TERMS OF REFERENCE (TOR)

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ETHIOPIA

GENERAL INFORMATION

Services/Work Description: Firm Level Consultancy Service to carry a Technical Investigation and Testing of Entoto (North Addis Ababa) Weather Radar

Project/Program Title: Strengthening Climate Information and Early Warning Systems in Africa for Climate Resilient Development and Adaptation to Climate Change – Ethiopia

Duty Station: North Addis Ababa, about 15km from central Addis Ababa

Type of the Contract: International Consultancy Firm with a possibility of its national counterpart.

Duration: Twenty (20) working days

Expected Start Date: Immediately after Signing the Contract

I. BACKGROUND / RATIONALE

The National Meteorological Agency of Ethiopia acquired MRL-5 Weather Radar, No.1272, Type A, from the former USSR. It was installed by five Radar experts from USSR in December 1990. The Radar is located in a mountain of northern Addis Ababa, Entoto (9o05'05"N, 38o43'31"E 2895m). It was calibrated and tested for its operation after the completion of the installation. The Radar manual is identified by the numbers 1.230.032 Ф0, 1.230.032 3И and 1.230.032ДИ. It operates in a dual bandwidth with S-band and X-bands operating channels.

Due the problem with licensing of using the frequency the radar has never been used for operational purposes. The main issue was fear of interference with the nearby national telecommunication satellite receiving ground station. At a time relocation of the radar to another site in Eastern Addis Ababa was proposed. In later years it was proved that the weather radar has insignificant interference and agreed to make it operational at the present location. Since some years passed without any operation, it needed a technical assessment to prove it to be operational once again. In 1999, a radar expert from WMO visited the radar and reported that the radar is generally in a good condition and could be operational with servicing. Unfortunately, the proposed servicing could not be made to make the radar operational during that time. In another attempt, in 2005, with the technical support of Ethiopian Air Force Engineers, tried to service the radar. After minor maintenances of different components of the radar, it could operate in S Band with a horizontal scanning. It was also identified that the vertical scan is not functioning due to failure of the scanning motor. In addition, the Intermediate Frequency Amplifier (IFA) of Chanel I or X-band is identified to be malfunctioned and need replacement of spare parts to repair. Thus, the recommendation from the Air Force engineers during that time was to servicing the Elevation Scanning Mode of the Antenna, especially the current collector part, and the repair or replacement of IFA of X-band enables the radar to make it operational. No further action taken to make the radar functional afterwards.

II. OBJECTIVES OF THE SERVICE / WORK

- The purpose of this consultancy work is to carry a technical investigation and testing of Entoto Weather Radar and produce a technical report on its operational and operability status.
- The specific objective is to carry a technical examination and testing of Entoto MRL-5 Weather Radar and confirm if it is reparable and make it operational. Prepare detailed technical requirement specification to make it fully operational with the estimation of the finance required.

III. SCOPE OF THE SERVICE / WORK

a. Carry a technical investigation of the weather Radar to identify failed components which could be repaired and which need replacement.
b. Define the details of maintenance requirements including all the necessary spare parts and consumables and prepare technical specifications required to make the radar fully operational
c. Identify and suggest options and associated specification to retrofit the Radar to make it digital and automated.
d. Assess the surrounding and identify if there are any signal interference problem with the weather Radar. Consult and identify with relevant telecom organs to cheek if there are a possibilities of interference of electromagnetic radiation generated by the radar
e. Prepare a technical and budget proposal and specification including spare part, maintenance, retrofitting, upgrades and consultancy to make the Radar fully operational and also to upgrade it from analog/manual to digital/automatic.
f. Identify and propose the main suppliers of the required spare parts and companies that give maintenance services.
g. Assess and specify the training requirement for NMA technicians and meteorologist to make future preventive and corrective maintenance and calibration and also data processing
h. In case the radar is proven to be unserviceable and not be operational after maintenance, prepare a report with sufficient and scientific evidence as to why it is un-reparable. Prepare detailed requirement and specification for its dismantling and disposal.

IV. EXPECTED OUTPUTS / DELIVERABLES

a. Report on assessment of the current MRL5 radar support and service global market
b. Comprehensive report and technical specification to make Entoto Weather Radar operational, including all necessary details on technical specification with required budget proposal and identification of potential suppliers of required radar components and the service.
c. The technical specification shall incorporate details of the necessary hardware, software, retrofitting, professional skill, training, etc so that it will operate in a digital form.
d. In case, it is proven to be unserviceable, comprehensive report of scientific justification with a technical specification with budget proposal for dismantling shall be prepared.

V. METHODOLOGY / APPROACH OF THE SERVICE (WORK)

a. Prepare detailed implementation proposal with detailed action plan
b. Review and assess the global support market and documentations on service and components of MRL5 Radar, and prepare initial report
c. Physically visit and examined Entoto Weather Radar to assess its operability status and identify the required components to make it operational
d. Make onsite technical checking and testing of the radar components
e. Visit and discuss with authorities of different offices to check for electromagnetic interference
f. Prepare interim report and present to NMA staff to get feedback before finalizing it
g. Prepare and submit final report

VI. LOCATION, DURATION AND TIMEFRAME OF THE WORK /DELIVERABLES/OUTPUT

a. The task will be carried in Addis Ababa, with a field work at the radar site location, which is at the northern hill of Addis, about 15 km from the center.
b. The consultant firm makes the necessary preparation in reviewing all necessary documents on MRL5 Weather radar and related market before coming to Addis Ababa for the physical examination of the Radar, which may take about a week.
c. Visiting the radar and testing its component and consultation of relevant institution for electromagnetic interference along with the preparation of interim report may take up to two weeks. The interim report shall

be presented to NMA and give feedback at the middle of the two weeks so that feedbacks from NMA be incorporated to the final report

d. Finalizing and submitting the report could take two working days.

No.	Deliverables	Implementing Partners (IP)	Location and Action to be Undertaken	Duration (approx.)
1	Produce initial report on the current status of the global support and service market on MRL5 Weather Radar.	None	Global support and serviced market assessment for MRL5 Weather Radar and its document review to be carried out	5 working days
2	Produce and present interim report on the radar operability status.	National Meteorological Agency (NMA)	Onsite radar inspection, checking and testing of its components functionality, electromagnetic interference, etc, which will be carried out at Addis Ababa and the Radar site	8 working days
3	Produce final comprehensive report with detailed technical specification and budget proposal for the Entoto MRL5 Weather Radar make it fully operational	NMA	Incorporate all comments and other assessment inputs to finalize the report and the specification to be carried out in Addis and/or back office	7 working days
Total Working Days				**20 working days**

VII. INSTITUTIONAL ARRANGEMENT / REPORTING RELATIONSHIPS

a. The consultant shall report all its activity to UNDP-CO, Addis Ababa with a copy to the Country Project Coordinator

b. A minimum of three reports: Initial, Interim and Final shall be produced and submitted. A presentation to NMA staff and other relevant project staffs shall be delivered after the production of the Interim report to show the approach and findings. A final briefing shall be presented before the consultant team finalizes its site visit.

c. The final report shall be produced within two weeks from the site visit.

d. NMA facilitate the visits of government and non-government office which are required to be visited for the electromagnetic interference and required licensing requirement assessment.

e. NMA also assign its technicians to facilitate the access of the Radar site to the consultant during onsite testing and verification.

VIII. PAYMENT MILESTONES AND AUTHORITY

Prospective Service Provider will indicate the cost of services for each deliverable in US dollars when applying for this consultancy. The Proposer will be paid only after approving authority confirms the successful completion of each deliverable as stipulated hereunder. In accordance with UNDP rules, the lump sum contract amount to be offered should consider the professional fee inclusive of travel, living allowances, communications, taxes, out of pocket expenses, and other ancillary costs.

A winning Proposer shall then be paid the lump-sum contract amount upon certification of the completed tasks satisfactorily, as per the following payment schedule:

Installment of Payment/ Period	Deliverables or Documents to be Delivered	Approval should be obtained from:	Percentage of Payment
1st Installment	Initial report	NMA / UNDP-CO/ PC	30%
2nd Installment	Interim report	"	20%

Installment of Payment/ Period	Deliverables or Documents to be Delivered	Approval should be obtained from:	Percentage of Payment
3rd Installment	Final report	"	50%
Total Payment Percentage			**100%**

IX. MINIMUM ORGANIZATION AND CONSULTANCY TASK FORCE REQUIREMENTS

Minimum Organization and staff Requirements

- A firm with at least 10 years of experience in Weather Radar maintenance work preferably has an experience of at least three MRL5 Weather Radar maintained in the last ten years.
- A team of **at least three (3) staff led by Electrical engineer or related professional**, who have at least five years of experience in weather radar maintenance or similar experience.
- The team member engineers or technicians should have a proven practical experience of at least three years in weather radar maintenance and servicing with some experience on MRL5 Weather Radar.
- Have knowledge and access to relevant sources and stakeholders of MRL5 Weather Radar component producers
- It shall demonstrate its capabilities, understanding of the TOR, and methodology and, communicate and report with professional English proficiency.

X. CRITERIA FOR SELECTING THE BEST OFFER

Upon the advertisement of the Procurement Notice, qualified Consultancy Firm is expected to submit both the Technical and Financial Proposals. Accordingly; the firm will be evaluated based on Cumulative Analysis as per the following conditions:

- Responsive/compliant/acceptable as per the Instruction to Bidders (ITB) of the Standard Bid Document (SBD), and
- Having received the highest score out of a pre-determined set of weighted technical and financial criteria specific to the solicitation. In this regard, the respective weight of the proposals are:
    a. Technical Criteria weight is 70%
    b. Financial Criteria weight is 30%

XI. LOGISTICAL SUPPORT

NMA will ensure that the Consultancy Firm receives access to the Entoto Weather Radar Site and also assign its technicians to facilitate onsite supplies, such as electricity.

XII. RECOMMENDED PRESENTATION OF TECHNICAL PROPOSAL

For purposes of generating quotations whose contents are uniformly presented and to facilitate their comparative review, a prospect Service Provider is given a proposed ***Table of Contents***. Therefore prospective Service Provider Proposal Submission must have at least the preferred contents which is outlined in the RFP Proposal Submission Form incorporated hereto.

XIII. CONFIDENTIALITY AND PROPRIETARY INTERESTS

The consultants shall not either during the term or after termination of the assignment, disclose any proprietary or confidential information related to the consultancy or the Government without prior written consent. Proprietary interests on all materials and documents prepared by the consultants under the assignment shall become and remain properties of UNDP. This assignment will be administrated by the United Nations Development Programme (UNDP), and all relevant UNDP rules, policies and procedures will apply.

XIV. ANNEXES TO THE TOR

Annex I and ***Annex II*** of previous Radar Operability Assessment

Annex I

Report on Visit to Ethiopia to Determine the Serviceability of the Russian MRL-5 Weather Radar located in Addis Ababa by WMO Expert

This radar had stood on its present site for some 10 years and had not been operated since its installation in the year 1990. The site is well maintained and the unit housing the radar is in fairly good physical condition. However it could do with a coat of paint as the exposure to the sun and weather has deteriorated the paint work on both the radome as well as the trailer housing the radar. The antenna dish needs to be rubbed down as the paint is flaking and a new coat of paint applied. Painting of certain specifications required in the case of the radome and antenna. The radar itself is in excellent condition, and required a minimum amount of repair to demonstrate the operational capability of the various sub-units. There exists an excellent spares complement. However in order to bring the radar to a reliable operational status it would need an extensive mechanical and electrical alignment and some attention focused on an array of items such as indicators, lamps, connectors that might have deteriorated from oxidation or other cause over the period. It would also be expedient to perform some antenna field checks to establish the beam pattern of the antenna. The working diagrams are all in Russian languages and would need to be translated into English to facilitate their use by the maintenance staff. The complexity of the radar would necessitate that a training programme for the technical staff be initiated. In summation, the radar is in a good condition and can be rehabilitated to an operational status after maintenance attention.

The de facto possession of the dual wavelength MRL-5 radar with S-band and X-band operating channels and the capability of a multiplicity of the operating modes make this radar ideal for the quantitative measurement of stratus form rain as well as convective storms. The superiority of S-band radar in the qualitative measurement of rainfall lies in the minimal attenuation of the signal whilst propagating through precipitation and that the majority of the meteorologically detectable echoes associated with this measurement fall within the Rayleigh scattering zone. The comparison of an X-band frequency monitoring the same sampled region within a thunderstorm as that of the S-band can be used to detect the presence of hail.

The radar and its derived data will serve as an excellent tool for the training of a core of meteorological scientific and technical disciplines as well as be of benefit to the community at large.
Is to be considered that the purchase costs of second hand comparable radar of western technology would be in excess of one hundred and sixty thousand dollars in procurement along with extended guarantee and excluding delivery and assembly costs replacement parts for these sophisticated radars come with an accompanying expensive price tag. The MRL-5 radar lends itself to be adaptable to the inclusion of western units in the event that this should be desirable.

PROPOSAL AND RECOMMENDATIONS

1) The radar is situated at present on a fairly good site with a good operational horizon the supply of public utilities and accessibility to the site is convenient. However a problem exists in that a satellite earth station is situated an estimated 10 km due west of the site, but depressed from the radar horizon by an estimated

8 degrees. Concern is that the radar antenna beam, in sweeping over the earth station would cause interference to the operation of the earth station. To minimize the risk of any interference it is proposed that the radar antenna elevation lower limit be set at zero degree, ensuring that the earth station is illuminated only by the antennas minor side lobes, with the path of the main beam pattern being well above the earth station antenna.

Too still further assist in reducing any possibility of interference a screen mesh could be erected at the radar site in such a position as to effectively screen the earth station from the radar antenna side lobes, yet not impinge unduly on the radars operational horizon.

The need to liaison with earth station operators to determine the acceptability of the above proposal would be of importance and could save the coast of relocation and the establishment of a new acceptable site for the radar.

On the above having a negative response from the earth station operators and re-location of the radar is resorted to then the following is proposed.

2)

a) In order that the radar functions as a multi-purpose meteorological sensing instrument it is necessary to ensure a good visible horizon of the lowest elevation angle. The previous suggested new site location does not remotely approach the criteria preferred in this instance with severe beam blockage in almost the entire western sector making it technically unsuitable for the positioning of the radar.

The location of the earth station and the surrounding geological position dictate that any new location of the radar will, of necessity, require it to be situated where a ground structure will screen the earth station from the radars emissions. Therefore a site location approaching the apex of the hill, but that the hill forms an horizon of 0.5 degree elevation from the horizontal; in the direction of the earth station would be suitable in this circumstance. Access to the site and the provision of public utilities will have to be considered in selection of the site

Consideration must be taken of the fact the radar has an unstable cone of …. 10km radius at its source due to "waveguide ring" due to the pulse transmission and recovery time of the receiver and that quantitative measurements end to fall off at radials greater than 150 km due to the beam width not being entirely filled by the sampled atmospheric phenomenon. However the radar does display data to radial of 300 km where at that distance and at a pointing angle of 1.5 degree above the horizon based on the calculated atmospheric refractive index model, the centre of the main lobe samples at a height of XX km above ground level.

b) Relocation would necessitate the removal of the radome, antenna, pedestal and the supporting platform. Re-assembly and alignment of the units to be performed at the new site. This would necessitate participation from heavy lifting equipment operation and the use of a crane and transportation vehicle.

c) Onsite training to be give during the re-assembly and alignment process to selected technical staff, with a strong emphasis on a hand on approach to maximize the opportunity to gain experience on the radar and ensure a degree of self reliance in the maintenance of the radar. Of the utmost importance here would be the transition of the technical drawing into English prior to commencement of the job.

CONCLUSION:

I wish to thank World Meteorological Organization (WMO) for sponsoring my visit to Ethiopia to assess the radar and wish also to thank the National Meteorological Service Agency of Ethiopia for their generous assistance in the completion of the task.

Dennis J Dicks

10th March 1999,

Annex II

Summary of technical report of technicians of the Ethiopian Air Force regarding the status of the MRL Radar

The following summarized version of the status of the MRL Radar in Addis Ababa is based on the assessment made by the technical staff of the Air force, which was carried out in response to the request made by the National Meteorological Services Agency for the assessment of the status of the radar.

1. The generator did have a problem of fuel filter, however, after maintenance work was undertaken and after the change/or substitution of Fuel Filter Gasket, the problem was solved.

2. The radar as a whole seems new (had not been in service) and has been for a long time without any maintenance and servicing.

3. When electricity was supplied to the radar, it first showed problems starting from its distribution board on-wards. Problems of special significance were:

   a. The transmitting unit
   b. Receiving unit
   c. Indicator system
   d. Antenna rotation and scanning system
   e. Signal processing unit
   f. Operating Panel board

3.1 By now, some of the problems have been solved. Thus, it has become possible for the radar's antenna to rotate horizontally, i.e (azimuth wise) and using the S band it has been possible to view cloud developments.

3.2 However, the elevation-scanning mode of the antenna does not work **Elevation scanning motor shows shorting**, where the main reason given by the technicians can be associated with leakage of motor oil into the motor and thus the motor has been dis-assembled to undertake the task of cleaning the oil leakage. However even after a new motor has been changed and installed, the new substituted motor also shows also an **over load**. This shows again that some of the oil must have entered into the Current Collector, which means that the same procedure of disassembling and clearing the current collector has to be undertaken. (The current collector is the instrument, which sends an electric signal from the non-revolving part of the radar to the revolving part of the radar).

3.3 The Intermediate Frequency Amplifier (IFA) of Channel I or X-band is not working properly. Thus, though it should be changed, there are no spare parts available.

3.4 In general the work so far accomplished is that of solving the problem of shorting and rusting in many of the units, changing burned fuses, especially on the power board, signal processor and over operating

panel, changing amplifier and discharge lamp in the transmitters, solve relay and contact problems in the distribution board, tuning receivers and indicators and solving the problem of the rotation system in the antenna.

4. The general conclusion of the report is that:

i) There should be a general servicing of the Elevation Scanning Mode of the antenna, especially the current collector part and use spare parts to solve this problem.

ii) The technical problems associated with the X-band, which needs procurement of spare parts for the Intermediate Frequency Amplifier (IFA), which has been found not to work properly.

If the two problems associated with the elevation scanning Mode of the antenna and the Intermediate Frequency Amplifier of the X band are solved then it is expected that the Radar can become fully operational. However, by the existing conditions it has become possible to view cloud developments by using a fixed angle (as elevation mode does not work) by the S band only.