

MIRANDA HOUSE मिरांडा हाऊस

Professor (Dr.) Bijayalaxmi Nanda Officiating Principal

TO WHOMSOEVER IT MAY CONCERN

14.03.2022

This is to certify that a R & D CARS project is sanctioned from MTRDC, DRDO on 11 January 2022 to Professor Monika Tomar as Project investigator for a duration of one year with a total outlay of Rs. 23.60 Lakh only. Further it is certified that Professor Arijit Chowdhuri (Department of Physics, Acharya Narendra Dev College, University of Delhi) and Dr. Anjali Sharma (Department of Physics, Atma Ram Sanatan Dharam College, University of Delhi) are Co-PI in the said project.

I extend my best wishes to the project team for successful implementation of the project.

कार्यवाहक प्रधानान्तर्या / Officiating Principal मिरांडा हाऊस / Miranda House दिल्ली विश्वविद्यालय / University of Delhi दिल्ली / Delhi-110 007



No. MTRDC/MMG/20206/TE/LP/2021-2022/BUP

То

University of Delhi Department of Physics, Miranda House DELHI – 11 007

Kind Attn.: Prof. Monika Tomar

Date: 1

December 2021

SUBJECT : FINALISATION OF CARS CONTRACT IN R/O "DEVELOPMENT OF PROCESS AND EVALUATION OF ELECTRON SUPPRESSION COATING ON THE GRIDS USED IN TWTS"

1. Your proposal for the subject CARS contract has been accepted to the extent of Rs. 23,60,000.00 and we are enclosing 03 copies of CARS contract with terms and conditions for your approval and return to us.

2. One original copy would be sent to you after signing by the Centre Head, MTRDC

S Vijay Mahendra भंडार अधिकारी/ Stores Officer For Centre Head

্ৰুমা বিধা পৰিলা নিৰ্দ্য কুমা ধাইব বলং ইব ধান্য গুনাই মৰ ধঁওয়া লগা হিলাক লিওঁ। যন্ত ব্যামক মৰ ধঁৱাং ক বলং ইশ ন আহিক ধান্নায়লা ইগী। Kindly always quote our letter number and date while replying. This will immensely assist prompt attention to your communication.



Contract for Acquisition of Research Services (CARS)

By Signature of authority identified at (11) below, DRDO hereby contracts on the Research Service Provider identified at (3), the provision of the Research Services described at (6), within the time stated at (8), for payments at (9.2), and subject to other conditions overleaf, as follows:

1.	Shor Dev Coa	t title of Research Servic elopment of Process a ting on the Grids used	Contract No. MTRDC/MMG/20206/CARS/LPO/ /2021-22/BUP Date: Dec. 2021 Period of the Contract:						
						12 Months from	the date of signing		
2.	RSQR Document Ref. No.: 		Date	of Issue	Issuing DRDO Lab/ Estt/ Project:	Dates of CAR	S Amendments:		
Constant of	10.00	an air a faith an an thank a	YY	MM DD	MTRDC, DRDO,				
-	Name and address of D		2021	12	Bangalore				
3.	Department of Physics, Miranda House, University of Delhi DELHI – 110 007				r (RSP):	4. KSP's Oller Kel.			
5.	(a) This Contract will require a formal amendment if the following key professional are not available to RSF Prof. Monika Tomar , Department of Physics, Miranda House, University of Delhi – DELHI – 110 007.								
	(b)	RSP is authorized to eng	age these	professiona	Is as research consultant	ts (names, institutes/ o	companies):		
6.	Princ	ipal technical features of O	offer as rel	ated to RSQ	R (Detailed in Annexure-	I)			
7.	DRDO will make available the following DRDO-owned equipment to RSP (Detailed in Annexure-II): NII								
8.	The technical performance of this contract shall be complete when RSP submits the Final Report before (date):12 Monthe								
9.1	Expenditure on items below shall not expend sume shawn assisted as the sume shawn assisted as the Contract of								
0.1	a)	Personnel		ceu sums si	iown against each sums :	shown against each			
	b)	Equipment (shall be reall	located as	per actual e	xpenditure)		0.00		
	c)	Others (miscellaneous, c	contingenc	y and spare	s)		5.00		
		(onul de realicouted as j	per dotta	experiature	L	Total Rs.	20.00		
			GST @ 18%	3.60					
	1	23.60							
9.2	Sch	edule of payments (Rs. I	In Lakhs))	Date (To - Date	Date (T ₀ – Date of Contract)			
	a) Initial Advance			$T_0 + \dots$ Months		18.0			
	(C)	at performance Milestone	e II of RSC	DR +	T ₀ +6r	$T_0 + 0$ months			
		Submission of Final Repo	ort						
@Pay of Co	yments ntinger	will be made within 45 day at Bill	ys of recei	pt by L/E/P		Total:	23.60		
10.	General conditions of CARS remain unchanged. Other								
11.	DRD there by the Regis	O will deem this contract, to, to have been consumma ne authority of the acar strar) competent to enter in	including ated when demic ins to this cor	amendmen signed belo stitution (e.g	ts 12. Signature of L/E/ w g.	12. Signature of L/E/P contract administrator:			
-									
		[Sign ove	er seal]				is here commend in the second		
	Name	e:			Name:				
	Dest				Designation:	Designation:			
	Designation:				Date:	Date:			
	Date:								

GENERAL CONDITIONS OF CARS

ANNEXURE TO CONTRACT NO. MTRDC/MMG/20206/CARS/LPO/ /2021-22/BUP Dt.

Specific Conditions of this contract : The following conditions apply (L/E/P to stipulate) in addition to General Conditions listed at II below: <u>Technical Performance</u>: The satisfactory execution of the technical features of this contract shall be established against Performance Milestones

as specified in the Contract.

Delivery Schedules : The interim reports and/or other outcome(s) of this contract shall be delivered as specified in the Contract.

General Conditions of this CARS

1.Equipment:

1.1 All equipment of a capital nature purchased, to execute this contract are the property of DRDO (L/E/P). These shall be returned to L/E/P within 03 months of expiry of this contract, unless L/E/P specifies otherwise separately.

NOTE : Should there be a difference of opinion between the RSP and L/E/P on whether or not a piece of equipment is of 'capital nature', the decision of L/E/P shall be final and binding on the RSP.

1.2 Equipment included in the Summary Offer of Research Services [at entry 9.1] shall be procured by the RSP.

1.3 The RSP shall be responsible for the proper maintenance of the equipment and shall not alienate them, or use them without the prior permission of L/E/P for purposes other than those specified in this contract.

2.0 Financial provisions : By entering into this contract, the RSP agrees to make available to the L/E/Ps, or to any person or bodies designated by it, if requested by the L/E/Ps, all financial documentation and records on supplies and services purchased or acquired by the RSP for executing the contract.

2.1 Advances, work in progress and schedule of payments :

(a) Advances or milestone payments are interim payments, which shall be deducted from the total sums due to the RSP

(b) The L/E/P shall make payments for executing this contract on demands made through "Contingent Bills" after certification by the pertinent financial authority of the RSP that the monies already released have been utilized for the purposes for which they were provided.

(c) Except with the specific written pre-agreement of the L/E/P, the RSP shall not use for any purposes other than those specified in this contract, any material or services for which advances or milestone payments have been made.

2.2 Financial documentation and records :

(a) For work whose estimated time for completion is six months or less, the RSP shall submit only those reports as relate to the purchase of equipment by the RSP, within thirty (30) days of such purchase(if applicable).

(b) For contracts whose estimated time for completion is more than six months, the RSP shall provide the L/E/P not later than thirty (30) days after the end of each half-year, with a half-yearly financial report showing the actual expenditure incurred, against each of the entries at 'item 9.1' overleaf, for the execution of the contract up to the end of the previous half-year.

(c) The L/E/P, or other authority specified by DRDO, may inspect all books, bills, vouchers and other financial records at any time until the final settlement of accounts. The RSP shall supply the L/E/P with such documents as are necessary for final settlement of claims, without explicit request by the L/E/P, within three (3) months after the date of submission of the final report.

(d) The documents supporting claims shall be preserved by the RSP until one year after the contract accounts are finally settled.

3. Disclosure and use of information by the RSP : The RSP will ensure that the documents supplied by the L/E/P are not disclosed to any person other than a person authorized by the L/E/P. Any pattern, sample or information in documentary or other physical form remains the property of the L/E/P throughout the period of the contract and shall be returned to the L/E/P after execution of the contract, unless their disposal is otherwise provided for in the contract.

4. Delivery Schedule :

4.1 The interim outcomes of the contract shall be delivered at the time or times and in the manner specified in I above.

4.2 The RSP shall inform the L/E/P properly of any occurrence that is likely to cause delay in delivery of above contracted outcomes. The L/E/P

shall determine, in the light of circumstances reported, the extent of change(s) required in the delivery schedule of the contract.

Note: The above covers only unexpected technical difficulties, gross delays in deliveries by suppliers of purchased equipment or consumables, illness or other justifiable cause of unavailability of research personnel and similar unforeseen circumstances.

4.3. An extension of the time limit for execution of the contract, or a postponement of delivery of outcomes shall require the explicit approval of the L/E/P, which approval shall be contractually valid only when this contract is formally amended by the L/E/Ps as recorded on top right hand corner overleaf.
5.Short-closure of contract: The contract may be short-closed at any time during the currency of its execution if the L/E/P feels that no useful purpose will be served by continuing its implementation. The short closure will be deemed to be effective from the day the short closure order is received by the RSP. Subsequent to this short-closure the RSP will submit a technical report on the work done till short-closure. The monies left unspent on the date of receipt of short-closure order by the RSP shall be returned to L/E/P. All equipment/stores acquired out of contract monies shall also be returned to L/E/P.

6. <u>Reports</u>: Reports giving details of the progress of the work shall be sent to the L/E/P at intervals as specified in I above. On completion of the contract, the RSP will submit a final report (Contractor Report). All reports shall be in a format conforming to Indian Standard IS:1064-1980, bound with Bibliographic Description sheet conforming to IS:9400-1980.

7. Ownership of intellectual Property (IP):

7.1. The ownership of intellectual property, whether or not legally protected, generated by contract research performed under this contract shall vest in DRDO. However, the RSP shall receive, upon demand by it, a royalty-free licence from DRDO to use these intellectual properties for its own purposes, which purposes specifically exclude sale or licensing to third parties.

7.2. Notwithstanding the above, all documents and information detailing the technical performance of this contract (including pertinent laboratory notebooks, sketches, photographs, video tapes of experiments, electronic data acquisition records and other similar) shall be the property of DRDO, whether or not in the physical possession of DRDO.

8. <u>Publications</u>: Interim technical results and the outcome of

the contract, intellectual or physical, are the property of DRDO. If the investigator intends publishing the technical outcome, he shall send a written request to L/E/P for permission to publish along with a copy of the manuscript. Within 60 (sixty) days of the receipt of such request, the L/E/P will inform the investigator(s) about its decision. If no communication is received from the L/E/P by the investigator/RSP within this period of 60 (sixty) days, the investigator / RSP shall be free to publish the material as proposed by him.

<u>Publicity relating to this contract</u>: This existence of the contracts or the status of their execution shall not be publicised by the RSP in the media or in its Periodic / Annual Report except with the written consent of L/E/P. The latter shall specify the text relating to this contract that may be made public.
 <u>Communications</u>: All communications affecting the performance of the contract or its terms and conditions shall be contractually valid only when confirmed by formal communication by the signatory.

11. Compliance with law :Notwithstanding anything contained in the contract, the RSP shall be solely responsible for complying with all laws in force in India.

12. <u>Settlement of disputes</u>: All disputes to a CARS shall be settled mutually between the RSP and Director of L/E/P placing the CARS. Any remaining unresolved disputes shall be referred to final binding settlement by authorities mutually decided by the Secretary, Defence Research & Development, Ministry of Defence, and Secretary, HRD, Government of India, unless otherwise provided for in

Research Service Qualitative Requirement (RSQR) of "Development of process and evaluation of electron suppression coating on the grids used in TWTs"

INTRODUCTION:

MTRDC is developing non-intercepting gridded electron guns for Travelling Wave Tubes (TWTs) at various frequency bands. Non-intercepting gridded electron gun is a very important and critical sub assembly of a TWT and used for pulsing the electron beam in a pulse TWT. The control grid, which is a thin vane like structure with opening of 50% to 80% is placed very close in front of cathode to control the electron beam from the cathode by applying a small pulse voltage and the shadow grid is an exact replica of the control grid and placed just above the cathode (and operate at cathode potential) matched in orientation with the control grid. This will stop the emission of electron from the part of the cathode shadowed by shadow grid and hence protect the control grid from electron bombardment. Typical grid material used is molybdenum. After few 100 hours of operation of the TWT the emitting mixture material of the cathode (responsible for electron emission from the cathode) accumulates on the shadow grid and shadow grid starts emitting electrons. This results in higher control grid current as the shadowing effects reduces with time and subsequently lead to catastrophic failure of the TWT. Hence for long life and better reliability of the TWT, the shadow grid requires electron suppression coating. Typically a thin film of Zirconium is coated on the Molybdenum with a Tungsten as intermediate layer to act as electron suppression coating. For better performance of the TWT, the shadow grid requires to be coated only on the concave side and control grid on both sides.

OBJECTIVE:

To develop the process of deposition of thin films of Zirconium on the Molybdenum grids with Tungsten as intermediate layer which will withstand the high temperature (1050 degree Centigrade) in the Ultra High Vacuum (UHV $\sim 10^{-7}$ Torr) environment of a TWT.

SCOPE:

- 1. Development of process of deposition of thin films of Zirconium on the Molybdenum grids with Tungsten as intermediate layer.
- 2. High temperature (1050 degree Centigrade) withstanding capability and peel off test of the coating.
- Coating of grids supplied by MTRDC (5 pairs) for experimental evaluation in the actual TWT environment.

DELIVERABLES:

1. Process documents - 1 hard copy

2. Coated grids – 5 pairs (Molybdenum grids will be supplied by MTRDC)

DURATION:

12 (Twelve) months

MILESTONE WISE PAYMENT SCHEDULES:

Sl. No.	Milestone	Time	Work Completion	
1	Initial advance	То	Project initiation and signing of contract	
2	Milestone 1	T0+6 months	Purchase of equipments/ subsystems, deposition of Tungsten and Zirconium coating, process optimisation on samples and peel off test and interim report	
3	Milestone 2	T0+12 months	Deposition of coating on actual grids, peel off test and high temp withstanding capability test in UHV environment and final report	

B. Bherot Kund Bharat Kumar, Sc-D 7/10/2/

and Flield

Dr. M Santra, Sc-G