

Proposal Template

Name of the institute: CSIR-Central Scientific Instruments Organisation, CSIR- National Aerospace Laboratory, CSIR-Indian Institute of Petroleum, CSIR-4PI and IIIT Bengaluru

Incubator: -

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Objective: Safe and optimized distribution of COVID-19 vaccine using unmanned aerial vehicles: a pilot scheme to prove feasibility

Type of Intervention: (Choose one)

Proposal on Cold storages and Cold chains battery or solar operated for last mile connection

Details of intervention:

(Should cover details about the product/ technology, methodology, milestones, timeline, Line-item wise financials along with tentative cost of transportation, annual maintenance etc.)

The unprecedented large-scale vaccination drive in India for the COVID-19 presents enormous challenges for the safe and optimized distribution of the vaccines into all regions. Arranging for the last mile delivery of the vaccine by refrigerated transport is an option that is severely limited by the availability as well as by road connectivity. Development, production and delivery for integration of refrigerated containers in the short time of a few months is also a great challenge. Given that

- Vaccine will require storage in a prescribed range of temperature (2°-8°C) during the last-mile transportation
- Poor road connectivity in the rural areas,
- High traffic congestion within city areas,
- Large time taken for even short distances in mountainous regions such as the Himalayan hills, western ghats and the Vindhya regions etc.,

we propose here that the last mile delivery of the vaccines to public health centers as well as hospitals may be safely made by small category unmanned aerial vehicles with long endurance. Through an optimized delivery schedule designed by a specialized software to plan for the UAV sorties and combining the packaging with a cold pack of dry ice (solid carbon dioxide) made by a miniaturized plant, safe delivery of the vaccine can be ensured. Here a pilot scale scheme for the demonstration of such a

planned delivery of vaccines in a plain region is proposed. Once successful, this scheme can be replicated, up-scaled and launched in various regions of the country, particularly with difficult terrains. The main components of the scheme are:

- The pilot scale demonstration is planned in the region of Hoskote and Doddaballapura, near Bengaluru where the proposers have substantial institutional backup as well as industrial partners. Delivery of vaccine can also be taken through the Kempegowda Airport in Bengaluru and transported to the hub. A suitable warehouse capable of storing vaccines for a short time as well as suitable for launching drones (outside regulated areas) will be identified to serve as the hub. As per the 2011 census, the villages of Hoskote Taluk have a population of about 57 thousand and Doddaballapura taluk has a population of about a hundred thousand people. This pilot scheme is projected to target these populations for vaccination. In case of any logistic difficulties of UAV flights in that region, similar populations will be identified after discussion with the state government authorities.
- Long endurance drones with excess of 100 km range and some with shorter rangewill be utilized to cater to PHCs and notified camps in towns and villages within a radius of 50 km of the warehouse. Such drones have been recently developed by NAL, IIT Kanpur and some industries such as Dynamatic Technology Ltd., IdeaForge Ltd., and General Aeronautics, and these will be taken on lease for this project. Given the very short times available and proposed, it would not be possible to obtain new drones for this project and it is likely that different drones will have different ranges and payloads. Over time, appropriate drones for shorter ranges and larger payloads will also included in the scheduling. But the number of different kinds of platforms need to be kept manageably small from the perspectives of trained personnel, spares and maintenance.
- The drones will be appropriately geo-fenced, equipped with long range telemetry, registered on Digi-sky platform and will conform to all regulatory requirements including return to home facilities. Permission with the DGCA will be sought for all UAV flights through the Digi-sky platform or independently. The drones will be piloted by experienced and licensed pilots of NAL, IIT Kanpur or associated UAV industry.
- Dry Ice packaging sufficient to last for the flight of the vaccine will be made available. CSIR-IIP has developed a miniaturized small scale dry ice manufacturing unit that utilizes only compressed CO₂ from gas cylinders and does not require any electricity. This will enable us to employ it for safe transit of the vaccine during the flight expected to last less than 45 minutes.
- A specialized software will schedule pre-specified drop locations (latitude, longitude), using several drones of varying capabilities and ranges, in a 40-50 Km radius area, around the hub along specified (permitted) paths and flying times. The award winning software will minimize the number of sorties, flying times and expenses by considering various possibilities of multiple package drops at different locations. This algorithm for drones based delivery scheduling has already been developed at IIIT Bengaluru and the software is being finalized. All computing resources requiredfor this effort will be made available through CSIR institutions.
- Liaison with the local bodies and state government medical authorities will enable the scheduling to be followed as generated by the software and collection of the vaccine from the UAV drop-points will be arranged. It is planned to operate the scheme by involving a well-established NGO in Bengaluru and /or industrial partners.

Upon successful implementation in these regions, grant of a quick extension will enable the scheme to cover more areas nearby that will be identified through the State government medical authorities. IT is expected that within a span of two months, an identification of the issues in such UAV based vaccine distribution system will be made and issues addressed so that the scheme can be applied across the country in all problematic areas, particularly the hilly, forested or riverine areas. Further sanction of funds for expanding the scheme will be sought once the pilot scheme is established and proven.

The full project is expected to take about two months from the time of approval. The timelines for different envisaged activities for the pilot-scale demonstration are:

Activity	Month 1	Month 2
Setting up the warehouse, logistics for storing and transporting the vaccine		
Identifying the UAVs available and training the pilots for the specified machines.		
Liaison with State Government, NGO and Identification of the drop-points.		
Schedule of drop-points through the developed software.		
Indentification of the allowed pathways and programming of the paths for the UAVs		
UAV sorties and Distribution of the vaccine.		
Evaluation of the scheme and filing of report		

Costs:

1	Lease of drones (rental)	@ Rs. 100000 per drone helicopter drone with range of 100+km and 3-4 kg payload) for two months	Rs. 10 Lakhs
2	Long range telemetry	upgradation of drones	Rs. 5 Lakhs
3	Manpower	11 Pilots for drones @35000 per month per pilot	Rs. 770000
		6 Maintenance staff @25000 per month per staff	Rs. 300000
		12 Project associates @ 35000 per month per associate	Rs. 840000
		5 support staff @ 25000 per month per staff	Rs. 250000
	Total Manpower		Rs. 21. 60 Lakhs
4	Operating cost of drones	Rs. 15 per km. The suggested areas involve over 500 villages, some with a population of few thousands.	Rs. 10 Lakhs
5	Travel and transport costs	Including the transport of the drones to Bengaluru	Rs. 12.50 Lakhs
6	Dry ice machines	Deployment, packaging costs and other arrangements for hookup to drones: Rs. 1000 per sortie.	Rs. 10 Lakhs
7	Cost of Hub	Establishment of Hub with drone launch pads	Rs. 10 Lakhs

		and incidentals	
8	Cost for NGO	To organize the vaccination drive in targeted areas, (@Rs.6 per vaccination)	Rs. 9 Lakhs
9	Drone consumables	Including incidental expenses	Rs. 6 Lakhs
10	Other Research Expenditure	Including Licensing of Software.	Rs. 10 Lakhs
11	Cost of vaccines and logistics to deliver vaccine to hub	It is expected that the vaccines for this pilot scheme is supplied by the government free of cost to the hub. Else there will be a major cost of 3 Crores of the vaccine cost itself @Rs. 200 per shot.	Not budgeted here
12	Total		Rs. 104.1 Lakhs

The above costs do not include costs of overheads by any of the Institutions.

Do you have State Government connection, or will you require support from CSR –

We do not have funding from State governments. CSR is desirable for large scale deployment.

States that you can provide technology to –

In the pilot scale demonstration at Bengaluru, only Karnataka. Upon successful demonstration, we can provide the service in all areas difficult terrains, particularly in all hilly and forested regions: Kerala, Karnataka, Maharashtra, Madhya Pradesh, Chhattisgarh, West Bengal, Assam, Uttarakhand, Himachal Pradesh. CSIR laboratories across the country will be used as launch pads across the country.

Please answer following questions depending on the intervention you choose and if applicable to you:

Can you do the Community engagement yourselves or will need help by CSR-

We will be able to engage with the State Government for local arrangements and local people through NGOs. CSR funding will be required for logistics.

If you have a Market ready technology available,

- How do you plan to deploy:
- Number of units available: 10 helicopter petrol driven drones are available with IIT Kanpur and Endure Air (a startup company at IIT Kanpur Incubation Center) with 100 km range and 3-4 kg payload. CSIR-NAL has several shorter range drones with large payload available. Dynamic Technology Ltd. and General Aeronautics also have another set of UAVs available with 10-20 km range and 10 kg payloads.

Do you wish to partner with an NGO? If yes, name the NGO and provide details on how you will partner? (item wise costing should include cost to NGO for their scope of work)

Yes, an appropriate NGO will be partnered to organize the vaccination programs in a coordinated manner with the vaccine delivery schedule. The NGO is yet to be identified and this part of the project will be carried out by CSIR-4PI Bengaluru.