - 2.2.3 Provision for bringing NWP model rainfall products in the GIS platform in the IMD website. Functionality for computation of sub-basin wise areal average rainfall and also superimposition of different boundaries viz., basin, sub-basin, district, state, taluka etc on the rainfall analysis maps.
- 2.3 An application for design storm studies which contains Return Period Rainfall analysis, preparation of Isopluvial maps, Intensity Duration Frequency (IDF) Curves Standard Project Storm (SPS), Probable Maximum Precipitation (PMP) etc.
- 2.4 Any other work/development/design/requirement etc which is not mentioned here in this document but are operationally essential and may arise during the execution of work/design/development/testing/hosting/ maintenance of the website.
- 2.5 The successful Bidder is required to provide a turn-key solution, which would include supply / installation / development of the required software, hardware and other accessories & services thereof, for commissioning of the system (Website with integrated Mobile App, related hardware and software).

3 IMD's Obligation

- a. IMD will provide a high speed global (Single) IP to host the website.
- b. IMD will provide a high speed LAN IP to all servers required for the system.
- c. IMD will provide normal rainfall values.
- d. IMD will provide technical details/algorithm to compute rainfall statistics for various boundaries viz., district, state, met sub division four homogeneous regions, country, river basin/sub basin etc., design storm studies, rainfall analysis.
- e. IMD will provide shape files for Indian Block/Taluka, District boundary, Indian State boundary, Met Sub division boundary, Four Homogeneous Regions boundary, Country Boundary, River basin/sub basin boundary.

4 Bidder's Obligation:

4.1 Functionality in customized application for Rainfall Monitoring module

- (i) Functionality for desktop application module to any no of users as interface at RMCs/MCs/Hydromet Division (remote sites) to the centralized server at HQ with remote logging facility.
- (ii) Functionality for uploading the real time spatial (Lat./Long.) rainfall data and other georeferenced products (shape files) to the centralized server through web base GUI interface tool at RMCs/MCs. Provision to update database in offline mode from email received in csv, txt, xls format from various users.
- (iii) Functionality for automatic uploading the station wise hourly AWS/ARG based rainfall data from GTS to the centralized server and automated functionality to plot real time cumulative rainfall data of short duration (1hr, 3hr, 6hr, 9hr, 12hr, 15hr, 18hr, 21hr, 24hr) from AWS/ARG on GIS map layer on IMD website(Hydro).
- (iv) The system shall have capability to receive and ingest ASCII and binary data from AMSS/RTH system of IMD.
- (v) There will be provision for automated Quality Checks on realtime station wise rainfall data in the software. The detail steps for quality checks of real-time rainfall data will be provided by IMD in the RFP/SRS(Annexure -13).
- (vi) There should be mechanism to show status of the communication channels.
- (vii) The system shall check reception of data from designated centres with predefined time limits and in case of not receiving of data, the system shall give notification to the Administrator as well as the users and decision makers through auto generated e-mail & sms to the administrator of respective defaulter center/s (RMCs/MCs).
- (viii) The web-application-software should have the provision for automatics generation of
 - a). Rainfall Maps: Map of Rainfall statistics (Actual, Normal & % Departure) for Daily/ Weekly / Monthly/ Seasonal / Annual / desired period for districts, states, met sub

divisions, four homogeneous regions, Pan India, river basins and river sub basins. b).
Rainfall Statistics: Daily/ Weekly / Monthly/ Seasonal / Annual / desired period of rainfall statistics (Actual, Normal & % Departure) in tabular form for districts, states, met sub divisions, four homogeneous regions, Country, river basins and river sub basins.

- (ix) These products will be generated centrally at HQ after getting all the rainfall data uploaded by RMCs/MCs.
- (x) The template of rainfall reports as per area of jurisdiction of RMCs/MCs as well as at HQ will be provided by IMD. These reports can be downloaded by designated offices with web interface facilities.
- (xi) Functionality for preparation of various rainfall statistics, maps, graphs will be customized as per area of interest of various offices at RMCs/MCs and at HQ. The detail in this regard will be provided at the time of finalization of SRS(Software Requirement Specifications).
- (xii) The system shall have capability to provide data latency reports as per user defined time intervals.
- (xiii) Automated Functionality for prepare Rainfall statistics and maps for the country as a whole, four homogeneous regions, Met. Subdivisions, States, Districts and Block/Tehsil for the country on daily, weekly, monthly, seasonal, for any specified period and on annual basis (with option for user to specify the duration). The methodology is given in Annexure - 14 Module 1.
- (xiv) The different maps will be available in the CRIS portal in the IMD website with different GIS layer.
- (xv) Functionality for filtering of different rainfall categories, viz., normal, excess, large excess, deficient, large deficient, no rain on the maps of district/met sub division/state/four homogeneous regions/pan India map with zooming facility in the of GIS layers and also in the table as per user choice / filter facilities in the GIS layer available in the CRIS portal.
- (xvi) There will be provision for inclusion or non-inclusion of label of the attributes in the map.
- (xvii) Automated Functionality for GIS based Isohyetal analysis of station rainfall for the country (techniques at Annexure - 14 Module 1) for computation of the areal rainfall of District, Block/Tehsil and for the various river basins & sub-basins or any pre-defined boundary at specified temporal scales. These areal rainfall values will be tabulated and available to the user in json/xml/excel/text formats. Also, the map of Pan India with respective boundaries (like District, Block/Tehsil, River- basin/sub-basin etc.) will be

prepared with depiction of % departures of rainfall using category-wise color codes. The products will be published in the CRIS portal with GIS layers.

- (xviii) Functionalities for preparation of Subdivision-wise Rainfall Distribution and Monsoon Activity is to be plotted on Pan India map.
- (xix) Cumulative %departures of rainfall for a station/Block/Tehsil/district/state/homogenous region/country/river basin/river subbasin starting from first day of the season shall be prepared using the realized rainfall and normal till date or for any user specified period.
- (xx) The rainfall statistics and its maps will be generated and archived for a specified user defined period across different temporal and spatial (district/met sub division/state/pan) domains. For Example;
 - a) Current year cumulative – Last year
 - b) Current year cumulative – 2 years ago
 - c) Current year cumulative – 3 years ago
 - d) Current year cumulative – 4 years ago
 - e) Current year cumulative – 5 years ago
- (xxi) The system should also be able to generate dynamical model based forecast maps of cumulative rainfall/departures for a Block/Tehsil/district/state/homogenous region/country by using the gridded forecast rainfall which will be equivalent to station rainfall for next 5-7 days. In this case, computation methodology will be same as used for station wise observed rainfall. These maps will be uploaded on the IMD website as various GIS layers.
- (xxii) Functionality for Add/Edit/Delete the Station/ Block/ Tehsil/ District/ Subdivision/ State/ homogeneous region/ Basin/ Sub-basin etc. from master database consequently as well as respective shapefile boundary by administrator at HQ.
- (xxiii) Migration and integration of existing (legacy and current) Rainfall data to the data base. Develop a GUI query analysis tool for retrieval of rainfall information from the available data base.
- (xxiv) Currently two normals, 1951-2000 and 1961-2010, for the rainfall data are available with IMD which are updated once in a decade and will be provided by IMD. Functionality to compute % departure of rainfall based on any of the available normals as per user choice.
- (xxv) The rainfall products e.g., statistics and maps will be in bilingual (Hindi/English).
- (xxvi) A website will be prepared in both English/Hindi for all rainfall products under CRIS.
- (xxvii) The system shall generate log file of all activities on the server.

(xxviii) There will be a provision for sending approved rainfall report / derived rainfall products via e-mail to the authenticated users/stakeholders automatically.

4.2 Functionality in customized application for Design Storm Module:

- i). Functionality for desktop application module for any no. of users as interface at Hydromet Division to the centralized server at HQ.
- ii). There will be a Functionality to integrate station wise historical rainfall data (.csv/.txt) received through FTP/E-mail to the data base.
- iii). Retrieval of rainfall information by a GUI query analysis tool from the available rainfall data base and getting the query output in different format such as Excel, Text, image and chart/graphical formats.
- iv). Functionality for quality checks will be available for the rainfall data and it will be provided by IMD (at Annexure – 13).
- v). An application for selection of storms using the updated database (ORG, SRRG, AWS, ARG), computations of (Bullets) design storm estimations, drawing the rainfall patterns for the selected storm and having plots for DAD curves in tabular and graphical form, preparation of time distribution curves for 24-hrs, 48-hrs and 72-hrs etc. There should be provision for transposition of rainstorm to get maximum rainfall at the project area within the orientation limits of $\pm 20^\circ$ (Automatic as well as user controlled). (Annexure - 14 Module 2). Also, there should be provision to restrict the analysis defined by the existence of some physical barrier like mountain range etc.
- vi). Storm Analysis as Annexure - 14 Module 2.
- vii). There will be provision for showing the status bar of progress of different stages of analysis.

4.3 Functionality in customized application for Flood Meteorological Module

- i). Functionality for desktop flood meteorological application module for any no. of users as interface at FMOs, RMCs, MCs and Hydromet Division at HQ to the centralized server at HQ.
- ii). Functionality for uploading the real time rainfall data (past 24-hour rainfall at 8:30 hrs IST) to the centralized server through desktop & server GUI interface tool.
- iii). After complete uploading of georeferenced station wise rainfall data by RMCs/MCs/FMOs on realtime in the predefined time limit in the centralized sever, all these data will be used for isohyetal analysis over river sub basin maps under different jurisdiction of FMOs and computation of sub basin wise areal average

rainfall using Isohyetal analysis which will be used for the issuing Hydromet and QPF bulletins (Annexure-14 Module 3).

- iv). Provision should be there to generate a tabular report containing the catchment-wise average rainfall, Maximum rainfall and list of stations (and reported rainfall) reporting significant rainfall (> 5 cm or user defined threshold). The catchment/sub-catchment-wise Isohyetal map will be exported to .JPEG or any image format for archival purpose. (Annexure-14 Module 3).
- v). Provision will be available to FMOs to download the isohyetal analysis map and computed AAP from the data base as per their required duration and area of interest.
- vi). Automated Functionality to plot real time cumulative rainfall data of short duration (1hr, 3hr, 6hr, 9hr, 12hr, 15hr, 18hr, 21hr, 24hr) from AWS/ARG on Google/Bhuvan map layer on IMD website starting from 0830hrs IST. Each duration rainfall data shall be plotted on separate map. There shall be provision to the user to select the date of rainfall for current day and past 7 days.
- vii). Synoptic analogue tool for RMC's/MC's based on last five years data and also a software will be developed to enter the historical as well as latest synoptic information in respect of each sub basins to a software which will be used to update the synoptic analogue model for each FMOs (Annexure-14 Module 3).
- viii). Development of decision support system for issuing QPF for different river basins/sub basins by various FMOs: A uniform single window platform will be made available for providing simultaneously all dynamical model rainfall forecast i.e. model based QPF products (WRF/GFS/NCUM), sub basin wise dynamical model based probabilistic QPF (GEFS/NEPS), past 24 hour observed Rainfall analysis (isohyetal) over sub basins under the jurisdiction of each FMO and computation of sub basin wise AAP, Computation of Sub basin wise Areal Average and synoptic analogue model based QPF. Also, there will be provision for interfacing with Synergie products for developing dynamical DSS for sub basin QPF.
- ix). Provision for selection of the reference dynamical model for proper initialization of QPF in the QPF bulletin as well as Hydromet Bulletin over the area of responsibility of each FMO and automatic dissemination of bulletins through email/website/sms etc to Flood Forecasting divisions of Central Water Commission and other stake holders.
- x). Automatic uploading of operational QPFs in the hydromet website. The display of sub basin wise QPF for day 1 to day 5 and past 24 hour AAP will be made on India map (Google/Bhuvan etc.) along with the provision of GIS layers for basin, sub basin,

rivers, FMO Jurisdiction, district, state, met-sub division. There will also be the zooming (in/out) Functionality for these products.

- xi). GIS software will be used for bringing NWP model rainfall forecast products in the GIS platform in the IMD website. Functionality for computation of estimation of sub basin wise NWP model average rainfall and also superimposition of different boundaries viz., basin, sub basin, district, state, taluka etc on the rainfall analysis maps. Similarly, Radar, Insat 3d satellite based sub basin-wise rainfall estimate products will be prepared. The data format may be binary viz., *.nc, *.grib1/*.grib2, *.hd5 etc.
- xii). Functionality for a QPF verification software (database type) for both operational QPF as well as dynamical model QPF. Mainly it will compute various skill scores and plotting the same in the graphs & maps (Annexure-14 Module 3). As per user requirement, verification will be done for a specified river basin/sub basin area and for a user defined period.

4.4 General functionalities:

- i). Provision for attribute based Spatial Analysis and hotspot analysis for the daily rainfall will be available in the application.
- ii). Website will be Bilingual
- iii). Facilities will be available for Heavy Rainfall analysis, Trend Analysis for rainfall etc.
- iv). Automatic generation on near real-time basis & dissemination of Products and Reports through different platforms.
- v). Application of standard techniques for estimation of missing rainfall data (technique will be provided by IMD).
- vi). The application should have Backend / Forward online approval systems.
- vii). The application should have Functionality for on demand generation of rainfall products.
- viii). Functionality for domain oriented product generation by RMC's/ MC's/FMO's/DGM(RMU)
- ix). Majority Web GIS Application features includes Dynamic Query, Overlay analysis, Buffer analysis, Data Modelling, Animations., Zoom in/Zoom out
- x). A mobile app is to be developed to access on the fly (less than a sec) all the information available on website. The webserver of mobile app and website should be same, however, the data base of website and mobile app are different and synchronized.

- xi). Alignment of AI & ML concept to support Data Gap, quality, etc
- xii). Real-time integration of data and products with NDC for archival.
- xiii). Centralized GIS Web Portal – Anytime / anywhere concept
- xiv). Cross-platform capability: Application can run on Microsoft Windows, Linux, and macOS etc (independent of OS).
- xv). The system should have Functionality for Data Redundancy through Virtualisation of the server.
- xvi). The system should have Redundant Data Archival and its management facilities.
- xvii). User Management and Authentication Module
This module shall offer user management which shall allow the administrator to create, edit and delete the decision makers and users.
- xviii).** Using the Admin portal, Administrator shall be able to create a list of authorized decision makers and users shall also generate the credentials for all those users at RMC/MC/FMO & Hydromet Division at HQ.
- xix).** Data upload interface Module
This module shall allow the authorized users to upload/insert the rainfall data to the database. Once authorized users get their user credentials, they can use this module to change their password and upload/insert the data/files. Whenever the password gets changed by user, the same should be notified to Administrator.
- xx).** Data validation interface module
There should be a Functionality for Administrator at RMCs/MCs/FMOs & also at HQ to verify and modify the data uploaded by station users added to the database. If any requirement for modification of data will arise after approval of data by administrator at RMCs/MCs/FMOs, this can be done in coordination with Hydromet Division at HQ.
- xxi).** Map browsing Module
The proposed application will have user interface with standard map navigation tools like Zoom In, Zoom Out, Full View and Pan etc. These functionalities would support the basic operation in the map viewer window.
- xxii).** Thematic Mapping Module
The GIS interface module will offer the functionalities for thematically viewing the Rainfall distribution over a thematic map displayed in different colors. It will allow the users to thematically view various GIS default data layers (Country, State, Met sub divisions, Districts, river basins/sub basins, Railways, Highways, Rivers etc.) made available.
- xxiii).** Locate/Search

Locate/ Search functionality will allow the user to search and locate the desired GIS features in the map. This Functionality will be provided for both spatial and non-spatial data.

xxiv). Attribute Query & Reporting Module

This module will facilitate the user to build queries on the tables as well as on the layers of the map. If the query is being built on layer, user will be able to view the queried data on the map.

xxv). The module will have querying functionality on rainfall database (Updated and Real-time) and report should have generated.

xxvi). Spatial Analysis Isohyetal Module

This module will offer the Functionality to perform isohyetal analysis based on the rain-gauge station data. The Isohyetal analysis algorithm will be implemented in the application as per the input from the IMD during development phase. There will be provision for utilization of various interpolation techniques(e.g. topo to raster, idw etc) for this analysis. There will be provision for utilization of Thiessen polygon technique for rainfall analysis.

xxvii). Dissemination Module

This module will have the facilities for automatic dissemination of products & information through e-mail, ftp, sms to the various users, website and also to the social media.

xxviii). Reporting Module

The proposed GIS application will offer the functionality to user to generate different reports from the system based on various parameters like, Reports based on station rainfall, Summary reports based on various durations viz. Daily, Weekly, Monthly, Seasonal and Annual etc. The reports are likely to be generated out of this system in required formats and templates. Also numerous rainfall products generated through the present CRIS system may be seen which is available in the IMD website link at [http://hydro.imd.gov.in/hydrometweb/\(S\(fogda3fpnzje0s45ec15xenh\)\)/landing.aspx](http://hydro.imd.gov.in/hydrometweb/(S(fogda3fpnzje0s45ec15xenh))/landing.aspx).

xxix). Printing Module

The Print functionality prints the rainfall reports including maps that is currently displayed on map window. This functionality will also allow the user to print the map along with north arrow, scale bar, IMD logo, copyright and disclaimer statements.

xxx). Product upload module

The Products to be uploaded on IMD website, there shall be a utility for the products to be uploaded automatically after the approval by the Administrator/User at Hydromet Division.

xxxi). Audit trail

The system/application will keep track of all the above mentioned activities and the system shall generate a log for the same.

xxxii). RDBMS for rainfall monitoring module:

- a) An application module as interface at Hydromet Division & at various users (RMCs/MCs/FMOs) to have access to the database. There will be provision for one time uploading (historical) and realtime data uploading of data by various centers to the data base. The rainfall data required for quality checks is given in Annexure - 13.
- b) The application will process the data and the final rainfall products/reports will be uploaded on the website. The system shall be capable to keep data/products on FTP server. The system shall allow to e-mail the data/products to the designated addresses.
- c) The station wise rainfall data which were uploaded by the field offices (RMCs/MCs) to the centralized server through remote logging access to the server will be added to the data base.
- d) The Functionality of modification/updating of any data in the data base will also be available with proper approval Functionality of administrator at HQ with proper log file.

5.0 Requirements

The project is a turn-key based solution for which the software and hardware etc., are required to supply, install and commissioned by the bidder as per requirement. There shall be two servers to work in hot stand-by mode with peripherals, windows operating system and software, installed at HQ, New Delhi. The application software and database will run on both the servers. Detail specification in respect of H/W and S/W will be prepared by the successful bidder after issuance of Supply Order and submit to IMD for procurement.

6. Other Terms and Conditions:

- 6.1.** The Bidder should suggest the configuration and specification of the computer hardware and OS required for installation of the application software.
- 6.2.** The System shall be synchronized using a Network Time Server (through software or Hardware timing system).
- 6.3.** The Bidder should provide the source code with documentation of all customized software exclusively developed for this project under no-disclosure guarantee.
- 6.4.** The Bidder should work closely with Hydro-Met Division at each stage of design/development for the understanding of requirements, functionalities, etc. He should

involve the designated representatives of Hydro-Met Division actively throughout the installation and customization of the system.

- 6.5. The Bidder should provide Lifetime License of the application software.
- 6.6. Auto-backup of the complete database with log of Emails received and content as per user-defined criteria.
- 6.7. The system should be built up in such a way to keep the 99.9% uptime of all the services and systems.
- 6.8. The Bidder should provide a detailed flow diagram indicating the function and the output products of each software module. The Bidder should also provide the full details as to how he is going to provide the complete solution right from the input Email message, and various functionalities of modules.
- 6.9. The bidder should provide the block diagram of their own implementation strategy with full details in their technical proposal.
- 6.10. The Bidder should be ready to accommodate changes in application software and its customization, hardware, etc., in order to fulfil such requirements that may arise during the intervening period between preparation of this document and commissioning of the system within the scope of the project.
- 6.11. The Bidder shall submit his technical proposal giving full technical details of every module of application software, computer hardware with specifications, details of Operating System (OS), communication equipment and subsystem along with interface
- 6.12. **Testing and Acceptance:** Firm should submit a test and acceptance plan well in advance for the approval by the customer and Test and Acceptance committee. The test and acceptance plan must include the following;
 - 6.12.1. Website should be live without fail/crash for continuous 15 days on 24x7 basis.
 - 6.12.2. Requisite information on website as well as on mobile app should be accessible on the fly (less than a sec).
 - 6.12.3. The deliverables (s/w) by the Bidder will be accepted by the Test Acceptance Committee as per terms of contract only after testing the s/w for the functionalities and generated products defined under the scope of work. The development-installation cycle should be completed within the stipulated contract period to the full satisfaction of Test and Acceptance committee constituted by the Purchaser. All the technical changes and defects pointed out by the Test and Acceptance committee needs to be resolved within the prescribed time. The complete system should be

under the sole responsibility of the bidder until it is accepted by the test and acceptance committee constituted by the purchaser. The same date is considered as date of deliverables.

6.13. Warranty and CAMC: Entire website system including all the hardware, software, applications, Mobile APPS, etc. shall be under warranty for 24 months from the date of acceptance & commissioning of the system. Post warranty, the complete system shall be under comprehensive AMC for 36 months from the date of expiry of warranty. Upgradation of system if required due to any change in technology, hardware, software, or any other unforeseen reasons, shall be done by the firm during warranty and AMC period.

6.14. Penalty Clause: The complete system should be failure proof at any point of time (during **warranty** and **CAMC** period) without which a penalty shall be imposed as per following:

6.14.1. Delivery: The purchaser shall, without prejudice to other rights and remedies available to the purchaser under the contract, deduct from the contract price a sum equivalent to 1% (one percent) per week of delay or part thereof on delayed supply of goods and/or delayed services subject to a maximum of 10% of the total contract price of delayed items. Once the maximum is reached purchaser will apply both of the following:

6.14.1.1. Forfeiture of its performance security.

6.14.1.2. Termination of the contract for default.

6.14.2. Installation and Commissioning & Test and Acceptance: The Bidder should complete the installation of the complete hardware, OS, connectivity with the existing systems, and to facilitate the installation of application software in the new set-up is to be completed within Six months from the issue of supply order.

6.14.3. Due to circumstances beyond the control of the Purchaser and successful Bidder, if the Purchaser desires so, "No-Cost Extension (without LD)" will be considered for a period not more than 6 (SIX) months. Consideration of "No-cost extension (without LD)" will be under the sole discretion of Purchaser. No-cost extension (without LD) means, the bidder is not allowed to claim any escalation and whatsoever charges incurred by the successful Bidder during the period of extension. Beyond the no-cost extension period (without LD), if any, the Bidder is liable for imposition of LD for delay in the submission of deliverables. At any point of the contract period, the Bidder is not allowed to claim any additional charges other than prices mentioned in the contract.

6.14.4. Delay in installation and Test and Acceptance of the system will attract the penalty that the purchaser shall be entitled to recover Liquidated Damages, 0.5% of the value of the purchase order for each week of delay or part thereof or a period upto 10(TEN) weeks subject to a maximum of 10% of the total work order. Once the maximum is reached purchaser will apply both - Forfeiture of its performance security and Termination of the contract for default.

6.15. During Warranty

Beyond 10% limit period, the purchaser is free to get issues resolved through outside vendor and recover the amount thereof from Performance security.

Down time of System	Penalty
Less than 1 Hour	NIL
1-2 Hour	0.1% of the total work order excluding CAMC Charges
2-6 Hour	0.5% of the total work order excluding CAMC Charges
More than 6 Hour	In addition to above @ 0.1% per hour of the total work order excluding CAMC Charges subject to ceiling of 10% of the total work order excluding CAMC Charges per quarter

6.16. During CAMC

Down time of System	Penalty
Less than 1 Hour	NIL
1-2 Hour	0.1% of CAMC Charges
2-6 Hour	0.5% of CAMC Charges
More than 6 Hour	In addition to above @ 0.1% per hour CAMC Charges subject to ceiling of 10% of the total CAMC Charges per two quarter.

Beyond 10% limit period, the purchaser is free to get issues resolved through outside vendor and recover the amount thereof from Performance security.

6.17. Training: Firm shall provide 5 working days training each for maintenance/administration and operation of the complete system for 100 IMD officials through VC. Firm shall also provide training material in hard and soft copy separately each for system maintenance/ administration and system operation.

6.18. Documentation: Firm shall provide three sets of hard copy along with softcopies of "Technical manual", "Operational manual" and "System Administrator manual".

6.19. Licencing: Bidder has to provide lifetime licences for all the applicable hardware and software and services; if any.

6.20. Firm will provide educational details and working experience of the persons (Software developer/Program Manager/Coordinator etc.) those are going to handle this project till the final products goes live.

6.21. Firm will not have any kind of ownership of the developed system and including data/codes/scripts/tools/software generated /produced /developed/ inferred for this work. It is solely the property of IMD. The detail source code of the whole system is to be shared with IMD after commissioning the system and time to time after any its modifications.

6.22. Delivery Schedule: Firm must complete the work within 6 months from the date of issue of work order as per following:

Item	Time Lines					
	1M	2M	3M	4M	5M	6M
PDR	T+1M					
CDR		T+1M				
Development, Hosting and Security audit			T+4M			
Test, Acceptance and commissioning						T+6M

T= Date of issue of supply order; M= months, PDR = Preliminary Design Review, CDR= Critically Design Review

6.23. Disclaimer

This call of RFP/Tender will carry no right in getting precedence/privilege for a particular firm/ its representatives/agent, but to enable authorities/ representatives of India Meteorological Department in devising a document leading to the procurement through an unbiased competitive bid.

6.24. Copyright: Copyright of IMD

7. Glossary

- AMSS – Automatic Message Switching System
- AMC – Annual Maintenance Contract
- ARG – Automatic Raingauge
- ASCII – American Standard Code for Information Interchange
- AWS – Automatic Weather System
- CPU – Central Purchase Unit
- CWC – Central Water Commission
- DAD – Depth Area Duration
- DRMS – Districtwise Rainfall Monitoring System
- FTP – File Transfer Protocol

GIS – Geographical Information System
HQ - Headquarter
IMD – India Meteorological Department
MC – Meteorological Centre
NDC – National Data Centre
OEM – Original Equipment Manufacturer
OGC – Open Geospatial Consortium
ORG – Ordinary Raingauge
RF - Rainfall
RMC – Regional Meteorological Centre
RTH – Regional Telecommunication Hub
SOI – Survey of India
SRRG – Self Recording Raingauge

CHAPTER-4
PRICE SCHEDULE

Annexure-1

Price bid form

Note: Kindly write complied/value/agreed/ deviation, etc. No cell should be left blank.

SN	Item	Quantity	Rate(₹)	GST (if any)	Total (₹)
A	B	C	D	E	F=Cx(D+E)
1	Design, Development, Hosting and maintaining the Web-GIS based customized rainfall information system portal as per RFP including warranty.	1			
2	Design, Development, Hosting (on market place) and maintaining Mobile app as per scope of work including warranty.	1			
3	Charges for Security Audit from CERT empanelled Vendor for website and mobile app.	1			
4	Training with resource material as per the RFP.				
5	Any other charges (for third party software or service not mentioned above) to meet the requirement of the RFP.				
6	Post warranty Comprehensive Annual Maintenance Contract for three years*	1 st Year			
		2 nd Year			
		3 rd Year			
7	Total (1+2+3+4+5+6+7+8)				

* shall be paid post warranty; quarterly basis on completion of period.

Signature of Tenderer_____

Seal of Tenderer_____

CHAPTER-5

OTHER STANDARD FORMS

Annexure -2

Details of manpower involved in the project

SN	Name	Designation / Role	Qualification	Experience	
				(Months/Years)	Discipline /Subject

COMPLIANCE STATEMENT

SNo.	Tender Clause No.	Compliance
1	Undertaking for the pointwise compliance of each and every term and conditions mentioned under Section-I and Section-II of Tender Document.	Yes/No

Signature of the Bidder

Name & Designation:

Date

Place

Company Seal

Annexure-4

CHECKLIST

S No.	Activity	Compliance Yes/No/N.A.	Page No. of your bid
1	Company Profile, Infrastructure, and Registration Certificate		
2	Have you enclosed EMD (Bank Guarantee /FDR) of required amount (as per Clause no. 13)?		
3	Is the EMD submitted by other firm other than participating firm? If yes, then bid is likely to be ignored.		
4	Is Registration certificate from Ministry of Micro, Small & Medium Enterprises (MSME), NSIC attached for relaxation of EMD?		
5	Details of Permanent Income Tax account number& GST number? (Attach a copy)		
6	Have you kept EMD validity (210 days)?		
7	Have you enclosed all supporting documents as mentioned in 7.9 (a to k) and 7.10 (a to g)		
8	Copy of Tender document with each page signed and stamped as per Clause no. 7.9 (d)		
9	Have you enclosed Tender Acceptance Form (Annexure-5) duly filled and signed (i.e., terms and conditions are acceptable) with original set of tender. Tenders may be ignored if not signed.		
10	Have you enclosed clause-by-clause compliance statement for the general terms and RFP requirements mentioned under Section-1 and Section-II?		

11	Supporting documents for the terms mentioned under “Bidders Eligibility Criteria” (Clause no. 6.1 to 6.11)		
12	Have you submitted copy of the last purchase order(s) and performance certificate from users?		
13	State whether the business dealings with you have been banned/blacklisted by the Ministry of Earth Sciences (MoES) or any other State/Central Government Department, in the past, as per clause no. 7.8		
14	Is tender Submitted by an OEM?		
15	Is tender Submitted by an authorized Agent/Dealer/Supplier/Distributor/ Stockist of OEM? If so is authorisation certificate attached?		
16	Is tender Submitted by an integrator Agent/Dealer/Supplier/Distributor/ Stockist of OEM? If so whether Back-to-back support agreement with equipment manufacturer and software developer company attached?		
17	Have you submitted the Un-priced bid containing Bill of Materials as per Clause no. 7.9 (g)		
18	Name of the firm who quoted the price		
19	Name of tender currency		
20	Name of the supplier with complete address to whom supply order to be placed.		
21	Have you given details of persons going to handle this project as per Annexure-1		

Signature of Bidder:

Full name, designation, and address of the person signing(in block letters)

Whether signing as proprietor/ partner/ Constituted attorney / duly

Authorized by the company:

Annexure-5

TENDER ACCEPTANCE FORM

(For all the terms & conditions of tender document are acceptable to Tenderer)

To

The Director General of Meteorology, India Meteorological Department,
Mausam Bhawan, Lodi Road, New Delhi-110003

Ref: TE document No. IMD/_____dated _____

I/We, the undersigned have examined the above mentioned TE document, including amendment/corrigendum No. _____, dated _____ (if any), the receipt of which is hereby confirmed. We now offer to CAMC services in conformity with your above referred document.

If our tender is accepted, we undertake to supply the goods and perform the Services of **“Hardware and Software Solution for GIS based Customized Rainfall Information System-II”**, as mentioned in tender document with the requirements, terms and conditions specified in the Section 1 and Section II of tender document.

I/We further confirm that, if supply / purchase order is placed to firm, we shall provide performance security of required amount in an acceptable form for due performance of the contract.

I/We agree to keep our tender valid for acceptance as required in tender document or for subsequently extended period, if any, agreed to by us. I/We also accordingly confirm to abide by this tender up to the aforesaid period and this tender may be accepted any time before the expiry of the aforesaid period. I/We further confirm that, until a formal contract is executed, this tender read with your written acceptance thereof within the aforesaid period shall constitute a binding contract between us.

I/We further understand that you are not bound to accept the lowest or any tender you may receive against your above-referred tender enquiry.

We confirm that we do not stand deregistered/banned/blacklisted by any Govt. Authorities.

I/We confirm that we fully agree to the terms and conditions specified in above mentioned TE document, including amendment/ corrigendum etc. if any.

(Signature with date and seal of the company)
(Name and designation)

Duly authorised to sign tender for and on behalf of Bidder / Tenderer

Note* : Firm/company shall use their own printed letter head for issuing this certificate

Acceptance shall be unconditional.

Annexure – 6

MODEL BANK GUARANTEE FORMAT FOR FURNISHING EMD

(format only)

Whereas
(hereinafter called the "tenderer") has submitted their offer dated.....for offering the VSAT services of(hereinafter called the "tender") against the purchaser's tender enquiry No.KNOW ALL MEN by these presents that WEof having our registered office at..... are bound unto(hereinafter called the "Purchaser") in the sum of for which payment will and truly to be made to the said Purchaser, the Bank binds itself, its successors and assigns by these presents. Sealed with the Common Seal of the said Bank this..... day of20.....

THE CONDITIONS OF THIS OBLIGATION ARE:

(1) If the tenderer withdraws or amends, impairs or derogates from the tender in any respect within the period of validity of this tender.

(2) If the tenderer having been notified of the acceptance of his tender by the Purchaser during the period of its validity:-

a) If the tenderer fails to furnish the Performance Security for the due performance of the contract.

b) Fails or refuses to accept/execute the contract.

WE undertake to pay the "Director General of Meteorology, India Meteorological Department", up to the above amount upon receipt of its first written demand, without the Purchaser having to substantiate its demand, provided that in its demand the Purchaser will

note that the amount claimed by it is due to it owing to the occurrence of one or both the two conditions, specifying the occurred condition or conditions.

This guarantee will remain in force upto and including 60 days after the period of tender validity and any demand in respect thereof should reach the Bank not later than the above date.

Bank Guarantee issued with the tender enquiry reference No.IMD/..... Dated.....

.....

(Signature of the authorized officer of the Bank)

.....

Name and designation of the office

Seal, name & address of the Bank and address of the Branch

Annexure-7

APPLICATION-CUM-BILL FOR REFUND OF EMD

The Director General of Meteorology, (Kind Attn. to: DDO), India Meteorological Department,

Mausam Bhawan, Lodi Road, New Delhi-110003

MONTH.....BILL NO.

Original Challan or Receipt No. & date	Bank/Office in which deposited	Name of depositor	Amount Originally deposited
1	2	3	4

Received this day of20..... the sum of ₹(₹) only being repayable on Account of release of deposited described above.

Claimant's Signature.

(with revenue stamp affixed)

For use in Departmental Office

1. Received payment of ₹..... (₹.....
.....) for arranging disbursement to claimant.

2. Passed for Payment of ₹(₹
.....) to claimant(s) Shri/Smt./Ms.....
against personal deposit account administered by me.

DDO(IMD)
For Director General Of Meteorology
In case of endorsement of above

For use in Pay & Account office incase of endorsement of 1 above

Passed for payment of Rs.Payment by Cheque
No.

Pay & Account Office

MANUFACTURER'S AUTHORISATION FORM

(Bidders, quoting products other than his own manufactured products, shall submit this certificate in following format on the Letter Head of the firm)

To,

The Director General of Meteorology, India Meteorological Department,

Mausam Bhawan, Lodi Road, New Delhi-110003

Sub: Manufacturer Authorization for Tender No _____.

Sir,

We, **<OEM/ Manufacturer name>**having our registered office at**<OEM/ Manufacturer address>**, are an established and reputed manufacturer of

We confirm that **<Bidder Name>** having its registered office at **<Bidder Address>** is our authorized partner for We authorize them to quote for in the above-mentioned tender.

We hereby confirm that we shall provide all service and maintenance support to our authorized partner during the entire contract period. We also ensure to provide required spares and service support to the above authorized partner while offering onsite maintenance services.

Yours faithfully,

[Signature with date, name and designation]
for and on behalf of Messrs_____

[Name & address of the manufacturers along with Seal of the firm]

Note: This letter of authorisation should be on the letter head of the manufacturing firm and should be signed by a person competent and having legal binding to the manufacturer (original letter to be attached or to be shown at the time of opening of bids).

Non-Blacklisting declaration

(Sample Format only)

To: ,

Date:

(Consignee Name and address)

Subject: Non-Blacklisting declaration in connection with RFP No:dated for supply of Three (03) no of SSPA based C band Dual Pol DWRs to India Met Department.

Dear Sir,

This is to notify that our Firm/Company/Organization intends to submit a proposal in response to invitation for RFP No: for supply of Three (03) no of SSPA based C band Dual Pol DWRs to India Met Department. In accordance with the above we declare that:

- a) We are not involved in any major 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/ agency of Central/ State Government of India or any other country in the world/ Public Sector Undertaking/ any Regulatory Authorities in India or any other country in the world for any kind of fraudulent activities.

Sincerely,

[BIDDERS NAME]

Title

Signature with firm's seal

BANK GUARANTEE MODEL FORMAT FOR PERFORMANCE SECURITY

To,

The President of India

Through :-

**Director General of Meteorology,
India Meteorological Department,
Lodi Road, New Delhi-110008**

WHEREAS _____ (Name and address of bidder) (Hereinafter called "bidder") has undertaken, in pursuance of contract no _____ dated _____ to supply (description of goods and services) (herein after called "the contract").

AND WHEREAS it has been stipulated by you in the said contract that bidder shall furnish you with a bank guarantee by a scheduled commercial bank recognized by you for the sum specified therein as security for compliance with its obligations in accordance with the contract;

AND WHEREAS we have agreed to give bidder such a bank guarantee;
NOW THEREFORE we hereby bidder that we are guarantors and responsible to you, on behalf of bidder, up to a total of.

(Amount of the guarantee in words and figures), and we undertake to pay you, upon your first written demand declaring bidder to be in default under the contract and without cavil or argument, any sum or sums within the limits of (amount of guarantee) as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein. We hereby waive the necessity of your demanding the said debt from bidder before presenting us with the demand. We further agree that no change or addition to or other modification of the terms of the contract to be performed there under or of any of the contract documents which may be made between you and bidder shall in any way release us from any liability under this guarantee and we hereby waive notice of any such change, addition or modification. This guarantee shall be valid up to and including the _____ day of _____, 20____

(Signature with date of the authorized officer of the Bank)

Name and designation of the officer

Seal, name & address of the Bank and address of the Branch

Annexure-11(a)



Dated: dd/mm/yyyy
Time of Issue: hrs IST

HYDROMET BULLETIN

1) **Synoptic Situation**

2) a) **River Sub-basin-wise Quantitative Precipitation Forecast (QPF)**

S. No.	Basin Name	Sub-basin Name	QPF (mm)				
			Day-1	Day-2	Day-3	Day-4	Day-5
1.							
2.							
3.							
4.							

QPF categories (mm)	0	0.1-10	11-25	26-50	51-100	>100
---------------------	---	--------	-------	-------	--------	------

Forecast and Warning for any day is valid from 0830 hours IST of day till 0830 hours IST of next day

2) b) **River Sub-basin-wise Intensity and Distribution of QPF**

S. No.	Basin Name	Sub-basin Name	Intensity (I) and Spatial Distribution (D)											
			Day-1		Day-2		Day-3		Day-4		Day-5			
			I	D	I	D	I	D	I	D	I	D		
1														
2														
3														
4														
5														
6														

Spatial Distribution		
DRY	Dry	No station reported rainfall
ISOL	One or two places	25% or less number of stations recorded rainfall 2.5 mm
SCAT	At a few places	26%-50% number of stations recorded rainfall 2.5 mm
FWS	At many places	51%-75% number of stations recorded rainfall 2.5 mm
WS	At most places	76%-100% number of stations recorded rainfall 2.5 mm

Intensity					
M.Dry	NIL	0 cm	VL	Very Light Rainfall	Trace
L	Light Rainfall	Upto 1 cm	M	Moderate Rainfall	2-6 cm
H	Heavy Rainfall	7-11 cm	VH	Very Heavy rainfall	12-20 cm
EH	Extremely Heavy Rainfall	21 cm or more			
ExH	Exceptionally Heavy Rainfall	When the amount is a value near about the highest recorded rainfall at or near the station for the month or season. However, this term will be used only when the actual rainfall amount exceeds 12 cm.			

Forecast and Warning for any day is valid from 0830 hours IST of day till 0830 hours IST of next day

5) Outlook for subsequent two days

S No	Basin Name	Sub-basin Name	OUTLOOK	
			Day-6	Day-7
1				
2				
3				
4				

6) Station-wise significant rainfall recorded at 0830 hrs IST of today

S. No.	Name of Sub-Basin	Name of Station and Rainfall (≥ 5 cm.)
1		
2		
3		
4		
5		

7) River Sub-basin-wise observed Average Areal Precipitation (AAP) of today

S. No.	Basin Name	Sub-basin Name	AAP (mm)
1			
2			
3			
4			
5			
6			
7			
8			

Flood Met. Office,
 Phone:



Dated: dd/mm/yyyy
Time of Issue: hrs IST

HYDROMET BULLETIN

1) **Synoptic Situation**

2) a) **River Sub-basin-wise Quantitative Precipitation Forecast (QPF)**

S. No.	Basin Name	Sub-basin Name	QPF (mm)				
			Day-1	Day-2	Day-3	Day-4	Day-5
1.							
2.							
3.							
4.							

QPF categories (mm)	0	0.1-10	11-25	26-37	38-50	51-75	76-100	>100
---------------------	---	--------	-------	-------	-------	-------	--------	------

Forecast and Warning for any day is valid from 0830 hours IST of day till 0830 hours IST of next day

2) b) **River Sub-basin-wise Intensity and Distribution of QPF**

S. No.	Basin Name	Sub-basin Name	Intensity (I) and Spatial Distribution (D)										
			Day-1		Day-2		Day-3		Day-4		Day-5		
			I	D	I	D	I	D	I	D	I	D	
1													
2													
3													
4													
5													
6													

Spatial Distribution		
DRY	Dry	No station reported rainfall
ISOL	One or two places	25% or less number of stations recorded rainfall 2.5 mm
SCT	At a few places	26%-50% number of stations recorded rainfall 2.5 mm
FWS	At many places	51%-75% number of stations recorded rainfall 2.5 mm
WS	At most places	76%-100% number of stations recorded rainfall 2.5 mm

Intensity					
M.Dry	NIL	0 cm	VL	Very Light Rainfall	Trace
L	Light Rainfall	Upto 1 cm	M	Moderate Rainfall	2-6 cm
H	Heavy Rainfall	7-11 cm	VH	Very Heavy rainfall	12-20 cm
EH	Extremely Heavy Rainfall	21 cm or more			
ExH	Exceptionally Heavy Rainfall	When the amount is a value near about the highest recorded rainfall at or near the station for the month or season. However, this term will be used only when the actual rainfall amount exceeds 12 cm.			

Forecast and Warning for any day is valid from 0830 hours IST of day till 0830 hours IST of next day

5) Outlook for subsequent two days

S No	Basin Name	Sub-basin Name	OUTLOOK	
			Day-6	Day-7
1				
2				
3				
4				

6) Station-wise significant rainfall recorded at 0830 hrs IST of today

S. No.	Name of Sub-Basin	Name of Station and Rainfall (≥ 5 cm.)
1		
2		
3		
4		
5		

7) River Sub-basin-wise observed Average Areal Precipitation (AAP) of today

S. No.	Basin Name	Sub-basin Name	AAP (mm)
1			
2			
3			
4			
5			
6			

Flood Met. Office,
 Phone:

Annexure-12(a)

भारत सरकार
भारत मौसम विज्ञान विभाग
पृथ्वी विज्ञान मंत्रालय
बाढ़ मौसम कार्यालय,



GOVERNMENT OF INDIA
INDIA METEOROLOGICAL DEPARTMENT
(Ministry of Earth Sciences)
Flood Met. Office,
Phone:
email:

Dated: dd/mm/yyyy
Time of Issue: hrs IST

QPF Bulletin

River Sub-basin-wise Quantitative Precipitation Forecast

S. No.	Basin Name	Sub-basin Name	QPF (mm)				
			Day-1	Day-2	Day-3	Day-4	Day-5
1.							
2.							
3.							
4.							
5.							
6.							

Flood Met. Office,
Phone:

QPF categories (mm)	0	0.1-10	11-25	26-50	51-100	>100
---------------------	---	--------	-------	-------	--------	------

Forecast and Warning for any day is valid from 0830 hours IST of day till 0830 hours IST of next day

Annexure-12(b)

भारत सरकार
भारत मौसम विज्ञान विभाग
पृथ्वी विज्ञान मंत्रालय
बाढ़ मौसम कार्यालय,



GOVERNMENT OF INDIA
INDIA METEOROLOGICAL DEPARTMENT
(Ministry of Earth Sciences)
Flood Met. Office,

Dated: dd/mm/yyyy
Time of Issue: hrs IST

QPF Bulletin

River Sub-basin-wise Quantitative Precipitation Forecast

S. No.	Basin Name	Sub-basin Name	QPF (mm)				
			Day-1	Day-2	Day-3	Day-4	Day-5
1.							
2.							
3.							
4.							
5.							
6.							

Flood Met. Office,

Phone:

QPF categories (mm)	0	0.1-10	11-25	26-37	38-50	51-75	76-100	>100
---------------------	---	--------	-------	-------	-------	-------	--------	------

Forecast and Warning for any day is valid from 0830 hours IST of day till 0830 hours IST of next day

Annexure - 13

Quality Checks of Rainfall data

The following quality checks will be applied on the real-time as well as historical rainfall data. If it does not pass through the check, then to flag the data and notify the administrator/user with in tabular form. The system should provide an interface for unflagging, deleting or modifying the flagged data for further use.

The user should be able to incorporate other checks in the system, if any, defined afterwards. If required, the facility for deletion of any existing check from the system should be available.

1.0 Real-time daily Rainfall data

- (1) Rainfall should not be negative.
- (2) One day Rainfall > 20 cm for states Himachal Pradesh, Uttarakhand, Arunachal Pradesh, Meghalaya (Hill states), Konkan & Goa and Coastal Karnataka and > 10 cm for remaining states (plain regions) shall be flagged. In addition, the administrator shall have facility to redefine these limits.
- (3) Difference between the current cumulative rainfall and the previous cumulative rainfall shall not be negative for a district/subdivision.
- (4) One day and weekly rainfall should not be greater than the monthly normal rainfall for a particular station/district.
- (5) Rainfall for a day and week, if greater or equal to one day extreme rainfall for the corresponding season for that particular station shall be flagged. (Extreme rainfall shall be provided by IMD).
- (6) If any station reports same non-zero value of daily rainfall continuously for three consecutive observations, it should be flagged.
- (7) For horizontal spatial consistency check, the user should be presented with station rainfall plotted on the map with flagged data in different colors and with station names. The system should provide an interface for unflagging, deleting or modifying the flagged data for further use in preparation of rainfall statistics. After the un-flag operation is over, a log file should be created containing the details of error, its code, data received, action taken and revised data. This log file should also be sent to decision makers along with the products for approval. This information should be available in graphical as well as in tabular format. This information should be available for last 365 days or as defined by the user. There shall be a user interface to enable him to retrieve this log file.

2.0 Historical Rainfall data

- (1) Rainfall should not be negative.
- (2) Extreme rainfall, if more than 20% of the second highest, then such extreme RF should be flagged.

- (3) Those values of maximum Rainfall should be flagged which are more than $\bar{x} + 5 \times \sigma$, where,
 \bar{x} - Mean of maximum rainfall and σ - Standard Deviation. A list of the flagged data along with the Station name, Date of observation and RF should be provided to user for further checking.
- (4) For spatial and time consistency checks, the user should be presented with station rainfall plotted on the map for the date of extreme RF under consideration, one day prior to it and for the next one day for all the stations lying in the radius of 250 km. from the station recording extreme RF. User should be provided with facility for flagging the RF, he finds fit by observing for further checking, for unflagging, deleting or modifying the flagged data for further use.

Annexure-14

1. Module: RAINFALL MONITORING

Precipitation is highly variable over time and space. More than 75% of rainfall occurs over the country during four months (June –September). Also, the annual rainfall varies from less than 20 cm over west Rajasthan to more than 250 cm over Western Ghats and Meghalaya. Rainfall data is collected from all over the India at more than 3500 rain-gauge stations and received at HQ, New Delhi for computations of rainfall statistics at various spatial and temporal scales.

1.1 Computation of Actual Rainfall for the Block/Tehsil/District/Subdivision/State

Following is the procedure to compute the Block/Tehsil Rainfall:

Let the rainfall for (n) no. of days for a Block/Tehsil having (m) no. of stations is to be computed.

Block/Tehsil Rainfall & sub basin		DAYS								
		Day 1	Day 2	Day 3	...	...	...	...	...	Day (n)
STATIONS	Stn. 1	...	...	...	...	...	...	...	...	...
	Stn. 2	...	...	...	...	...	...	...	...	...

	Stn. (m)	...	...	...	...	...	...	...	...	...
Block/Tehsil Averages		Avg. 1	Avg. 2	Avg. 3	...	...	...	...	...	Avg. (n)

Block/Tehsil and sub basin Rainfall for (n) no. of days = Avg.1+Avg.2+Avg.3+ ... +...+...+...+Avg.(n)

Following is the procedure to compute the District Rainfall:

A. Technique 1:

District Rainfall is the weighted mean of the Block/Tehsil Rainfall, with District areas (will be provided by IMD) taken as weights

District Rainfall (mm.)		Rainfall for a given period of time		
		Block/Tehsil Rainfall (mm.) for the given period (n days)	Block/Tehsil (Sq. Km.)	Rainfall x Area
Block/Tehsil	Dist. 1	r_1	a_1	$r_1 \times a_1$
	Dist. 2	r_2	a_2	$r_2 \times a_2$
	Dist. 3	r_3	a_3	$r_3 \times a_3$

	Dist. (m)	r_m	a_m	$r_m \times a_m$

Daily District Average Rainfall (Avg.) = $\frac{\sum_1^m a_m r_m}{\sum_1^m a_m}$

District Rainfall for (n) no. of days = Avg.1+Avg.2+Avg.3+ ... +...+...+...+Avg.(n)

B. Technique 2

District Rainfall	DAYS								
	Day 1	Day 2	Day 3	...	...	...	...	...	Day (n)
Stn. 1
Stn. 2
...
...
...
...
...
...
Stn. (m)
District Averages	Avg. 1	Avg. 2	Avg. 3	...	...	...	...	...	Avg. (n)

District Rainfall for (n) no. of days = Avg.1+Avg.2+Avg.3+ ... +...+...+...+Avg.(n)

Sub-divisional/State Rainfall is the weighted mean of the District Rainfall, with District areas (will be provided by IMD) taken as weights.

Subdivision/State Rainfall (mm.)	Rainfall for a given period of time			
	District Rainfall (mm.) for the given period (n days)	District Area (Sq. Km.)	Rainfall x Area	
DISTRICTS	Dist. 1	r_1	a_1	$r_1 \times a_1$
	Dist. 2	r_2	a_2	$r_2 \times a_2$
	Dist. 3	r_3	a_3	$r_3 \times a_3$

	Dist. (m)	r_m	a_m	$r_m \times a_m$
TOTAL		SUM1	SUM2	

$$\text{Daily Sub division or State Average Rainfall (Avg.)} = \frac{\sum_1^m a_m r_m}{\sum_1^m a_m}$$

Sub-division/State Rainfall for (n) no. of days = Avg.1+Avg.2+Avg.3+ ... +...+...+...+Avg.(n)

The list of stations with lat./long., shape files of Blocks/Tehsils, districts, States, subdivisions, four homogenous regions and country will be provided by IMD. Also, the district areas will be provided by IMD.

1.2 **RAINFALL NORMALS**

The long term averages of rainfall known as "Rainfall Normal" for the stations, Block/Tehsils, districts, Subdivisions, States, river basin/sub-basins, regions and for the country as a whole will be provided by IMD. These will be Seasonally Daily Accumulated Rainfall Normal.

1.3 **Percent Departures from Normal**

Percent Departure from Normal for a given period for an entity (District/Subdivision/State/Region/Country/ river basin/river sub-basin) are calculated by the following formula:

$$\% \text{ Departure from Normal} = \frac{\text{Actual Rain for the period (mm.)} - \text{Normal Rain for the period (mm.)}}{\text{Normal Rain for the period (mm.)}} \times 100$$

If Normal for the specified period is Zero then the % Departure is calculated by taking the normal rainfall as negligibly small value like 0.01 mm and % departure if comes out to be more than 200%, it is displayed as 200% only (Provision shall be available to modify this value, if required), just to show that it is a large value with Excess rainfall.

1.4 **Category of the Rainfall**

Category of the rainfall is decided as per the % Departure calculated above with the following criteria:

<u>Category on Map)</u>	<u>% Departure from Normal</u>	<u>Colour (for depiction</u>
Large Excess	+60% or more	Dark Blue
Excess	+20% to +59%	Light Blue
Normal	+19% to -19%	Green
Deficient	-20% to -59%	Red
Large deficient	-60% to -99%	Yellow
No Rain	-100%	White
No Data		Gray

Provision should be there in the software to modify the existing categories or creating new categories.

1.5 **Computation of Actual/Normal Rainfall for the Region/Country**

The whole country has been divided in to 36 meteorological subdivisions, 37 States (including UTs) and 4 climatologically homogeneous regions and for the country for the purpose of rainfall monitoring. The rainfall (Actual or Normal) for the region or the Country is the weighted average of the sub-divisional rainfall under the Region/Country. Each subdivision has been given a weight which is the fraction of Sub-divisional Area to the Area of the Country.

Rainfall (mm.) for the	Rainfall for a given period of time
-------------------------------	--

Region /Country		Sub-divisional Rainfall (mm.) for given the period	Sub-divisional Weight	Rainfall x Weight
MET. SUBDIVISIONS	Subdivision 1	r_1	a_1	$r_1 \times a_1$
	Subdivision 2	r_2	a_2	$r_2 \times a_2$
	Subdivision 3	r_3	a_3	$r_3 \times a_3$

	Subdivision (m)	r_m	a_m	$r_m \times a_m$
TOTAL			SUM1	SUM2

$$\text{Rainfall for the Region or Country (mm.)} = \frac{r_1 \times a_1 + r_2 \times a_2 + r_3 \times a_3 + \dots + r_m \times a_m}{a_1 + a_2 + a_3 + \dots + a_m} = \frac{\text{SUM2}}{\text{SUM1}}$$

The sub-divisional weights for the country as well as for different regions will be provided by IMD.

1.6 Computation of % Area under various Categories of rainfall

$$\% \text{ Area of the country under a particular category of Rainfall} = \frac{\text{Sum of the Weights of the subdivisions under that category}}{\text{SUM1}}$$

1.7 Rainfall maps of Cumulative %age departures based upon NWP forecast

Rainfall maps of Cumulative %age departures of rainfall starting from first day of the season shall be prepared using the realized rainfall till date added to the NWP forecast for next 7 days, for given boundaries (Subdivisions, states etc.) and will be uploaded on the IMD website.

1.8 List of Products - Rainfall Monitoring

The following products shall be generated, archived and printed in booklet form (with index and legend) or separately on daily, weekly, monthly, seasonal, any specified period and annual basis in real-time and updated mode.

- (1) A Performance Sheet containing weekly and cumulative statistics of rainfall for the country and subdivision-wise and district-wise and Block/Tehsilwise comparison of rainfall statistics for last 5 years.
- (2) Subdivision-wise Rainfall statistics
- (3) State-wise Rainfall statistics
- (4) District-wise Rainfall statistics
- (5) Block/Tehsil-wise Rainfall statistics
- (6) State-wise distribution of Districts under various categories.
- (7) State-wise distribution of Block/Tehsils under various categories.
- (8) Subdivision-wise Rainfall Maps.
- (9) Statewise Rainfall Maps
- (10) District-wise Rainfall Maps for all the four regions of the country and for the country as whole.

- (11) Block/Tehsil-wise rainfall maps for each state/region of India.
- (12) Block/Tehsil diagram for Subdivision-wise Weekly Rainfall Departures
- (13) Block/Tehsil diagram for District-wise Weekly Rainfall Departures
- (14) Block/Tehsil diagram for Subdivision-wise Cumulative Rainfall Departures
- (15) Block/Tehsil diagram for District-wise Cumulative Rainfall Departures
- (16) Week by Week Rainfall with cumulative statistics for all the districts/state/subdivisions of the country.
- (17) Bar graph depicting the sub-divisional cumulative rainfall of the country/region along with the normal rainfall curve (line graph), daily for each season starting from the first date of the season.
- (18) Rainfall maps of Cumulative %age departures of rainfall starting from first day of the season shall be prepared using the realized rainfall till date added to the NWP forecast for next 7 days, for given boundaries (Subdivisions, states etc.)

Above products will also be published as documents on IMD website by the proposed application on approval from the user or administrator (Links for these products have been given at para 9, Reporting Module under details for Customised Application). Besides, following additional products will be put up on the IMD website:

- (19) District-wise monthly rainfall for last 5 years – provision for automatic upload from database.
- (20) Subdivisional Normal rainfall on maps and in tabular form
- (21) Isohyetal analysis of station rainfall as well as contours of %age departures of RF from Normals for the country and for the four regions separately on daily basis. Option for the user selectable isohyets/contours shall be available.
- (22) Block/Tehsil wise rainfall using isohyetal method on daily/weekly/ monthly/ seasonal/annual basis. However, there shall be facility for the user to exercise his option for preparation of products at S. No. 20 and 21 above.

2. Module: Design Storm Studies

The project area for the purpose of design storm studies is the specific area for which design storm values (maximum average rainfall, SPS, PMP etc.) are computed.

For any hydraulic project connected with irrigation, hydro-power generation, flood control and drainage, it is necessary to obtain the areal and time distribution of rainfall associated with the storm and to evaluate the average depth of precipitation yielded by it over a specified area during the storm period. Generally, the specified area for such project is the natural drainage basin, which is often called a river catchment. However, for the purpose of determining the greatest precipitation amounts for various-size areas and durations over the region, the area is considered to be the area enclosed by the peripheral isohyets of the rainstorm as a unit.

2.1 Isohyetal Method

Rainfall values are plotted at their respective stations on a digitized map and lines of equal precipitation, called "Isohyets" are drawn. The average depth of precipitation "P" is then determined by computing the incremental volume between

each pair of isohyets, adding these incremental volumes and dividing by the total area, as under :-

$$P = \frac{\sum_{r=1}^n P_r A_r}{\sum_{r=1}^n A_r}$$

Where $A_1, A_2, A_3, \dots, A_n$ are the areas between the successive isohyets and $P_1, P_2, P_3, \dots, P_n$ represent the average rainfall, i.e. the mean of the two successive isohyets over the areas $A_1, A_2, A_3, \dots, A_n$.

2.2 Standard Project Storm (SPS) & Probable Maximum Precipitation (PMP)

Standard Project Storm (SPS) is defined as the severe most rain-storm on record yielding highest rain depth over the catchment or in the meteorologically homogeneous neighbourhood of the catchment.

Probable Maximum Precipitation (PMP) is defined as the theoretically greatest depth of precipitation for a given duration that is physically possible over a given size project area at a particular geographical location. While estimating PMP, no allowance is made for long term climate trends.

2.3 Rainstorm & Storm Selection

A spatial distribution of rainfall yielding average depth of precipitation which equals or exceeds a specified threshold value over a region in association with some meteorological phenomena like depression/storm, etc. is termed as "Rainstorm"

Following steps are to be followed for selection of Rainstorm:

2.3.1 Area Selection:

Project area is the area for which design estimates are to be worked out. The Study area is the area around and inclusive of project area as defined by the user. Software shall provide facility for the user to draw a rectangle enclosing the Project area. Also, there shall be provision for the user to specify the study area by means of providing values for North, South, East and West extents from the rectangle formed above, in terms of Kms (and also Lat./Long.). However, while providing these values, the user shall take in to consideration the following criteria (criteria shall be displayed on the screen to help user to take proper decision):

- (i) The centre of the storm to be transposed should lie within the homogeneous region and within a radial distance of 300 km. from the boundary of the project area.
- (ii) The storms occurring on one side of the mountain range cannot be transposed to the other side. Further, storms occurring over mountainous area (a provision shall be there for the user to indicate the region of project area i.e. mountain/plain) should not be transposed to other areas, plain or mountainous, as the orography highly modifies the susceptibility of the clouds to shed their moisture, other meteorological conditions remaining same.

- (iii) A coastal storm (lying within a distance of 75 km. from coast, there shall be provision for the user to modify this value) should not be further transposed in land. However, it can be transposed along the coastal line within a range of ± 5 degree. (There shall be provision for the user to modify this value).

There shall be provision for the user to indicate if the study area lies in the hilly region.

A text file containing daily rainfall data for a no. of stations will be provided by the user. However the data file provided may contain data for those stations also, which lie far away from the area of interest and hence this data file needs to be shortened so that it keeps the records of only those stations which lie around the area of interest. There shall be provision for the user to select the stations as per their catchment no.s or as per some administrative boundary like state etc. The stations inside the study area will be utilised for preparation of ever recorded maximum rainfall as described in next para. There shall be provision for viewing/printing of map having study area along with stations inside the study area plotted on it with grid lines for lat./long.

2.3.2 Preparation of Ever recorded 1-day, 2-day, 3-day (consecutive days) Maximum Rainfall table using daily rainfall data for each station lying inside the study area:

The input data file for construction of maximum rainfall data set will be a text file containing daily rainfall for a no. of stations as mentioned in para 1 above. The output file will be in the form of following table giving the maximum rainfall details for each station lying in the study area.

Table 3.1.1: Ever recorded maximum 1-day, 2-day and 3-day rainfall for each station lying in the study area

Station	1-Day Maximum		2-Day Maximum			3-Day Maximum		
	RF (mm)	Date	RF (mm)	Starting Date	Ending Date	RF (mm)	Starting Date	Ending Date
Stn. 1
Stn. 2
.....
Stn. n

2.3.3 Prepare probable RF Storm Data Files:

From the above output table, those dates are to be selected for which 1-day maximum RF is ≥ 400 mm. However, this value of RF shall be modifiable by user (may be needed in case there are only four or less such instances are available satisfying the criteria) and there shall be provision for the user to specify any other threshold value other than 400 mm, if needed. For each date out of the selected dates, 1 file for 1 day, RF are to be prepared using the input file. Therefore, if there are 10 dates for which maximum 1 day RF is ≥ 400 mm, then the 1-day RF data file will include daily rainfall records for all the stations for the selected date.

Therefore number of such files shall be equal to the no. of dates, selected for 1 day max. RF e.g. Ten 1-day RF data files in this case. Suggested format of such data file is given in table 3.1.2.

Table 3.1.2 : 1-day RF data file format for probable rainstorm of Date:.....

<u>Station Name</u>	<u>Rainfall (mm)</u>
Station1	Day's RF
Station2	Day's RF
.....
Station k	Day's RF

2.3.4 Isohyetal Analysis of probable storms:

Rainfall values in respect of each of the selected storms using the 1-day RF data files prepared in step 3 above are plotted at their respective stations on a digitized map and lines of equal precipitation, called "Isohyets" are drawn. However, the height of 4500 m of orographic range (default value) shall be considered as a barrier while drawing the isohyets of the rainstorm. THE ISOHYETES CAN NOT BE DRAWN BEYOND THIS BARRIER. However, provision shall be there for the user to manually enter/edit the default value of the barrier height. The software will determine the line of barrier using the DEM data provided by IMD. If the storm extends to the sea region, the isohyetal pattern should be masked with the political boundary of the country.

Centre of the storm will be the station which is inside the study area and also recorded highest rainfall. There may be cases when there are more than one such centres inside the study area (recording equal as well as highest RF).

2.3.5 Deciding the periphery of the storm:

A storm isohyetal pattern generally reveals a natural boundary to the storm having centres as described in step 4 above, in the form of a peripheral isohyet. The default value of this peripheral isohyet is to be taken as 20 mm. However, there shall be provision for modifying this value of peripheral isohyet, if user decides. Only those isohyets are to be selected for further analysis which lie between the centre(s) and the peripheral isohyet (including). Rest of isohyets may be deleted and now the study area is extended so that it includes the Peripheral isohyet, if it is not already inside the study area. Thus we have isohyetal patterns for each of the selected storm. There shall be provision for viewing/printing of isohyetal analysis inside the study area having these patterns (including Station names, RF values, Isohyets at different values).

2.4 Rainstorm Analysis

The Isohyetal Analysis of the rainstorm is to be done using the isohyetal method as described in para 2.1. After the analysis, the areas enclosed between successive isohyets are to be measured up to the last closed isohyet. The entries are then made as per Performa called "Computation Sheet" sample given below:-

Table 3.2

Storm Date: From to.....

S. No.	Isohyetal Range (mm.)		Mean (Col 2 + Col 3)/2	Area (Sq. Km.)	Cummulative Area (Adding successive values under Col. 5)	Volume of Rainfall Col 4 x Col 5	Cummulative Volume of R/F	Average Depth of Rainfall (mm.)
	From	To						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

After the isohyetal analysis, Depth- Area- Duration Curve i.e. graph between Col. 6 (on X axis) & Col. 9 (on Y Axis) should be prepared. The average depth of rainfall corresponding to the area of the project under study, picked up from the DAD curve plotted above is the DAD value for the selected storm. This exercise is to be done for each of the selected storms and after arranging the storms on their DAD Values in decreasing order, only top four storms are to be retained for further study.

If the project area is in the hilly region, the highest DAD value corresponding to project area shall be subjected to Altitude Correction Factor (ACF) as explained in para 3.5 so as to get the Standard Project Storm (SPS).

However, if the area is not under the hilly region, the above four rainstorms are subjected to the transposition as explained in next para for computation of SPS.

Isohyetal patterns shall be stored for archival and retrieval purposes. There shall be facility for the user to archive/retrieve the old isohyetal patterns by means of user interface.

2.5 Transposition of Rainstorm

The rainstorms selected above in step 3.2 are to be transposed to the project area so that it gives maximum average RF over the project area. While transposition, it should be ensured that the orientation of the rainstorm (major axis of the isohyetal pattern of rainstorm) with respect to the project area and if necessary a tilt in the orientation of the storm to a maximum of 20° may be given in order to obtain the maximum rainfall (called as transposed rain depth). These Isohyetal patterns shall be stored separately for archival and retrieval purposes. There shall be facility for the user to archive/retrieve these isohyetal patterns by means of user interface.

A table shall be prepared having entries for the selected four rainstorms as given below:

Table 3.3: Selection of Storm for maximum rain depth

S. No.	Date of Rainstorm	Maximum RF Value of Storm	Centre (Station) of Rainstorm	Transposed Rain Depth
1				
2				
3				
4				

This table 3.3 shall be stored as text/excel file and should be available for viewing/printing.

The user shall have option to decide the transposed rain depth to be taken as Standard Project Storm (SPS).

2.6 2-Day & 3-Day Storm Selection

For each of the four 1-day storms computed in table 3.3 above and as selected for transposition in para 3.2 above, 2-day and 3-day storms are to be selected. Corresponding to each of the four storms, 2 files for 2 day and 3 files for 3 day RF are to be prepared using the input file as specified in para 3.1.1 above. The 2-day RF data file will include 2-day totals of rainfall for all the stations using the input data file. However, 2 day's duration will be of both of the two consecutive dates around the date of storm under consideration, thereby preparing two 2-day data files for the selected storm date. e.g. if for, say, a station 'A', 1-day Max. is on 10th Feb of a particular year, then the 2-days duration will be of 9th-10th and 10th-11th so, two 2-day files corresponding to 10th Feb. The 3-day RF data files will include 3-day totals of consecutive 3 day's daily rainfall for all the stations using the input data file. The 3 day durations will be selected in the similar way as that of 2 days. In the above example, the 3-day durations will be the 8th-9th-10th, 9th-10th-11th and 10th-11th-12th, thereby preparing three 3- day RF data files. Suggested formats of these output files are as below:

Table 3.4 : 2-day and 3-day RF data file format for probable rainstorm

2-day data file		3-day data file	
Start Date....	Ending Date....	Start Date....	Ending Date....
Station Name	Rainfall (mm)	Station Name	Rainfall (mm)
Station1	2Day's RF	Station1	3Day's RF
Station2	2Day's RF	Station2	3Day's RF
Station3	2Day's RF	Station3	3Day's RF
.....
Station k	2Day's RF	Station k	3Day's RF

The rainfall analysis and storm transposition methods for 2-day and 3-day storms will be same as explained above for 1-day storms in para 3.2 and 3.3 respectively.

Isohyetal patterns for 2-day and 3-day also shall be stored as were stored for 1-day patterns in different files for archival and retrieval purposes. There shall be facility for the user to archive/retrieve the old isohyetal patterns by means of user interface.

2.7 Correction Factors for computation of SPS & PMP

The following correction factors have to be computed for calculation of SPS.

2.7.1 Location Adjustment Factor (LAF)

The tables for reading precipitable water for corresponding values of dew point temperatures are given in section 3.10 and will form part of the database. There shall be an interface for the user to manually provide the maximum and persistent dew point temperature to the system.

$$\text{Location Adjustment Factor} = W_2 / W_1$$

Where,

W_1 is Precipitable water corresponding to maximum dew point temperature°C for the same fortnight in which storm occurred at the location of storm.

W_2 is Precipitable water corresponding to maximum dew point temperature°C at transposed site.

2.7.2 Altitude Correction Factor (ACF)

The software should have provision to apply altitude correction where the average height of catchment is more than 1500 m. ACF=1 for the average height less than 1500m.

$$\text{Altitude Correction Factor (ACF)} = (W_1 - W_3) / (W_1 - W_4)$$

Where,

W_1 is Precipitable water corresponding to maximum dew point temperature°C for the same fortnight in which storm occurred at the location of storm.

W_3 is Liquid water content corresponding to maximum dew point temperature°C at average height of catchment

W_4 is Liquid water content corresponding to maximum dew point temperature°C at height of storm centre

2.7.3 Moisture Adjustment Factor (MAF) (for computation of PMP)

$$\text{Moisture Adjustment Factor (MAF)} = W_1 / W_5$$

Where

W_1 is Precipitable water corresponding to maximum dew point temperature°C for the same fortnight in which storm occurred at the location of storm.

W_5 is Precipitable water corresponding to persistent dew point temperature°C during the period of the storm

2.8 Standard Project Storm (SPS) Value

The values of SPS shall be computed for the four maximum storms listed above using the following formula:

$$1\text{-day SPS} = \text{LAF} \times \text{ACF} \times 1\text{-day DAD}$$

$$2\text{-day SPS} = \text{LAF} \times \text{ACF} \times 2\text{-day DAD}$$

$$3\text{-day SPS} = \text{LAF} \times \text{ACF} \times 3\text{-day DAD}$$

The values of SPS may be kept in mm up to one place of decimal.

2.9 Probable Maximum Precipitation (PMP) Value

Probable Maximum Precipitation (PMP) Value :

$$1\text{-day PMP Value} = \text{MAF} \times 1\text{-day SPS}$$

$$2\text{-day PMP Value} = \text{MAF} \times 2\text{-day SPS}$$

$$3\text{-day PMP Value} = \text{MAF} \times 3\text{-day SPS}$$

The values of PMP may be kept in mm. up to one place of decimal.

2.10 Storm Selection from Hourly Rainfall Data and Preparation of TIME DISTRIBUTION CURVES

For selection of the rainstorms, hourly rainfall data of a particular station for consecutive 2 day (24 hr), 3 days (for 48 hr.) and for 4 observational days (for 72

hrly rainstorm) are to be scanned and consecutive 24-hour, 48-hour and 72-hour spells during which maximum rainfall is recorded, are to be selected (as per criteria given below).

- i. For 24-hour storm, minimum rainfall should be 50 mm or more and there should not be consecutive three hourly observations with zero rainfall. i.e. no break of rainfall for continuous three hours. The total no. of observations with zero rainfall should not be more than five (5).
- ii. For 48-hour storm, minimum rainfall should be 80 mm or more and there should not be consecutive five hourly observations with zero rainfall. i.e. no break of rainfall for continuous five hours. The total no. of observations with zero rainfall should not be more than nine (9).
- iii. For 72-hour storm, minimum rainfall should be 100 mm or more and there should not be consecutive seven hourly observations with zero rainfall. i.e. no break of rainfall for continuous seven hours. The total no. of observations with zero rainfall should not be more than fifteen (15).

By using the above criteria, maximum number of storms are to be selected from SRRG data (hourly rainfall data). For each storm, any 3 consecutive clock hour duration having maximum rainfall during 24-hour are to be selected. The design engineers generally require maximum of the percent rainfall for consecutive 3-hour, 6-hour, 9-hour,, 24-hour for a 24 hour, for determining storm hydrograph characteristics. Accordingly, this maximum rainfall value of each storm is expressed as percentage of 24 – hour rainfall value. The percentages values so derived for each storm and duration (3-hour, 6-hour, 9-hour,,24-hour are to be averaged over the no. of selected rainstorm over a specific station and these averaged percentage values are to be plotted against durationsto obtain Time Distribution Curves for 24-hour rainstorm).

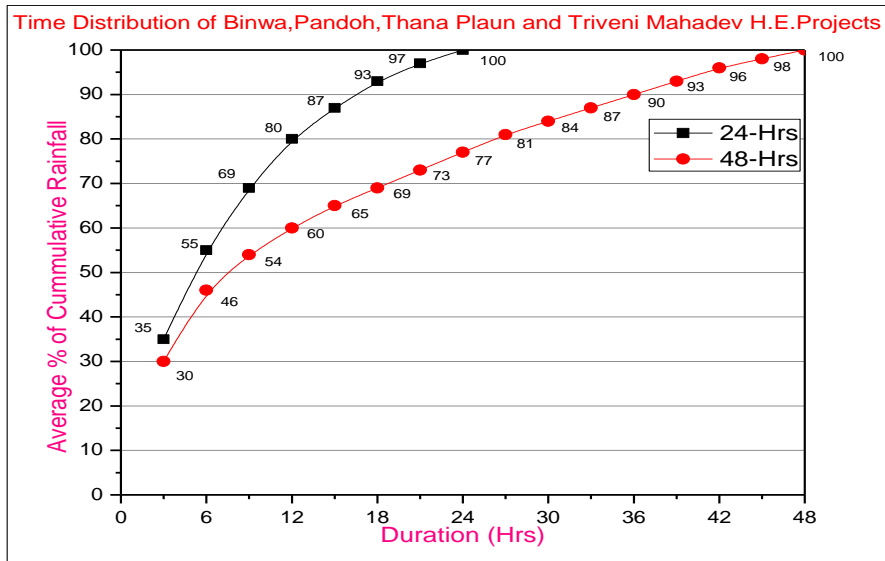
Similar procedure is to be adopted for 48-hour and 72-hour rainstorms.

From the curves, percentage values for each duration 3,6, 9,....., 24hour/48-hour/72 –hour are to be picked up and to be given in graphical as well as in tabular form as per following table and graph :

Table 3.8 :percentage values for each duration for 24 hrs., 48-hrs. And 72 hrs. Storm RF

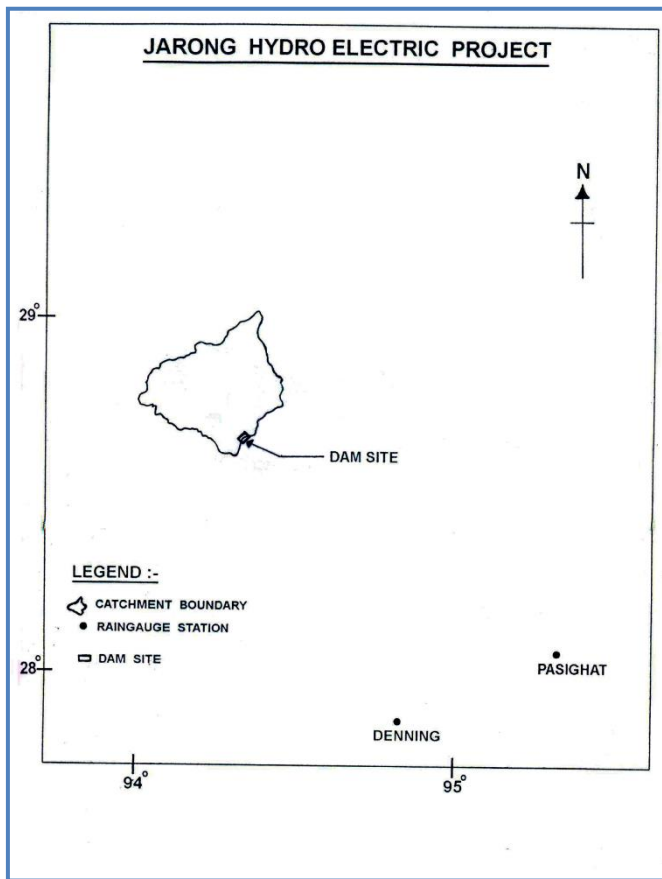
Duration (Hours)	%age of 24-hour rainfall storm	%age of 48-hour rainfall storm	%age of 72-hour rainfall storm
3
6
9
12
15
18
21
24
27	
30	
33	

36		.....	.....
39		.....	.....
42		.....	.....
45		....	.....
48			.....
51			.....
54			.....
57			.....
60			.....
63			.....
66			.....
69			.....
72			.....



2.11 Illustrations

Case 1: Design estimates by applying Altitude Correction Factor



Rainfed area : 1068 Sq Km

DAD Value corresponding to Rainfed area : 42.8 Cm

Average height of catchment : 3100 m

Height of storm location : 200 m

Max. Dew Point Temperature: 29.1°C

Persistent Dew Point Temp. during the Storm Period: 27.2°C

Altitude Correction Factor (ACF) =

$$(W_1 - W_3) / (W_1 - W_4)$$

Where

W_1 is Precipitable water corresponding to maximum dew point temperature 29.1°C for the same fortnight in which storm occurred at the location of storm.

W_3 is Liquid water content corresponding to maximum dew point temperature 29.1°C at average height of catchment.

W_4 is Liquid water content corresponding to maximum dew point temperature 29.1°C at height of storm centre

$$(ACF) = (W_1 - W_3) / (W_1 - W_4)$$

$$= (96.7 - 65.9) / (96.7 - 6)$$

$$= 30.8 / 90.7$$

$$= 0.34$$

$$\text{1-day SPS} = \text{ACF} \times \text{DAD}$$

$$= 0.34 \times 42.8$$

$$= 14.6 \text{ Cm}$$

$$\text{Moisture Adjustment Factor (MAF)} = W_1 / W_5$$

Where :

W_1 is Precipitable water corresponding to maximum dew point temperature 29.1°C for the same fortnight in which storm occurred at the location of storm.

W_5 is Precipitable water corresponding to persistent dew point temperature 27.2 °C during the period of the storm

$$\text{MAF} = W_1 / W_5$$

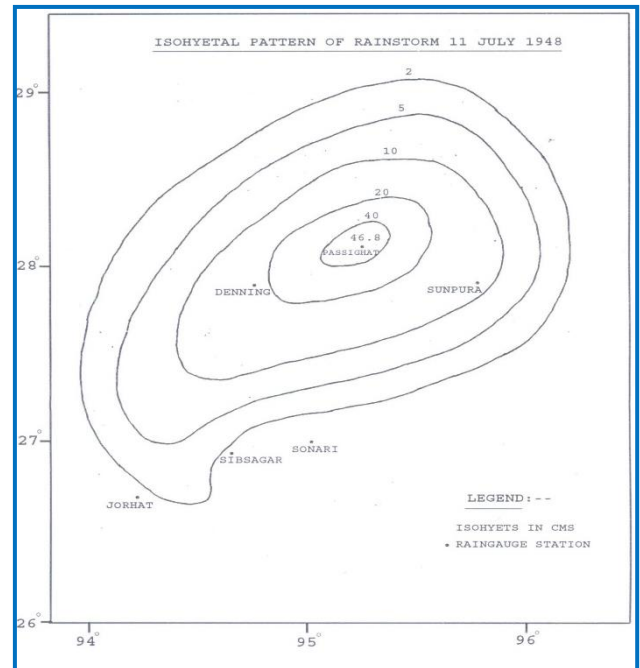
$$= 96.7 / 84.2$$

$$= 1.15$$

$$\text{1-day PMP Value} = \text{MAF} \times \text{1-day SPS}$$

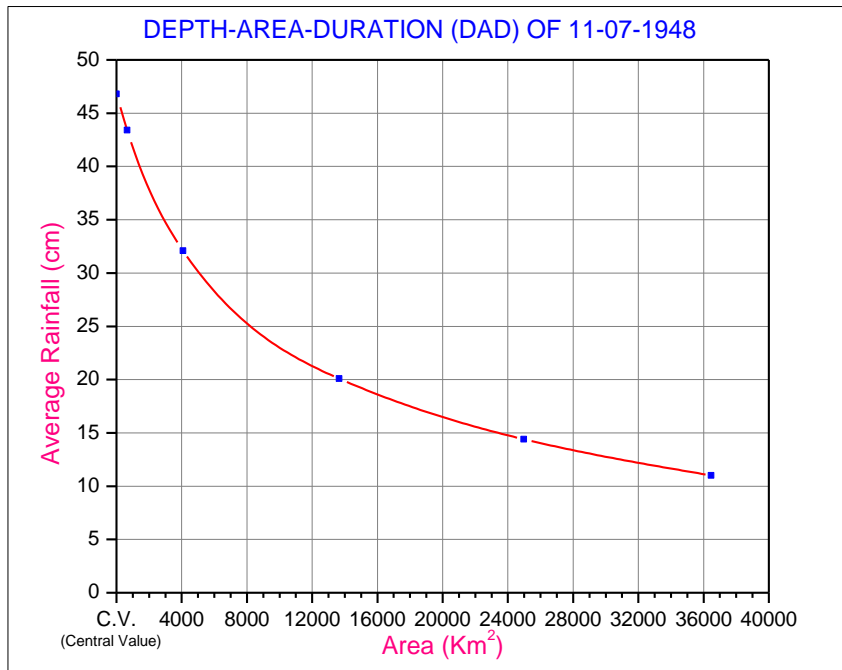
$$= 1.15 \times 14.6$$

$$= 16.8 \text{ cm}$$

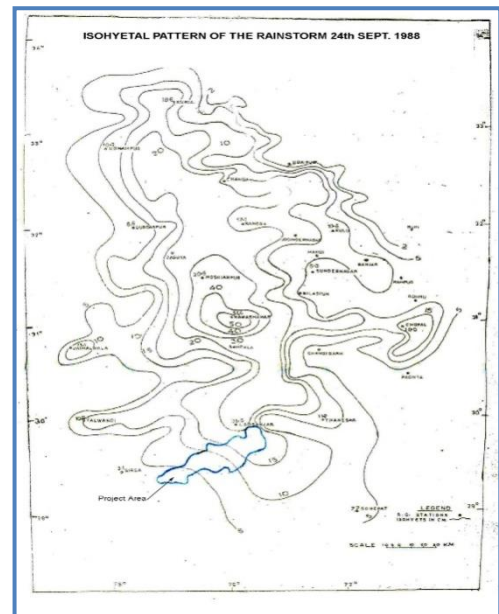
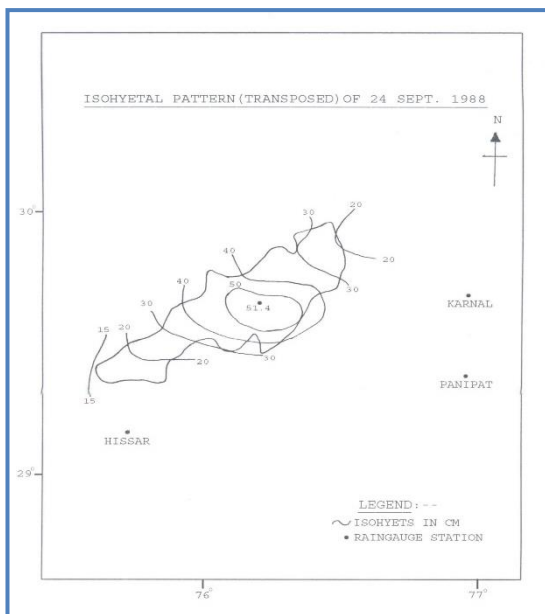


Isohyetal Range		mean value	Area	Accumulated area	Volume	Accumulated Volume.	Average R/F
From	To		(km ²)		(km ³)		(cm)
One-Day(11.07.1948)							
46.8	40	43.4	650	650	28210	28210	43.4
40	20	30	3430	4080	102900	131110	32.1
20	10	15	9570	13650	143550	274660	20.1

10	5	7.5	11310	24960	84825	359485	14.4
5	2	3.5	11500	36460	40250	399735	11.0



Case 2: When Storm is transposed over the catchment
Project Area near Hissar



Isohyetal Range (cm)		mean value	Area	Accumulated area	Volume	Accumulated Volume.	Average RF
From	To		(km ²)		(km ³)		(cm)
One-Day (24.09.1988)							
51.4	50	50.7	360	360	18252	18252	50.7
50	40	45	590	950	26550	44802	47.2
40	30	35	589	1539	20615	65417	42.5
30	20	25	441	1980	11025	76442	38.6
20	15	17.5	210	2190	3675	80117	38.6

1-day SPS value = 36.6 cm

Max. Dew Point Temperature: 28.0°C

Persistent Dew Point Temp. during the Storm Period: 23.0°C

Moisture Adjustment Factor (MAF) = W_1/W_5

Where

W_1 is Precipitable water corresponding to maximum dew point temperature 28.0 °C for the same fortnight in which storm occurred at the location of storm.

W_5 is Precipitable water corresponding to persistent dew point temperature 23.0°C during the period of the storm

$$\begin{aligned} \text{MAF} &= W_1/W_5 \\ &= 89/61 \\ &= 1.45 \end{aligned}$$

$$\begin{aligned} \text{1-day PMP Value} &= \text{MAF} \times \text{1-day SPS} \\ &= 1.45 \times 36.6 \\ &= 53.1 \text{ cm} \end{aligned}$$

2.12 WMO Prescribed tables for picking up the values of Precipitable Water Given below are the tables for finding precipitable water i.e. W_1 , W_2 , W_3 , W_4 and W_5 (mm) for specific atmospheric height (m/hPa) corresponding to dew point temperature (°C)

2.13 STORM ANALYSIS

Storm Analysis for Project Area (Sub-Zones/State etc.)

The country has been divided in to 7 zones and 26 hydro-meteorological homogeneous subzones for computing the design flood of a specific return period for small and medium catchments. For this, Depth-Duration-Frequency analysis using ORG/SRRG data has to be carried out. This study comprises of formation of extreme series of defined duration and 24 Hr. to short duration rainfall ratios.

Following products using the ORG/SRRG data shall be generated, archived and retrieved by the proposed application. ORG and SRRG data (excel/text format) will be supplied by IMD.

2.14 Computation of Rainfall Return Period Values for 1-day/24 Hr. duration

2.14.1 ORG Data (One Day rainfall recorded at 0830 Hrs. IST)

i. **Preparation of Annual Maximum Extreme Series using daily rainfall data for each station:**

The rainfall data for a station consisting of daily rainfall data for N no. of years, (Total no. of observations/records = 365 x N) will be the input for preparing this product. **Annual Maximum Extreme Series (the output) comprises of** highest one day rainfall for each year (N no. of Records : Date vs Rainfall). A series of N extreme values are formed for a station.

However, the following minimum requirements should be met for preparation of extreme series:

Only those years will be considered for preparation of extreme series in which at least 300 days of records with a minimum of 100 days of rainfall records during the monsoon season (June 1 to Sept. 30) are available. The user should be able to modify these limits, if needed. The Annual maximum extreme series are to be prepared for all the stations in and around the project area using the above mentioned method. Such a series should also contain the date (dd/mm/yyyy) for selected extreme values of rainfall. There should be provision for viewing and printing the series so formed.

ii. Extreme rainfall series for each of the stations prepared at (i) above are used to compute return periods by Gumble Method. Software for computation of return period using Gumble distribution (Fortran language) will be provided by IMD. The software computes the return periods using two methods, i.e. Least Squares method and method of moments. However, the return period values obtained from any one of the methods are to be used for further processing.

Rainfall estimates for various return periods (2, 5, 10, 25, 50 and 100, 150, 200, 500, 1000, 5000 and 10000 years) will be computed. There should be a provision for the users to view the output of Gumble program as well as to have it's print-out and if needed to archive it. The return period values obtained from Gumble program by Least Square method will be used for further data processing. A table-I containing the columns for Station Name, Index No., Latitude, Longitude, No. of years of data used 'N', 2-yr RPV, 5 yr. RPV, 10 yr. RPV, 25 yr. RPV, 50 yr. RPV and 100 yr. RPV will be generated (in Excel and Text formats)

2.14.2 SRRG Data (One Day rainfall recorded at 0830 Hrs. IST)

As in case of ORG data explained in para 4.1.1.1 above, products shall be prepared for all the SRRG stations in the project area. An other table, table-II containing the columns for Station Name, Index No., Latitude, Longitude, No. of years of data used 'N', 2-yr RPV, 5 yr. RPV, 10 yr. RPV, 25 yr. RPV, 50 yr. RPV and 100 yr. RPV will be generated (in Excel and Text formats) . This table shall be stored also, if the user needs. The station name, latitude and longitude will be read from a separate file (provided by IMD) based upon the index no. of the station (Index No. will serve the purpose of primary key). The RPVs computed by Least Square method will only be used for further analysis.

Return period values are calculated for 2, 5, 10, 25, 50, 100, 150, 200, 500, 1000, 5000 and 10000 years for each station lying in and near by the project area. Each of the Return period value from daily rainfall is converted to 24-hr return period rainfall value by multiplying it by a factor of 1.15.

2.14.3 RPV from ORG & SRRG Data for 1- Day/24 Hrs. duration

i. The values of particular return period (user defined from 2, 5, 10, 25, 50, 100, 150, 200, 500, 1000, 5000 and 10000 years) have to be tabulated for all the stations. There shall be two tables of station wise return period values, one for the stations having data ≥ 30 years and other for the stations having data < 30 years and the period of data shall also be written in the tables.

ii The 24 hr. – 25 year return period rainfall values (suppose 25 years return period value is defined by the user) as obtained in (iii), there shall be provision to the user to decide which stations from table-II should be processed for plotting on map in addition to stations of table-I and analysis is carried out by drawing isopluvial lines (lines of equal return period rainfall values) at suitable rainfall interval (default value 4cm interval, with user defined option). Similar isopluvial lines are to be drawn for user defined return periods out of the available options.

2.14.4 Computation of Return Period Values for short duration (≤ 24 Hrs.) rainstorms

(i) The annual series for short durations (1, 3, 6, 9, 12, 15, 18 and 24 hrs) will be prepared by using SRRG data (hourly data) in the same manner as mentioned in item 4.1.1.1 (i) for ORG data. For each short duration series ((1, 3, 6, 9, 12, 15, 18 and 24 hrs) the return period values (2, 5, 10, 25, 50, 100, 150, 200, 500, 1000, 5000 and 10000 years) shall be computed by Gumble distribution as mentioned in item 4.1.1.1(ii) & (iii). There shall be 8 tables, one for each duration (1, 3, 6, 9, 12, 15, 18 and 24 hrs) when $N \geq 30$ and 8 tables, one for each duration (1, 3, 6, 9, 12, 15, 18 and 24 hrs) when $N < 30$.

(ii) However, if the available data is < 30 years, using the SRRG(hourly) rainfall data the partial duration series shall be formed for different short durations (1, 3, 6, 9, 12, 15, 18 and 24 hrs) and the return periods will be computed using the software (in Fortran language) provided by IMD. There will be different tables in the output for different values of ' λ ' and provision shall be made for the user to decide the value of ' λ ' for each station, so that corresponding return period values can be picked up for all stations and prepare a table for each duration(1, 3, 6, 9, 12, 15, 18 and 24 hrs). Therefore, there will be total 8 tables.

(iii) There shall be provision to the user to decide which stations from tables formed in item (i) and item (ii) are to be processed to form a new table (say, X) for plotting of return periods values on map and analysis shall be carried out by drawing isopluvial lines.

(iv) Isopluvial maps shall be prepared using above mentioned method in item 4.1.1.1 (ii) and 4.1.3.1(i)-(ii)user defined return period for the return period values computed in item 4.1.2. (i) and (ii) separately. There shall be provision to user to form a new table using the return period value for each return period for all the stations computed in 4.1.2. (i) and (ii) for isopluvial analysis.

2.14.5 Short Duration Ratios:

For conversion of (1, 3, 6, 9, 12, 15 & 18 hrs) rainfall to 24 hrs rainfall. Using the return period values computed above at 1.1.2. (iii) in table-X shall be used to compute short duration ratios and there shall be provision to user to select the stations along with their return period values from this table.

Following steps to be followed for computation of short duration ratios from the selected stations:

- (a) Ratios of 2-yr, 5-yr, 10-yr, 25-yr and 50-yr t-hr rainfall (t=1, 3, 6, 9, 12, 15 and 18 hr) to 24-hr rainfall of respective return periods shall be computed for each station (e.g. **Ratio=50-yr t-hr rainfall/50-yr 24-hr Rainfall**).
- (b) The ratio for each duration for each Return Period for all station is to be averaged.
- (c) Using the above ratios, a graph of short period ratios against storm duration (t=1, 3, 6, 9, 12, 15 and 18 hr) will be drawn to facilitate estimation of short duration ratios for each return period (T=2-yr, 5-yr, 10-yr, 25-yr and 50-yr) for rainstorms of intermediate duration. Tables for each return period of intermediate values shall be prepared. There shall be provision to user to select a graph for a particular return period to plot separately and table of the corresponding return period shall be attached with graph.

Format of tables for Ratios of 24-Hours Point Rainfall to Short Duration Rainfall for a selected Return Period

DURATION (HOUR)	RATIO
1	
2	
3	
....	
23	
24	

2.14.6 Heavy Rainfall Analysis for very short period (15 min interval) data

2.14.6.1 Formation of extreme series

- a. To prepare the annual extreme series for 15 min, 30 min, 45 min and 60 min time intervals for each station from the supplied 15 min interval rainfall data (data will be in excel /text format).
- b. The rainfall data provided will be in terms of spells for say 'm' no. of years. For any particular year, the highest 15 min rainfall amount is picked up from each of the spell and the highest of these will be the extreme 15 min. rainfall for that year. So, a series of maximum 'm' extreme observations of 15 min rainfall will be formed. Such a series should also contain the date and time interval for selected extreme value of extreme 15 min. rainfall. There should be provision for viewing and printing the series so formed.

- c. Similar procedure shall be applied for 30 min, 45 min and 60 min duration rainfall and the isopluvial maps shall be drawn. While preparing the 30-min series, rainfall of 2 consecutive 15 min. time intervals of the same spell will be added up. Similarly for 45 min. duration, rainfall of 3 consecutive 15 min. time intervals and for 60 min. duration, 4 consecutive 15 min. time intervals will be added up.

2.14.6.2 Preparation of Isopluvial Maps

- a. The series formed in 4.3.1(b) above shall be subjected to return period analysis by Gumble techniques (program will be supplied by IMD) and rainfall estimates for various return periods (2, 5, 10, 25, 50 and 100 years) will be computed. There should be a provision for the users to view the output of Gumble program as well as to have it's print-out and if needed to archive it. The return period values obtained from Gumble program by Least Square method will be used for further data processing. Similar exercise shall be done for all the SRRG stations in the project area. An other table containing the columns for Station Name, Index No., Latitude, Longitude, No. of years of data used 'N', 2-yr RPV, 5 yr. RPV, 10 yr. RPV, 25 yr. RPV, 50 yr. RPV and 100 yr. RPV will be generated (in Excel and Text formats) . This table will be stored also, if the user needs. The station name, latitude and longitude will be read from a separate file (provided by IMD) based upon the index no. of the station (Index No. will serve the purpose of primary key). The RPVs computed by Least Square method will only be used.
- b. The table generated above will be used for preparation of the Isopluvial maps (lines of equal return period values) of different return periods. (Ref to 4.1.2 (i-iii))Magnitudes of 15 min rainfall having 2-yr return period as obtained above for all stations are plotted on map and analysis carried out by drawing isopluvial lines at suitable rainfall interval. Similarly isopluvial lines are drawn for 5, 10, 25, 50 and 100 years return periods.

2.15 List of Products – Design Storm Analysis

1. Extreme rainfall series alongwith dates for 15 min, 30 min, 45 min, 1hrs, 3hrs, 6hrs, 9hrs, 12hrs, 15hrs & 18 hrs and 24 hrs.
2. Table containing Station Name, Lat., Long., Years of data used, and Return period values 2, 5, 10, 25, 50, 100 and 500 years and Isopluvial maps is to be prepared for 15 min, 30 min, 45 min, 1hrs, 3hrs, 6hrs, 9hrs, 12hrs, 15hrs & 18 hrs and 24 hrs durations.
3. Preparation of rainfall series for 15 min, 30 min, 45 min, 1hrs, 3hrs, 6hrs, 9hrs, 12hrs, 15hrs & 18 hrs and 24 hrs is to be prepared, above a base value in case of no. of years of data < 30 years.
4. Table containing Station Name, Lat., Long., Years of data used, and Return period values 2, 5, 10, 25, 50, 100 and 500 years and Isopluvial maps is to be prepared for 15 min, 30 min, 45 min, 1hrs, 3hrs, 6hrs, 9hrs, 12hrs, 15hrs & 18 hrs and 24 hrs durations.
5. Station rainfall along with their Names and Lat./ Long. for four selected rainstorms with date of each of the 1 day, 2 day and 3 day durations. (Total 12 storms)

6. Isohyetal Patterns along with station name and rainfall values plotted, for each of the 12 storms at S. No. 1 above.
7. Isohyetal Patterns as at S. No. 2 above, but without the plotting of Station Names and Rainfall values.
8. DAD Curves along with computation sheets as mentioned at para 3.2 above for all the above 12 storms. Also, the rainfall values corresponding to specific project area/storm area (sq.km) as defined by the user should also be labelled on the DAD curve.
9. Isohyetal Transposed Patterns over the project area along with the transposed rain-depth (computation sheets) for each of the 12 storms.
10. Values of LAF, ACF, MAF for each of the 12 storms.
11. SPS and PMP values of four selected rainstorms (all durations, the above 12 storms)
12. List of all rainstorms selected from hourly data along with date(s).
13. Percentages of duration of hours as 3,6,9,.....24,.....48 hrs,,72 hrs, separately of each rainstorm in tabular form.
14. Computation of average percentage values of all selected rainstorms for each duration (24hrs, 48hrs, 72 hrs)
15. Time distribution curves with averaged values for each duration (24hrs, 48hrs, 72 hrs).

Table 12: Frequency table of occurrence of AAP in different ranges for various synoptic conditions and locations.

Sub-basin → (Sij) ↓	Sub-basin A						Sub-basin B					Sub-basin C											
	01-10	11-25	26-50	51-100	>100	Total	01-10	11-25	26-50	51-100	>100	Total	01-10	11-25	26-50	51-100	>100	Total					
S11																							
S12																							
S13																							
.....
Total																							
S21																							
S22																							
S23																							
.....
Total																							
S31																							
S32																							

S33																			
.....				
.....				

3. Flood Meteorological Module

The area defined by a geographical natural boundary from where the precipitation is contributed to a particular river is called it's river basin / Sub-basin. The objective of this task is to compute the basin/Sub-basin wise daily average rainfall on real-time basis using Isohyetal Method.

3.1 Steps for Isohyetal Analysis for computation of basin / sub basin wise Areal Average Precipitation (AAP)

1. Plotting of rainfall observation on the catchment
2. Isohyetal Analysis of rainfall on the catchment map considering the orography of the catchment/sub catchment.
3. Computation of area between the two consecutive isohyetal lines within the catchment/sub catchment
4. Areal rainfall by area weighted method

An Example are described considering Fig 1 as follows

- i) Rainfall values are plotted at their respective stations on a suitable basin/sub basin map.
- ii) Lines of equal rainfall values, called "Isohyets" are then drawn for different storms (e.g. two storms are considered in the Fig.1.).

Aa

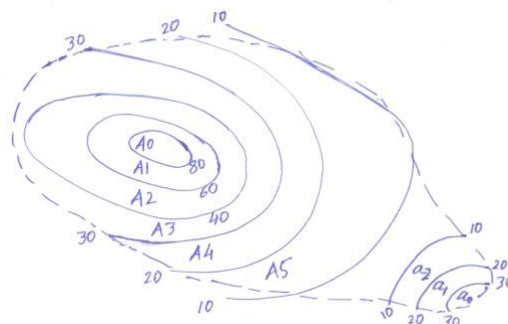


Figure- 1

- iii) A0, A1, A2, A3, A4, A5 and a0, a1, a2 are the areas between successive isohyets whereas Aa are the area beyond the storm area with in the basin /sub basin.
- iv) 35, 25, 15, 50, 70, 85 represent the average rainfall values, i.e. the mean of the two successive isohyets considering two storms as depicted in the Fig 1 for the areas (A3+a0), (A4+a1), (A5+a2), A0, A1, A2 respectively.
- v) Computation of the incremental volume between each pair of isohyets.

- vi) Areal rainfall (P) will be computed by adding these incremental volumes and dividing the total area of the basin/sub basin, as under :-

$$P = \frac{35(A3 + a0) + 25(A4 + a1) + 15(A5 + a2) + 85A0 + 70A1 + 50A2}{(A0 + A1 + A2 + A3 + A4 + A5) + (a0 + a1 + a2) + Aa}$$

Points to be considered while drawing isohyete

While drawing these isohyets, the analyst should take into consideration the orographic effects, storm orientation, etc. to adjust or interpolate between observation stations.

3.2 Synoptic cum Statistical Analogue Model: A tool for formulating Sub-basin wise QPF

Synoptic Analogue method is one of the helpful tool to issue QPF. It is based on synoptic systems and their location which are responsible for rainfall over the river basins.

Data and Methodology:

Each Flood Met Office (FMO) will identify the rain-bearing synoptic systems eg. Low Pressure Area/Well Marked Low Pressure Area, Depression/Deep Depression, Upper Air Cyclonic Circulation, position of Monsoon Trough, Cyclone etc which are responsible for rainfall over their basin area of jurisdiction and their location eg. over the basin/sub-basin, near E/W/S/N direction of the basin/sub-basin and over the adjoining area like state which effect AAP over their sub-basin/sub-basins.

I. In order to prepare synoptic analogue for each and every sub-basin, synoptic situations based on 0000UTC Upper Air Charts and 0300UTC Surface Charts during at least last 5 years which are responsible for different ranges of rainfall may be taken in to consideration.

II. Various synoptic systems responsible for different ranges of rainfall may be coded (i) as:

- 1- Low Pressure Area/Well Marked Low Pressure Area
- 2- Depression/Deep Depression
- 3- Upper Air Cyclonic Circulation
- 4- Position of Monsoon Trough
- 5- Cyclone

.....

III. Location of the synoptic situation in respect of various area may be coded (j)

- 1- Over the sub-basin
- 2- N/E/S/W of the sub-basin
- 3- N/E/S/W of the state/sub-division etc

.....

Now a table will be prepared as mentioned below:

IV. AAP is to be calculated for each sub-basin daily corresponding to the prevailing synoptic situations of the previous day. Average Areal Precipitation (AAP) in the ranges of 01-10,11-25,26-50,51-100 and >100mm during the South West monsoon season over a particular sub-basin/sub-basins are to be grouped.

V. Then identified observation S_{ij} in a frequency table is to be prepared as follows

3.3 Verification of QPF by categorical method:

The performance of categorical QPF issued for different river catchments is to be verified with contingency table given below:

Observed Rainfall Range (mm)	Rainfall Forecast range (mm)						Total
	0	0.1-10	11-25	26-50	51-100	>100	
0	a	b	c	d	E	f	A
0.1-10	g	h	i	j	K	l	B
11-25	m	n	o	p	Q	r	C
26-50	s	t	u	v	W	x	D
51-100	y	z	aa	ab	ac	ad	E
>100	ae	af	ag	ah	ai	aj	F
Total	G	H	I	J	K	L	T

The QPF issued for different river catchments are verified by computing; Percentage Correct Forecast (PC), Heidke Skill Score (HSS) and Critical Success Index (CSI) from Contingency table which are as follows:

$$PC = \frac{(a + h + o + v + ac + aj)}{T} \times 100$$

$$CSI = \frac{a}{A+G-a}, \frac{h}{B+H-h}, \frac{o}{C+I-o}, \frac{v}{D+J-v}, \frac{ac}{E+K-ac}, \frac{aj}{F+L-aj} \text{ for all six categories of forecast}$$

$$HSS = \frac{\{T(a + h + o + v + ac + aj) - (AG + BH + CI + DJ + EK + FL)\}}{T * T - (AG + BH + CI + DJ + EK + FL)}$$

The POD, FAR, MR, C-NON, CSI, BIAS, PC, TSS and HSS for each category is to be computed by reducing the above contingency table into 2 x 2 contingency table for occurrence / non-occurrence (YES/NO) Deterministic forecast. The computing procedure for various skill scores tests are as follows for sub basins:

Observed	Forecast	
	Yes	No
Yes	A	B
No	C	D

$$\text{Probability of Detection (POD)} = \frac{A}{A + B}$$

$$\text{False Alarm Rate (FAR)} = \frac{C}{C + A}$$

$$\text{Missing Rate (MR)} = \frac{B}{A + B}$$

$$\text{Correct Non – Occurrence (C – NON)} = \frac{D}{C + D}$$

$$\text{Critical Success Index (CSI) = Threat Score} = \frac{A}{A + B + C}$$

$$\text{Bias for Occurrence (BIAS)} = \frac{A + C}{A + B}$$

$$\text{Percentage Correct (PC) = Hit Rate X 100} = \frac{A + D}{A + B + C + D} \times 100$$

$$\text{True Skill Skore (TSS)} = \frac{A}{A + B} + \frac{D}{C + D} - 1$$

$$\text{Heidke Skill Score (HSS)} = 2 \left(\frac{AD - BC}{B^2 + C^2 + 2AD + (B + C)(A + D)} \right)$$

The final skill score will be the average of these.

For perfect forecast, POD=1, FAR=0, MR=0

The Warnings for Heavy, Very Heavy and Extremely Heavy Rainfall are also to be verified with this 2 × 2 contingency table.