

National Remote Sensing Centre (NRSC), ISRO

NSPARC Data Ingest Hardware

RFP (Production)

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1. Introduction

1.1. Purpose

The purpose of this document is to outline the scope of the work to be carried out by the vendor as part of production of Next Generation SPARC (NSPARC) Data Ingest Hardware. This document also gives the overview of the NSPARC card functionality and the brief description of the major subsystems. Document also gives the details of the different interfaces and their targeted throughput.

1.2. Scope

NSPARC Hardware is a high data rate PCI Express based Data Ingest hardware. This hardware will be used in the Ground station for data acquisition from Remote sensing satellites. Figure-1 shows the CAD drawing of the Hardware with dimension-

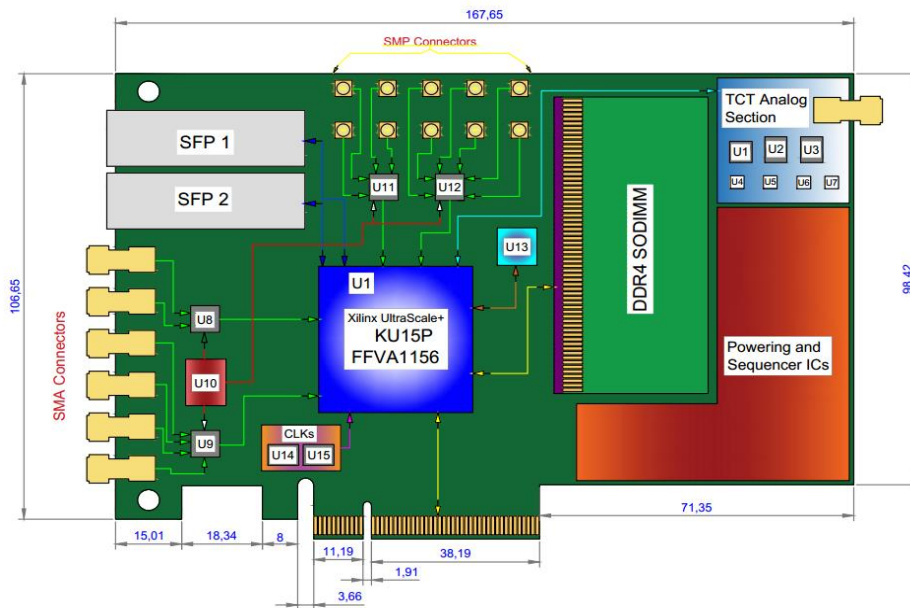


Figure 1: NSPARC CAD drawing

1.3. Abbreviations

ADC	Analog to digital converter
AM	Amplitude Modulation
ATP	Acceptance Test Procedure
BBT	Bare Board Testing
BGA	Ball Grid Array
BOM	Bill of Material
CAD	Computer Added Design
DDR4	Double Data Rate 4
FPGA	Field programmable gate array
IRIG	Inter Range Instrumentation Group
JTAG	Joint Test Action Group
LDO	Low Drop Out (voltage regulator)
LVC MOS	Low Voltage Complementary Metal Oxide Semiconductor
LVDS	Low Voltage Differential Signaling
LVPECL	Low Voltage Positive Emitter Coupled Logic
MEMS	Micro Electro Mechanical Systems
NECL	Negative Emitter Coupled Logic (-5.2V)
NDA	Non-Disclosure Agreement
NRSC	National Remote Sensing Centre
NSPARC	N ext generation S atellite data P rocessing and A cquisition R econfigurable C ard
PCB	Printed Circuit Board
PCI	Peripheral Components Interconnect
PI	Power Integrity
PDN	Power Delivery Network
SDRAM	Synchronous Dynamic Random Access Memory
SI	Signal Integrity
SMA	Sub Miniature version A
SoC	System-on-Chip
SODIMM	Small Outline Dual In-line Memory Module
TCT	Time Code Translator

2. System Overview

2.1. Overview

NSPARC DIH is a PCI express based Hardware, built around Xilinx Ultra Scale + Kintex FPGA. This hardware will be used for remote sensing satellite data acquisition and pre-processing in the ground stations. It will receive data from the demodulator over 10G Ethernet interface as well as conventional differential ECL interface. Hardware will support two stream of data acquisition with each stream supporting data rate up to 4 Gbps. NECL interface has 3 differential data pairs with one common differential clock pair per stream. It supports 3 channel data acquisition per stream with each channel supporting data rate up to 750 Mbps. This also takes AM modulated IRIG signal as input and performs the digital AM demodulation post analog to digital conversion. Hardware will be interfaced to the computer system through PCI Express Gen3 x8 interface. Figure below shows the hardware block diagram –

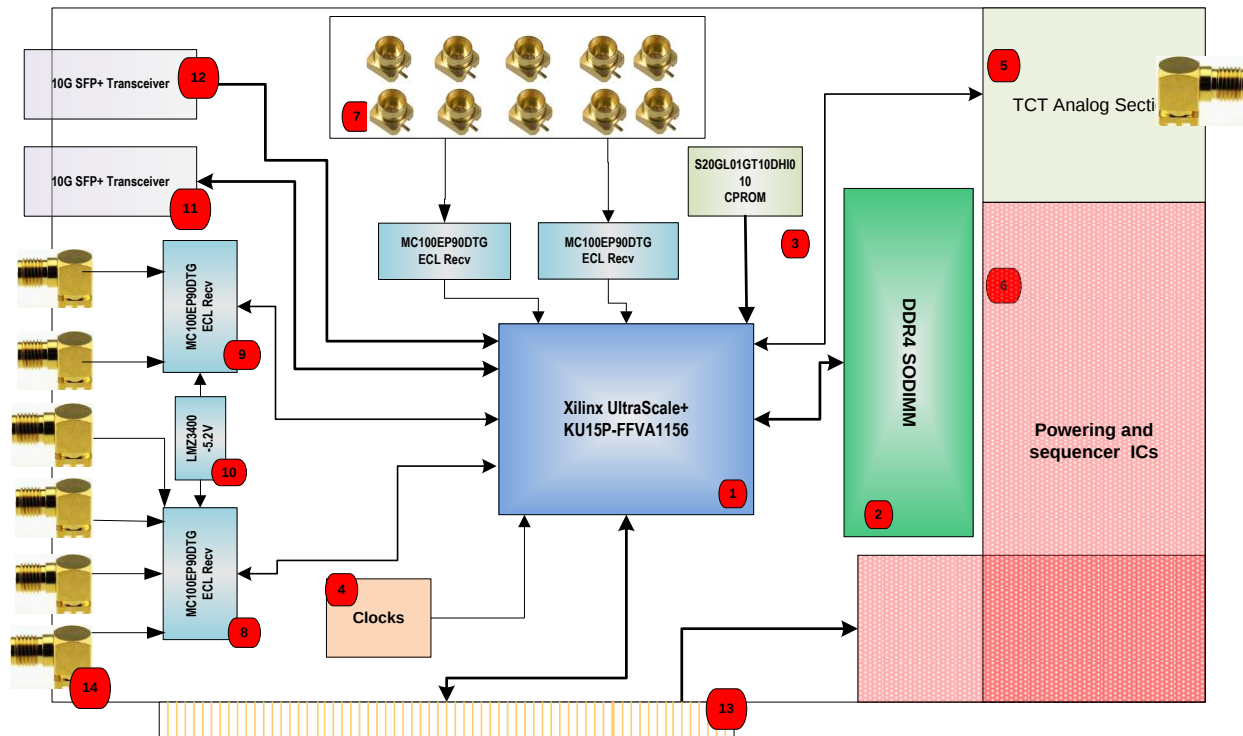


Figure 2: HW Block diagram

This SoC based hardware is built around the Xilinx Ultrascale+ Kintex FPGA (KU15P). It includes Power with sequencing circuitry, DDR4 SODIMM Memory, 10G Transceivers, NECL receivers, Time code translator subsystems. Configuration NOR flash memory used for storing the FPGA configuration data along with SoC software.

2.2. Bill of Material (BOM)

Table below gives the list of Major components for NSPARC board.

Table 1: Bill of Material

S/N	Part Number	Manufacturer	Description	Quantity
1	XCKU15P-2FFVA1156I	Xilinx	FPGA	1
2	S29GL01GT11DHIV20	Infineon Technologies	FPGA Configuration Flash	1
3	MTA8ATF2G64HZ-3G2F1	Micron Technology Inc.	DDR4 SODIMM Memory	1
4	MC100EP90DTG	Onsemi	NECL to LVPECL Level converter	4
5	MC100EP196BMNG	Onsemi	Programmable delay IC	2
6	510BBA156M250BAGR	Skyworks Solutions Inc.	XTAL 156.2500MHZ LVDS SMD	1
7	570BBB000374DGR	Skyworks Solutions Inc.	XTAL 300.000MHZ LVDS SMD	1
8	530FC200M000DGR	Skyworks Solutions Inc.	OSC XO 200.000MHZ LVDS SMD	1
9	UCD90160ARGCT	Texas Instruments	Power Sequencer IC	1
10	TPSM8D6C24MOWR	Texas Instruments	12V to 0.850 (VCCINT) DC to DC Converter	1
11	TPSM8A29RDGR	Texas Instruments	DC (12V) to DC (3.3V) Converter	2
12	TPSM82866AA0SRDJR	Texas Instruments	DC to DC Converter	3
13	TPS65941319RWERQ1	Texas Instruments	Multichannel PMIC	1
14	LMZ34002RKGT	Texas Instruments	DC to DC (-5.2) Converter	1
15	TPS259814LRPWR	Texas Instruments	E-Fuse	2
16	TPS22810	Texas Instruments	Load Switch	1
17	TMCS1100A2QDR	Texas Instruments	Current Sensor	2
18	TMCS1100A1QDRQ1	Texas Instruments	Current Sensor	1
19	TPS22950YBHR	Texas Instruments	Load Switch	1
20	TXU0102DTTR	Texas Instruments	Dual channel level converter	3
21	SN74LXC8T245RHLR	Texas Instruments	8 Channel bidirectional level converter	4
22	ADA4932-1YCPZ-R2	Analog Devices Inc.	ADC Driver	1
23	AD7626BCPZ-RL7	Analog Devices Inc.	16bit 10 Msps SAR ADC	1
24	ADR444ARZ	Analog Devices Inc.	2.048V Voltage reference LDO	1
25	ADP3330ARTZ-5-RL7	Analog Devices Inc.	Low noise 5V LDO	1
26	ADP3330ARTZ-2_5-R7	Analog Devices Inc.	Low noise 2.5V LDO	1

27	MAX1673ESA+	Maxim Integrated	-2.5V charge pump DC converter	1
28	AD8031ARZ	Analog Devices Inc.	2.048V Voltage feedback LDO	1
29	ADP7105ACPZ-R2	Analog Devices Inc.	12V to 7.25V LDO	1
30	REF3012AIDBZT-	Texas Instruments	1.25V Reference LDO	1
31	SML-D12M8WT86	Rohm Semiconductor	LED Green 2.2V/20mA	21
32	APTD1608SECK/J3-PF	Kingbright	LED Red 2.2V/20mA	2
33	APTBD3216SURKCGKC-01	Kingbright	LED Red/Green 1.95/2.1V 20 mA	12
34	SMBJ14A	Littlefuse Inc	DIO_DO214AA_SMB	2
35	BKP2125HS330-T	Taiyo Yuden	33E/4A Ferrite Bead	3
36	TFM322512ALMAR47MTAA	TDK Corporation	FB1210 0.47uH	3
37	HZ0805E601R-10	Laird-Signal Integrity Products	FB 600H	3
38	TFM322512ALMA1R0MTAA	TDK Corporation	1uH 4A Inductor	1
39	FBMJ2125HM330-T	Taiyo Yuden	FB 33 Ohm 0805 1LN	2
40	BLM31PG391SN1L	Murata Electronics	FB 390 Ohm 1206 1LN	16
41	L0805C1R0MPWST	Kemet	1uH 300 mA 150 mohm Inductor	4
42	TL3301AF160QJ	E-Switch	Push button S/W	2
43	CVS-04TB	Nidec Components Corporation	4 Position Sliding S/W	1
44	R284B02625	Radiall	Right angle MCX to Bulk head SMA 8 inch Cable	6
45	R125680000	Radiall USA, Inc.	SMA Right angle PCB mountable connector	7
46	R113426000	Radiall USA, Inc.	MCX Straight PCB mountable connector	10
47	2309409-1	TE Connectivity	DDR4 SODIMM Connector	1
48	MECT-110-01-M-D-RA1-TR	TE Connectivity	SFP+ RCPT Connector	2
49	2007198-1	TE Connectivity	SFP+ Cage	2
50	SM12B-GHS-TB	JST Sales America Inc	12POS 1.25MM SMD right angle Connector	3
51	GHR-12V-S	JST Sales America Inc.	GHR-12-S mating for SM12b-GHS-TB	3
52	1720641002	MOLEX	PCB mountable 2 Pin Power Connector	1
53	538-171692-0102	MOLEX	Mating connector for	1

			1720641002	
54	609-3210-ND	Amphenol	HEADER VERT 6POS 2.54MM Connector	2
55	MTLW-103-07-G-D-230	SAMTEC Inc	HEADER VERT 6POS 2.54MM Connector	2
56	MTLW-103-07-G-S-230	SAMTEC Inc	6 POS HDR 0.100" UNSHR Connector	2
57	878311420	Molex	14POS 2MM Header VERT (JTAG header)	1
58	HTSW-105-07-L-D	Molex	10POS 2.54MM Header VERT (TP)	1
59	DUAL PCI	Custom	Dual width PCI Bracket	1
60	HEAT SINK	Custom	Heat Sink for FPGA	1
61	OD3510-12MB01A	ORION	FPGA Cooling Fan	1
62	AFBR-709BMZ-IN3	Intel	SFP Module	2
63	SNT-100-BK-G	Samtec Inc	Connector Shunt 2Pos (Jumper)	10

2.3. Reference Documents / Standards

1. IPC-A-600F or better : Acceptability of PCBs
2. IPC-A-610E or better : Acceptability of electrical assemblies
3. IPC/JEDEC J-STD-033 : Handling, Packing, Shipping and use of moisture / re-flow sensitive SMDs.

2.4. NSPARC card Specification

- PCI Express Full Height Half Length add-on card with Gen3 x8 interface
- PCB Dimension: 168 mm X 111 mm
- Type of PCB: FR4 glass epoxy with high TG and ENIG surface finish
- PCB Class: Class 2
- Number of layers: 16
- PCB thickness: 1.60 mm (10% tolerance)

3. Scope of Work

Scope of work is production and supply of 12 Numbers of PCI Express based NSPARC cards (Gen3 x8 lane based). The work to be carried out by vendor involves

- Component Procurement: Components shall be procured as per BOM from authorized dealers only. Certificate of compliance should be provided.
- PCB Fabrication: PCBs shall be fabricated by using NRSC provided Gerber files. Fabricated PCBs shall be compliant with IPC-A-600F standard or better.
- PCB Assembly: Components assembly meeting standards IPC-A-610E or better.
- Functional Testing: This includes loading of programming files provided by NRSC in to FPGA/Flash memory and loading of firmware in the Power Sequencer & PMIC. Testing the functionality of the card with PC / Work station with Linux RHEL /CentOS version 8 or above by using NRSC provided firmware, device driver and application software.

3.1. Component procurement

- Vendor shall procure the components as per BOM from authorized vendors only. He has to provide certificate of compliance for the components.
- He shall maintain a part list per PCB which includes
 - Part number and type
 - Screening details (date code/ batch number)

3.2. PCB Fabrication

- Shall be fabricated from reputed PCB fabricator
- PCB base material shall be of FR4 glass epoxy with high Tg and ENIG surface finish
- Board warpage to be less than 1% of largest dimension of PCB and free from bow and twist.
- PCBs to be free of blistering, de-lamination and smooth without wrinkles and bumps.
- PCBs should be compliant with IPC-A-600F standard.
- Inspection of the bare PCBs, and BBT report for each board should be given to NRSC.
- Record the non-conformity, if any and re-fabrication should be done.

3.3. PCB assembly

- PCB Assembly process should as per the IPC-610G standard
- Component mounting stage
 - PCB cleaning and baking
 - Inspection and rework if required, followed by inspection
 - Component mounting
 - Inspection
 - Rework if required, followed by inspection.

- Component soldering stage
 - Soldering
 - Inspection
 - BGA assembly correctness to be verified
 - Rework if required, followed by inspection.

3.4. Cooling solution

- Vendor must procure / fabricate the heat-sink as per the design provided by NRSC.
- Vendor must use the NRSC advised thermal adhesive / compound for attaching the Heat sink with KU15P FPGA.
- Vendor must procure the fan as per BOM and mount on top above heat sink.

3.5. Functional testing

- Impedance check on all the Voltage rails of the Power Delivery Network (PDN) has to be carried out and the values have to be compared with the ATP document.
- Voltages to be verified for all the rails of the PDN and values to be compared with the ATP document.
- Firmware up-gradation has to be carried out for Power Sequencer UCD90160A and the PMIC as per the ATP document.
- FPGA /PROM firmware up-gradation has to be carried out as per the ATP document with NRSC provided files.
- Part of the functional test ensuring functionality of the major interfaces of the card has to be carried out at vendor site using NRSC provided device driver & application software on the PC /workstation (with RHEL 8.0 or above OS) by vendor .
- Complete functional test for the card has to be carried out by the vendor at NRSC as per the ATP document.

3.6. Record maintenance / Documentation

- Maintenance of production logs for each cards which includes
 - Parts list prepared
 - PCB fabrication and assembly check list
 - BBT report
 - The non-conformance identified in each stage shall be addressed along with rework record if any.
 - Test reports of previous stages.
 - QC clearance report

4. Inputs from NRSC

Following Input will be provided to the selected vendor post acceptance of the purchase order and signature of NDA by the vendor-

- NSPARC PCB Gerber files, BOM file, Assembly file & schematics in pdf format
- PCIe Bracket design file in dxf format
- Heat Sink custom design file
- Xilinx Ultrascale+ Kintex FPGA (KU15P) firmware.
- TI UCD90160A sequencer IC firmware
- TI TPS6594A PMIC firmware
- Linux PCIe device driver kernel object file.
- NSPARC testing application software executable.
- Acceptance Test plan document.

5. Deliverables

- a. 12 numbers of assembled & tested NSPARC cards
- b. BBT & Other QA reports as per subsection 3.6

6. Schedule

Fabricated & Tested board along with test reports should be delivered to NRSC within 120 days from receipt of Purchase order and inputs from NRSC. Vendor has to visit the NRSC within 10 days from date of delivery and demonstrate the functionality of the board as per the ATP document. Table below provides the delivery schedule breakup-

Timeline	Details of activity to be completed
T_0	Receipt of the Input (design files) from NRSC
$T_1 = T_0 + 120$ days	Deadline for the delivery of fabricated NSPARC boards along with test reports to NRSC
$T_2 = T_1 + 10$ days	Deadline for execution of Acceptance test by vendor at NRSC

7. Acceptance/Rejection Criteria for Assembled & Tested Boards

7.1. Acceptance Criteria

- a. Submission of the Bare Board Testing (BBT) report with 100% coverage for each PCB.
- b. PCBs shall be compliant to IPC-A-600 standard.
- c. Assembled board must be qualified as per IPC-A-610 standard.

- d. Fabricated board must pass the functional test as per ATP document provided by NRSC.
- e. Submission of vendor QA report with reference to point b, c & d.
- f. NRSC team will be carry out the inspection & functional test and based on which the assembled board will be finally accepted.

7.2. Rejection criteria

- a. Non-conformance of quality (based on QA/QC inspection report).
- b. Non-conformance of functionality (based on Test report).
- c. Any deviation from the specifications of the card provided.

If any NSPARC card has any of the above issues, then it will result in rejection of that NSPARC card. The root cause of rejection shall be analyzed and corrective action shall be implemented by vendor. Rejected NSPARC cards shall be re-fabricated by the party without any extra cost and to be supplied within 30 days after receiving information from NRSC. The rejected material will be handed over to the party against replacement.

8. Warranty

Vendor has to provide warranty for each fabricated board for a period of 1 year. In case of any malfunction of the card during the warranty period due to fabrication/manufacture/component defects/failures, vendor has to repair/replace the card without any additional cost.

9. Vendor Selection Criteria

The Infrastructure and Technical competency will be verified during the technical bid evaluation. Following sub sections provides the details of vendor selection eligibility and preferability criteria. However NRSC reserves the right to physically cross-check the required technical facilities & competency for the execution of this contract at vendor site.

9.1. Vendor Eligibility Criteria

Vendor must fulfill the below mentioned requirement for eligibility for the contract-

- I. ISO-9001 certified company.
- II. Vendor must have experience during last 5 financial year in production of FPGA based boards with-
 - a. High density BGA components similar to BOM of this project
 - b. High speed interfaces like 10G Ethernet, PCI Express & DDR4 Memory

Vendor must submit 2 Purchase Orders along with Performance Satisfactory Certificate and the technical details of the project executed supporting the point a & b.

9.2. Vendor Preferability Criteria

- I. Vendor should have a team of skilled and trained man power to carry out all activities. Vendor may provide the list of the above staffs on payroll along with their qualification & expertise in the required field.
- II. Vendor should have the required infrastructure to carry out the production & testing of the high density & high-speed FPGA based hardware.
- III. Vendor should have the following Hardware and software tool required for carrying out the testing of the NSPARC Hardware-
 - a. Xilinx Vivado Lab Tool for programing Xilinx FPGA
 - b. Xilinx Platform Cable USB II programming Hardware
 - c. TI make USB to GPIO programming Hardware and required software package
 - d. Computer system with RHEL 8 OS and capable of housing NSPARC hardware.

Vendor may preferably provide the above mentioned documentary evidences.

10. Terms & Conditions

As part of this contract vendor has to adhere the following terms & conditions-

- a. The Vendor has to submit signed copy of Non-Disclosure Agreement (NDA) which is provided in the annexure.
- b. NSPARC is totally NRSC proprietary design and vendor is not authorized to share or reuse the design.
- c. NRSC reserves the right to terminate the contract on the basis of finding non-adherence of the criteria mentioned in 9.
- d. NRSC reserves the final right for rejection of NSPARC boards with Non-conformance of quality and functionality.
- e. Inspection can be carried out by NRSC team at any stage of production, to ensure adherence to the guidelines, quality levels and procedures, if required.
- f. The maximum number of reworks shall be limited to 3 times only.

NON-DISCLOSURE AGREEMENT

This affidavit is to be made on Judiciary/ Non-Judiciary Stamp paper of Rs. 100.

This **NON-DISCLOSURE AGREEMENT** ("Agreement") is made effective from the date of signing of NDA ("Effective Date") between M/s
..... with its Registered Office at
.....(hereinafter referred to as "vendor") and NRSC, Indian Space Research Organization, Hyderabad

(NRSC and vendor shall be individually referred to hereinafter as "party" and collectively as "parties").

Background

NRSC has released **Tender No 202300026201 for PCB fabrication of Next Gen SPARC boards (Production)**

In connection with the Purpose, it will be necessary for certain confidential information to be disclosed between the parties. NRSC and vendor agree that the following terms and conditions shall apply when one party discloses confidential information to the other party under this Agreement. The objective of this Agreement is to provide appropriate protection for such information whilst maintaining the parties' ability to conduct their respective businesses.

RECITALS

WHEREAS, in order for vendor to perform the work required as per the Tender, it will be necessary for NRSC at times to provide vendor and vendor's employees with access to certain information that it deems confidential information (the "Confidential Information")., till completion of Contract and even after Contract validity period.

NOW, THEREFORE, in consideration of being given access to the Confidential Information in connection with the Purpose and as per the Tender, and for other good and valuable consideration, the receipt and sufficiency of which the parties acknowledge the parties do hereby agree as follows:

1. Vendor's Personnel will be bound by and will be obliged to comply with all the provisions of the **Official Secrets Act, 1923.**
2. Confidential Information means any and all information provided by or made available by NRSC to vendor in connection with the Tender and subsequent Contract, regardless of the form, format, or media on or in which the Confidential Information is provided and regardless of whether any such Confidential Information is marked as such. Confidential Information includes, by way of example only, information that vendor views, takes notes from, copies (if NRSC agrees in writing to permit copying), possesses or is otherwise provided access to and use of by NRSC in relation to the Tender and subsequent Contract.
3. Vendor shall not copy, disclose, publish, release, transfer, disseminate, use, or allow access for any purpose or in any form, any Confidential Information provided by NRSC except when used exclusively in connection with the Purpose. Vendor shall limit access to the Confidential Information to vendor's Personnel who have a demonstrable need to know such Confidential Information in connection with the Tender and subsequent Contract and who have agreed in writing to be bound by the disclosure and use limitations pertaining to the Confidential Information. Vendor will remain solely liable to the NRSC for their acts.
4. Vendor hereby agrees to hold the Confidential Information in trust and in strictest confidence, to adopt or establish operating procedures and physical security measures, and to take all other measures necessary to protect the Confidential Information from inadvertent release or disclosure to unauthorized third-parties and to prevent all or any portion of the Confidential Information from falling into the public domain or into the possession of persons not bound to maintain the confidentiality of the Confidential Information.
5. Vendor shall promptly advise NRSC in writing if it learns of any unauthorized use, misappropriation, or disclosure of the Confidential Information by any of vendor's personnel or vendor's former personnel. Vendor shall at its own expense, cooperate reasonably with NRSC in seeking injunctive or other equitable relief against any such person(s).

6. Vendor shall return all copies of the Confidential Information to in its care, custody, control or possession to NRSC upon request of NRSC or on termination of the Purchase Order at its own cost. Provided vendor shall be entitled to retain a record of its involvement in the Purpose, as per its internal record retention policies, subject to confidentiality as per the terms of this Agreement.
7. A breach of this Agreement by vendor or by vendor's Personnel shall constitute a breach of the Contract between vendor and NRSC.
8. Vendor acknowledges that any failure by the vendor or vendor's Personnel to abide by the terms and conditions of use of the Confidential Information may cause irreparable harm to NRSC and that monetary damages may be inadequate to compensate NRSC for such breach. Accordingly, vendor agrees that NRSC may seek to obtain an injunction to prevent the disclosure, copying or improper use of the Confidential Information. Vendor consents to personal jurisdiction of Hyderabad Courts. NRSC's rights and remedies hereunder are cumulative and the State expressly reserves any and all rights, remedies, claims and actions that it may have now or in the future to protect the Confidential Information and to seek damages from vendor and vendor's Personnel for a failure to comply with the requirements of this Agreement. In the event NRSC suffers any losses, damages, liabilities, expenses, or costs (including, by way of example only, attorneys' fees and disbursements) that are attributable, in whole or in part to any failure by vendor or any of vendor's Personnel to comply with the requirements of this Agreement, vendor shall compensate NRSC from and against any such direct losses, damages, liabilities, expenses, and costs as determined by a court of competent jurisdiction.
- 9. The parties further agree that:**
 - a) This Agreement shall be governed by the Indian laws;
 - b) The rights and obligations of vendor under this Agreement may not be assigned or delegated, by operation of law or otherwise, without the prior written consent of NRSC;
 - c) The invalidity or unenforceability of any provision of this Agreement shall not affect the validity or enforceability of any other provision of this Agreement;
 - d) Signatures exchanged by facsimile are effective for all purposes hereunder to the same extent as original signatures; and
 - e) The Recitals are not merely prefatory but are an integral part hereof.

10. Upon signature of both the parties, this Agreement shall come into effect from the Effective Date and shall continue in full force and even after Contract validity period.
11. **Assignment, Modification and Waiver:** No assignment, modification or waiver of any Term of this Agreement shall be effective unless set forth in writing by an Authorized representative of each party. No failure to enforce any provision of this Agreement shall be construed as waiver.
12. **Entire Agreement:** This agreement constitutes the entire agreement between the parties with respect to the matters covered by this agreement, supersedes all prior agreements and understandings with respect thereof and may only be amended in writing signed by both the Parties. In the event that the parties enter into further agreement, the provisions of such agreement concerning confidentiality of information shall supersede and prevail over any conflicting of this Agreement.
13. **Binding Effect:** This Agreement shall be binding to the benefit of the undersigned parties, their successors and assigns.

Written communications requesting or transferring confidential information under this Agreement shall be addressed only to the respective designees as follows (or to such designees as the parties hereto may from time to time designate in writing.

IN WITNESS WHEREOF, the vendor has executed this Agreement to be executed as the effective date written above when signed below by their duly authorized representatives.

For on behalf of vendor:

Name: _____

Sign: _____

Title: _____

Date: _____

(Authorized Signature with Stamp)

Witness:

Name: _____

Sign: _____

Title: _____

Date: _____