

Requirement Document
For
**Atmospheric forecast system for Landslide
Early Warning**



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1. Organization Profile - K-DISC

K-DISC is a strategic think-tank and advisory body constituted by the Government of Kerala. It aims at bringing out path-breaking strategic plans that reflect new directions in technology, product and process innovations, social shaping of technology, and creating a healthy and conducive ecosystem for fostering innovations in the State. In the sphere of development, K-DISC is promoting and initiating new projects in Emerging Technologies such as Blockchain, Internet of Things, Machine Learning, Artificial Intelligence, Robotics, that soon that would enable transparent and cognitive advances in various departments of the State Government and deliver the ultimate benefit to the citizens. K-DISC would facilitate with different government departments that may need any of these technological advances to solve their critical problems and to arrive at the proof of concepts stage with adequate technical and financial resources to promote innovation. Also, K-DISC will ease the implementation by overseeing the same.

2. Introduction

2.1 Business Case for the Project

The excessive loss of life and property experienced recently during 2018, 2019 and 2020 floods and landslides across the State of Kerala highlighted the need for an integrated approach for flooding and landslide management. Landslides can occur due to the reactivation of old landslides and hence it is of utmost importance to predict the occurrence accordingly and save the property and loss of human life.

Rainfall forecasting is crucial for the development of landslide early warning systems as it serves as the primary trigger for landslide events. By accurately predicting rainfall patterns, authorities can anticipate and mitigate potential landslides, providing essential lead time for evacuation and resource allocation. This information is integral to risk assessment, enabling prioritized responses to high-risk areas. Rainfall forecasts also facilitate real-time monitoring and dynamic decision-making, ensuring that emergency responses align with evolving weather conditions. Furthermore, the integration of rainfall data into early warning systems enhances community preparedness, allowing for timely dissemination of warnings and fostering resilience in vulnerable regions. Overall, the significance of rainfall forecasting lies in its pivotal role in shaping effective mitigation strategies, infrastructure planning, and scientific research to enhance the overall effectiveness of landslide early warning systems.

Reliable rainfall forecast systems that can provide hyperlocal weather predictions are required for modelling of Landslide Early Warning Systems and their successful implementation. Remote sensing based hyper local rainfall prediction with minimum on-ground deployment of instrumentation can help in scaling the Landslide Early Warning Systems to larger geographical regions in future. K-DISC is planning to implement such a pilot Landslide Early Warning System for Kerala State Disaster Management Authority (KSDMA) at Kanichar, Kannur. Madasseri Mala (11°51'38.3" N/75°47'01.0" E), Ward No 8, Kanichar panchayat, Kannur is considered as the pilot location for this project.

The purpose of this document is to brief the requirements regarding the atmospheric forecast system based on Global Navigation Satellite System (GNSS) Tomography sensors to be used as input for the proposed Landslide Early Warning System.

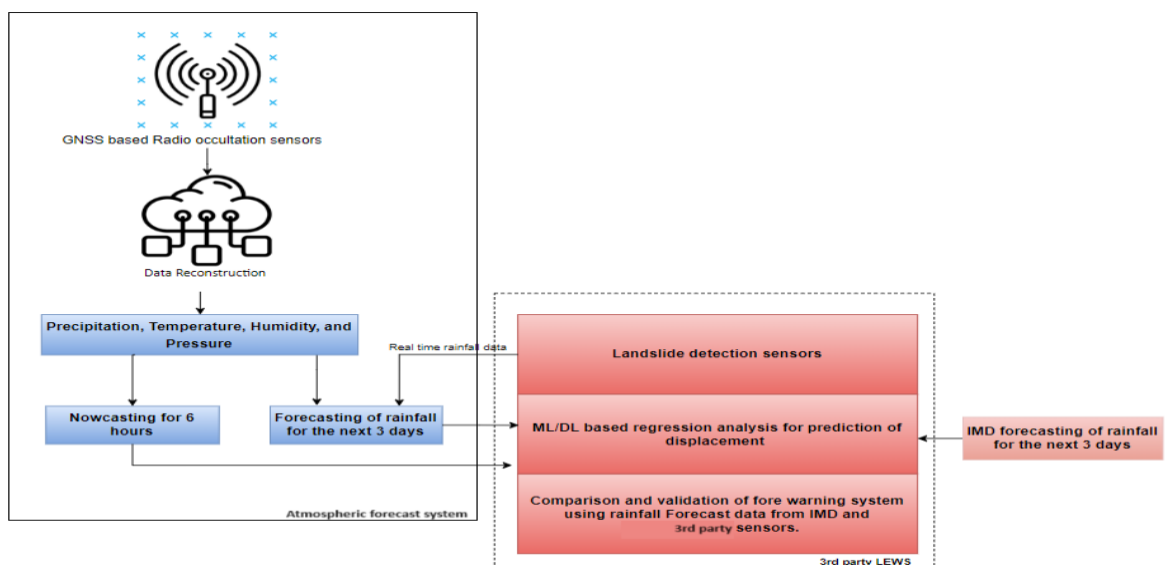
3. Project Objectives

1. To design and implement an atmospheric forecast system based on Global Navigation Satellite System (GNSS) Tomography sensors.
2. The atmospheric forecast system should provide nowcast and 3-day forecast of atmospheric pressure, atmospheric temperature, relative humidity, and precipitation through Application Programming Interfaces (APIs). This will be used as input to the Landslide early warning system being developed by K-DISC, to be piloted at Kanichar Panchayath, Kannur.
3. A comparative Study on effectiveness of IMD's Forecast vs Forecast from GNSS Tomography Sensors as input for predicting displacement / landslide in the area of interest and submit recommendations on the scalability of the model for the State of Kerala.

4. Scope of the Project

1. Deployment of GNSS-based radio occultation system to record data as per hardware and software below and then execute GNSS Tomography algorithm to provide nowcast and forecast of atmospheric parameters - pressure, temperature, relative humidity, and precipitation using a Numerical Weather Prediction (NWP) model for hyper-local weather forecasting. K-DISC shall provide the real-time precipitation data using on ground sensors, which needs to be used as input for finetuning the NWP model.
 - Hardware - GNSS based Radio occultation system
 - Software - Web Dashboard for real time and historic display of all acquired and computed parameters with reports
2. Develop and deliver the APIs for accessing Nowcast and 3-Day Forecast of Pressure, Temperature, Humidity, Precipitation and accessing Refractivity Indices and a web dashboard to display this data.
3. Conduct a comparative study to assess the efficacy of landslide early warning between early warning provided by IMD rainfall forecast and rainfall forecast provided by radio occultation method. The Landslide early warning derived from both IMD forecast will be provided by K-DISC.

Architecture Diagram



5 Deliverables

1. The system should be able to display all acquired and computed parameters correctly and consistently in real time and from a historical perspective.
2. In addition, the system shall provide accurate 3-Day Forecast of Pressure, Temperature, Humidity, Precipitation etc to connected third party systems as per agreed frequency and with API for accessing nowcast and 3-day forecast.
3. The following reports shall be submitted:

a.	Monthly report on the radio occultation sensor system	PDF/WORD
b.	Comparative Study Report on effectiveness of IMD's Forecast vs Forecast from GNSS Tomography sensors	PDF/WORD
c.	Project Completion Report	PDF/WORD

6. Key Benefits of the Project

1. Radio occultation enhances rainfall forecasting accuracy by providing precise measurements of atmospheric conditions, including temperature, humidity, and pressure for landslide early warning systems.
2. Accurate rainfall forecasting in landslide early warning systems enables proactive identification of heightened susceptibility periods for timely evacuation and resource allocation.
3. Assessing and predicting rainfall patterns aids in prioritizing risks, ensuring targeted interventions in vulnerable areas.
4. Real-time monitoring and integration of rainfall data enhance system responsiveness, enabling dynamic adjustments to emergency plans in evolving weather conditions.
5. Incorporating rainfall forecasts into early warning systems fosters community awareness and preparedness, empowering individuals to take preventive measures and ultimately reducing casualties, property damage, and fostering long-term resilience through informed infrastructure planning and mitigation strategies.
6. Utilizing radio occultation for rainfall forecasting over large areas improves the effectiveness of early warning systems, allowing for timely preparedness and mitigation measures in regions prone to severe weather events.

7. Service Level Agreement Terms

The offer submitted should cover all details covered as per the requirements of K-DISC. The technology partner is required to adhere to the following guidelines while preparing and submitting financial proposals to K-DISC.

7.1.1 COMMERCIAL PROPOSAL

- a) If there are any one-time costs, recurring costs, etc., they should be explicitly stated in the relevant sections of the table.
- b) One-year warranty, covering both the software and hardware, must be included in the proposal.
- c) The Annual Maintenance Charge (AMC) after warranty period should be within 10% of the total project cost.

- d) If any third-party services are involved and their costs impact the proposal, the details of these services shall be provided.
- e) The system will be hosted at the State Data Centre (SDC), and K-DISC will supply the necessary virtual machines (VMs) for the project. Technology partner should ensure the specifications for the VMs are included in the cost summary table. Technology partner should also account for the resource cost involved in deployment to the SDC, while preparing the financials.
- f) K-DISC will carry out a Security Audit and Load Testing through CERT empanelled agency. The Technology partner should consider the efforts required to resolve any issues identified in the Vulnerability Assessment and Penetration Testing (VAPT) process and Load Testing until the Final VAPT and Load Testing certificate is obtained.
- g) The source code along with any other project related artifacts must be transferred to K-DISC before raising the final payment invoice.
- h) The Technology partner is responsible for covering expenses for promissory note and courier charges for the agreements and any addendums (if applicable).
- i) Technology partner shall submit the required utilization certificates in K-DISC format for processing payments other than advance payment.
- j) The Technology partner is responsible for any expenses related to SSL certificates, domain validation, etc.
- k) In manpower section the details of different types of resources should be provided along with duration of their engagement

7.1.2 PAYMENT TERMS

PAYMENT TERMS	
Payment (% of the total project cost)	Particulars
10%	Upon signing the agreement
20%	Upon successful achievement and acceptance by the client of Milestone 1
20%	Upon successful achievement and acceptance by the client of Milestone 2
20%	Upon successful achievement and acceptance by the client of Milestone 3
30%	Upon successful achievement and acceptance by the client of Milestone 4 , with Bank-Guarantee from the Technology Partner, worth 5% of the Total Amount (Exclusive of GST) for Warranty.

(Note: The payment terms can be restructured to 4-6 payments according to the project)

1. Technology partner shall submit utilization certificate in the prescribed format along with the expenditure statement signed by the Head of the institution from the second instalment. Utilization Certificate along with the audited expenditure statement duly

signed by both the Chartered Accountant and Head of the institution is compulsory for above Rs. 5 Lakhs.

2. A final audited utilization certificate for the entire project cost shall be submitted to the Client at the end of the project.

7.1.3 AGREEMENT

An agreement shall be signed between K-DISC and Technology Partner after due approvals.

7.1.4 TERMINATION OF CONTRACT

- a) Either Party may terminate the Agreement by giving notice in writing to the other Party if,
 - i. the other Party materially breaches the Agreement and does not remedy the breach within 15 (fifteen) days of receipt of such written notice, or
 - ii. the other Party is or appears likely to be unable to pay its debts or become insolvent, or
 - iii. breaches any applicable law or regulation for the time being in force.
- b) Upon expiration/termination of the Agreement, the Technology Partner shall promptly deliver/ return without any pre-condition to Client all documents, data, source code and other information acquired by them from the Client. If Client is desirous of getting any further documents, data prepared/generated/ developed by the Technology Partner pursuant to the Agreement or any Scope of Work, such documents/ data should be provided to Client after settling the payment dues, as per the agreed project milestones. The Technology Partner shall ensure Services to Client, for a reasonable period, to ensure a smooth transition.
- c) Upon early termination of the Agreement, the settlement shall be made after deducting any payments or other charges due from the client, as completed by Technology Partner and accepted by the Client, in accordance with payment milestone, to the Technology Partner under any of the clauses of the agreement.
- d) Termination based on non-delivery of products/services is not permitted, except in cases where Liquidated Damages (LD) and compensation are explicitly outlined as in clauses 6.2.5 below.

7.1.5 LIQUIDATED DAMAGES

The period of completion of the work, stipulated in the contract, is the essence of the contract. If the bidder fails to complete the work within the time period(s), then K-DISC shall, without prejudice to its other remedies under the Contract, deduct from the Contract price, as liquidated damages, a sum equivalent to 2% of the contract value per week or part thereof, up to a maximum of 10%. Once, the maximum is reached, then K-DISC may consider termination of the contract. K-DISC may withhold any payment due to the consultant until the whole of the work is completed. This clause is without prejudice to the right of K-DISC to make risk purchase mentioned and the liability under that clause shall be in addition to liquidated damages.

7.1.6 SETTLEMENT OF DISPUTES: -

(a) Amicable Settlement, -

If during the subsistence of the agreement, Parties have differences or disputes on any matter directly or indirectly related to and/or connected with the Agreement, the same would be resolved by mutual consultations and for which purpose the Parties shall engage with each other.

(b) Arbitration, -

In case the attempt to resolve differences and disputes does not result in amicable settlement within 21(twenty-one) days of such reference then, either Party may as per its position initiate disputes redressal by means of arbitration, in India, in accordance with the provisions of Arbitration and Conciliation Act, 1996(26 of 1996). The arbitration shall be presided upon by a sole arbitrator to be appointed by the mutual consent of the Parties. The venue of such arbitration shall be in Thiruvananthapuram, Kerala and the language of such arbitration proceedings and that of all documents and communications between the Parties shall be English. The decision of the arbitrator shall be final and binding on the Parties. The expenses of the arbitrator as determined by the arbitrator shall be shared equally by Client and the Technology Partner. However, the expenses incurred by each Party, in connection with the preparation, presentation of the documents shall be borne by the Party itself. All arbitration awards shall be in writing and shall state the reasons for such award.

7.1.7 GOVERNING LAW AND JURISDICTION

The Agreement, its meaning and interpretation, and the relation between the Parties shall be governed by the laws of the state of India (“Applicable Law”). Subject to clause “Settlement of disputes” mentioned above, the Courts of Kerala shall have exclusive jurisdiction. (The Client reserves the right to modify the agreement as may become necessary in terms of Government orders/circulars issued from time to time, during the term of this assignment based upon mutual consultation between both the parties.)

7.1.8 FORCE MAJEURE

- a) The Technology Partner shall not be liable for forfeiture of its performance security, liquidated damages, or termination for default if and to the extent that its delay in performance or other failure to perform its obligations under the Agreement is the result of an event of Force Majeure.
- b) For purposes of this clause, “Force Majeure” means an event beyond the control of the Technology Partner and not involving the Technology Partner’s fault or negligence and not foreseeable. Such events may include, but are not restricted to, acts of the State Government in its sovereign capacity, wars or revolutions, fires, floods, epidemics, quarantine restrictions and freight embargoes.
- c) If a Force Majeure situation arises, the Technology Partner shall promptly notify the Client in writing of such condition and the cause thereof. Unless otherwise directed by the Client /Government of Kerala in writing, the Technology Partner shall continue to perform its obligations under the Agreement as far as reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.
- d) It is hereby agreed between the parties that Force Majeure is applicable when need arises.

7.1.9 PENALTY

If the Technology partner abandons the project without fulfilling the terms and conditions of the agreement, they will be liable to return the amount received from the Client with interest (12% of the principal amount) and penal interest as applicable to the Government funds.

7.1.10 OEM CONDITIONS

OEM, as a recipient, shall ensure that their sub-recipients understand and acknowledge conditions and potential requirements that may be placed upon undertakings as a result of provisions of the Agreement with K-DISC. OEM shall defend, indemnify and hold K-DISC, and K-DISC’s officers, directors, and employees and agents harmless against any and all third party claims against K-DISC, including, without limitation, claims of infringement or misappropriation of intellectual property rights, arising from: (a) the OEM Products or services provided by OEM in conjunction with the OEM Products excluding the Product, or (b) OEM’s additions or changes to the Products, or use of the Products in combination with other materials not furnished by K-DISC or with systems, products or components

not reasonably anticipated to be used with the Product or part thereof; and OEM shall pay in all such cases the costs, including reasonable attorney's fees, finally awarded against K-DISC, provided that K-DISC:

(i) timely notifies OEM of the claim, and (ii) gives OEM a copy of each communication relating to the claim, and (iii) gives OEM the authority, information, and assistance, at OEM's expense, reasonably necessary to defend or settle the proceeding. OEM agrees that any and all warranties made to K-DISC and End User Department shall be made only by the OEM. OEM acknowledges and agrees that OEM will make no additional representatives or warranties. In connection with any sale of the licensed software bundled with the OEM products, OEM shall expressly and conspicuously disclaim all express or implied warranties of merchantability or fitness for a particular purpose shall exclude liability for consequential damages and loss of profits and information. In addition to its indemnity obligations hereunder, OEM shall indemnify and defend K-DISC against any loss or damages, including attorney fees, arising out of OEM's failure to comply with its obligations regarding warranties.

7.1.11 GUARANTEE/WARRANTY

a) During implementation period

During the implementation, the Technology Partner shall meet all conditions set forth in the Agreement and follow the implementation schedule strictly, failure to comply with the same, shall attract application of penalty clause.

b) During Warranty period

i. Software

As part of the warranty covered as part of the agreement, the Technology partner shall.

- 1) Provide and install, at Technology partner's sole expense, with bug fixes and code corrections to correct software malfunctions in order to bring the services into substantial conformity with the specifications set forth in the projects scope of work. Bug fixes shall be acknowledged within one hour of the client intimating them and fixed within reasonable time as agreed with the client as per the severity of the bug.
- 2) Provide and install relevant updates of the software released by the Technology partner within the warranty period, installing them within 48 hours of release, without causing any downtime. In the event the Technology Partner foresees downtime requirement, the same shall be carried out with permission of the client
- 3) Ensure that the database used in the Project will be managed with reasonable care and diligence, and that any updates or modifications to the database and related changes to application will be performed in a timely manner, without causing any downtime. In the event the Technology Partner foresees downtime requirement, the same shall be carried out with permission of the client.
- 4) Perform any updates or modifications related to changes in configuration (App server/Web server, DB server etc.)/ operating system (OS)/ other operating environment of virtual machine's hosted at SDC in a timely manner, without causing any downtime. In the event the Technology Partner foresees downtime requirement, the same shall be carried out with permission of the client.
- 5) Take necessary steps for maintaining SSL Certification and Domain validation and maintenance, including the initial purchase and any subsequent renewal during the Warranty Period.
- 6) The Technology Partner shall provide timely and adequate support to the Client whenever necessary, including technical support and customer service. Such support shall be provided within 12 hrs from the receipt of the support request from the Client.

- 7) The Technology Partner is responsible for implementing security measures to protect the application from unauthorized access and promptly addressing any security issues within 12 hours of identification.
- 8) The Technology Partner must provide monthly reports to the Client that outline the application's performance, availability, and incidents that occurred during the reporting period.
- 9) The Technology Partner is responsible for 24/7 monitoring of the application, proactively detecting and resolving any issues within 24 hours of detection.
- 10) The Technology Partner is responsible for providing training and documentation to the Client's staff on the proper use of the application, which must be provided after before handing over the project to the End User Department
- 11) The Technology Partner must maintain adequate staffing levels to provide timely and effective support for the application and provide a designated point of contact for the Client's staff to contact in the event of any issues.
- 12) All issues raised during the warranty period must be addressed and resolved by the Technology Partner.

ii. Hardware

- 1) The Technology Partner shall ensure that any hardware components supplied as part of the project will be free from defects in materials and workmanship. If any such defects arise during this warranty period, the Technology Partner will repair or replace the defective hardware at no additional cost to the Client.
 - 2) The Technology Partner shall ensure that
 - a. The hardware will meet the performance specifications specified in the Agreement throughout the warranty period
 - b. Periodic maintenance of the hardware is carried out as required.
 - c. If any issues arise due to the Technology Partner's improper actions or omissions, the Technology Partner shall promptly correct the issues at no additional cost to the Client
 - 3) The Technology Partner is responsible for providing training and documentation to the Client's staff whenever Hardware/ Equipment is repaired/upgraded during warranty period. The Technology Partner must maintain adequate staffing levels to provide timely and effective support for the Hardware/Equipment and provide a designated point of contact for the Client's staff to contact in the event of any issues.
- c) During AMC period

The Technology Partner shall comply with all the conditions in the AMC Agreement to be signed upon mutual agreement.

7.1.12 CONTRACT PERIOD / DURATION OR VALIDITY

The agreement is valid for one year with effect from the date of signing of the Agreement, covering the installation and commissioning and the warranty period.

7.1.13 CHANGE ORDERS / MANAGEMENT OF CHANGE IN SCOPE OF WORK: -

The Agreement is based on the scope of work given in 'Schedule A', furnished as part of agreement as well as in the K-DISC Project proposal as approved by end user department. Any change in Scope of Work, and any delay from end user department/ K-DISC with respect to approvals, site readiness etc. or decisions of end user department/K-DISC which may result in:

- a) Enhancement to Geographical, Functional or Technical Scope of Work
- b) Postponement of the major milestones in Project Plan or

- c) Any other matter to be mutually identified and agreed by the parties and shall be subject to the following change management process:
 - i. A Scope Change Request (“SCR”) as raised by either the Client or Technology Partner’s Project Manager accompanied by suitable supporting documents.
 - ii. Technology Partner shall prepare a detailed estimate of actual efforts to be required together with an estimate of additional fees and likely impact on the Project Plan for each SCR
 - iii. Only upon formal written approval by Client of the SCR, together with cost and time estimates, Technology Partner shall commence any work arising out of the SCR(s).

On approval by K-DISC, a new appendix containing the changes to the Agreement shall be mutually signed and appended to the Agreement, which together with the existing Schedules, shall constitute the entire Agreement.

7.1.14 SUBCONTRACT

The bidder shall notify K-DISC in writing of all subcontracts awarded under the contract if not already specified in his bid. Such notification, in the original bid or later shall not relieve the bidder from any liability or obligation under the contract.

7.1.15 RISK PURCHASE CLAUSE

Purchaser shall reserve the right to terminate the order or contract and purchase from anywhere at the risk and cost of the vendor, either the whole part of the system/goods which the vendor has failed to deliver within the stipulated delivery period or if the same were not available, the best and the nearest available substitute(s) thereof. The vendor would be liable to compensate the purchaser for any loss, which the purchaser may sustain by reason of such purchase. This clause will be operated only after completion of delivery period including extended period with penalty.

7.1.16 Project Monitoring and Feedback Collection

- a) The Technology Partner shall monitor and track the progress, milestones, and overall performance of the project. The project monitoring should include regular status meetings, progress reports, and key performance indicators (KPIs) to assess project success.
- b) The Technology Partner shall provide regular project status reports to the client, outlining the achieved milestones, deliverables, and any significant project updates. The frequency and format of the reports shall be defined and agreed upon by the client.
- c) The Technology Partner shall take necessary actions for collecting feedback from the client & end user department regarding the project's progress, quality, and adherence to requirements. Feedback collection methods may include surveys, meetings, or other communication channels to gather input from client & end user department.
- d) The Technology Partner shall review and analyze the feedback received from the client and end user department promptly. Based on the feedback, the Technology Partner shall develop an action plan to address any identified issues, concerns, or areas for improvement.
- e) The Technology Partner shall document the lessons learned from the project monitoring and feedback collection process.