Request for Proposal

Annual Maintenance Contract for Automated Antenna Positioning System of Near Field Test Range

Space Applications Centre - Ahmedabad
Indian Space Research Organisation

Contents

1. System Overview

Near Field Test Range (NFTR) automated antenna positioning system consists of –

1. Simultaneously operated 4-axis inverted T-scanner with motion controller
2. Simultaneously operated 4-axis DUT positioner with motion controller
3. Automated test configuration and Data acquisition software

The SAC NFTR is operational for frequency range from 1.0 GHz to 40.0 GHz used for characterization of planar antenna systems.

The antenna positioning system of NFTR is having multi-axis, simultaneously operated, highly precise, heavy-duty positioners for accurate and precise characterization of antenna systems in near field by scanning in different formats viz. *Rectangular, Plane-polar, Bi-polar, Cylindrical* and *Spherical scans*.

The positioning system axis details are as per below –

(i) *4-axis inverted T-Scanner* (**Roll** over **Lin-Z** over **Lin-Y** over **Lin-X** axis)
(ii) *4-axis Device Under Test (DUT) Positioner* (**Pol** axis over **Rot El** axis over **Rot Az** axis over **Lin. Slide** axis)

This positioning system is used to support and position test devices, antennas, model towers, etc. for antenna measurements. Measurement software is required to configure the axis motion profiles for fully automated antenna measurement.

2. Antenna Positioning System to be included for AMC

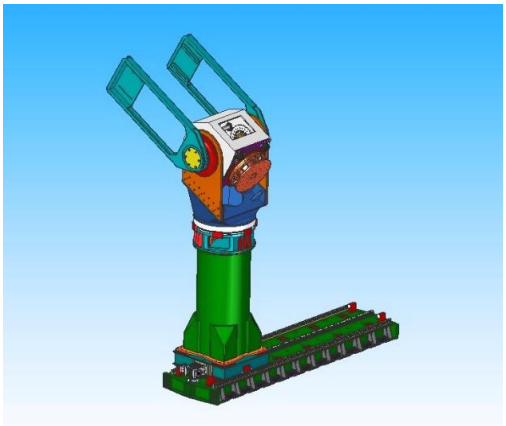
2.1 Simultaneously operated 4-axis inverted T-scanner with motion controller

2.1.1 **4-axis inverted T-scanner –** T-Scanner is a standard 4-axis positioner having 3-linear axes and 1-rotational axis. The linear travel axes are X, Y, Z & rotational axis is Roll axis. T-Scanner makes possible the scanning of DUT antenna mounted over the DUT positioner in different configuration. It carries the probe antenna required for DUT characterization. The drive mechanism of the slide axes are rack and pinion type. The driving unit is a DC servomotor with sufficient performance rating in order to operate at the required loads, velocities and accelerations. Slide motion is accomplished by the gear-motor, to ensure the required torque for machine operations. The reduction worm gear drives a pinion connected to the reduction worm gear. The pinion is engaging with a rack gear, which is located between bearing rails. The rack and bearings rails are mounted on a positioner surface.

2.1.2 **4-axis motion controller with Local Control Unit –** T-Scanner motion controller is a standard 4-axis controller with built-in PCU. The front panel of controller enables manual operation by means of an operating axis selector, display axis selector, motor speed and direction control knob. A portable hand-held unit connected with motion controller through a cable and being used for controlling the motion of all independent axes in a sequential manner. Also indicates the axis limits in Forward (CW) / Reverse (CCW) direction. It incorporates a rotary switch for selecting one axis at a time.

2.2 Simultaneously operated 4-axis DUT positioner with motion controller

2.2.1 4-axis DUT positioner – DUT Positioner is a standard 4-axis positioner having 3-rotational axis and 1-linear slide axis. The rotational travel axes are Polarization, Elevation, Azimuth & Linear axis is DUT linear slide. DUT Positioner makes possible the measurement of antennas radiation characteristics of satellite, ground and various development models. The drive mechanism of DUT Positioner is very much similar to T-Scanner. The additional safety features offered by DUT Positioner are Tacho output from DC servomotors and electromechanical braking system in all rotational axis.



2.2.2 4-axis motion controller – DUT-Positioner motion controller is a standard 4-axis controller with built-in PCU. The front panel of controller enables manual operation by means of an operating axis selector, display axis selector, motor speed and direction control knob. A portable hand-held unit connected with motion controller through a cable and being used for controlling the motion of all independent axes in a sequential manner. Also indicates the axis limits in Forward (CW) / Reverse (CCW) direction. It incorporates a rotary switch for selecting one axis at a time.

2.3 Automated test configuration and Data acquisition software

The Automated test configuration and Data Acquisition (DAQ) software initializes, controls, configures the RF instruments and the positioning system. It defines the measurement configurations as per user requirement and performs the acquisition. It also has data processing and analysis module to process the raw measured data to compute the far field and near field characteristics of the AUT.

3. System Specifications

3.1 Four (4) – axis inverted T-scanner System

3.1.1 4-axis inverted T-scanner – T-Scanner is a standard 4-axis positioner having 3-linear axes and 1-rotational axis.

Table-01: Technical specifications related to T-Scanner

Parameters		**X-axis**	**Y-axis**	**Z-axis**	**Roll-axis**
Travel Range		9.0 m	6.0 m	0.25 m	360 deg
Travel Load over axis		1750 kg	350 kg	60 kg	30 kg
Structure Material		Cast Iron / Steel			
Velocity	min	250 mm/sec	250 mm/sec	12 mm/sec	5 deg/sec
	max	500 mm/sec	500 mm/sec	20 mm/sec	12 deg/sec
Mechanical System Planarity		< 0.12 mm RMS			
Motor Drive Power		3/4 hp	3/4 hp	1/3 hp	1/20 hp
Axis Accuracy RMS		0.07+X(m)/300	0.07+Y(m)/300	0.05+Z(m)/300	0.1deg
Repeatability		< 0.05 mm	< 0.05 mm	< 0.05 mm	<0.03 deg
Positioning Accuracy		< 0.1 mm	< 0.1 mm	< 0.1 mm	<0.06 deg
Readout Resolution		< 0.005 mm	< 0.005 mm	< 0.005 mm	<0.001 deg
Operational movement must be without jerking, no position hunting, and noise free smooth operation.					

Table-02: Technical specifications related to T-Scanner axis alignments

Parameters	**Unit**	**Specifications**
Parallelism between T-scanner Roll axis and Z-axis	deg	± 0.02
Orthogonality between T-scanner Z-axis and Y-axis	deg	± 0.02
Orthogonality between T-scanner Y-axis and X-axis	deg	± 0.02

3.1.2 4-axis T-scanner motion controller – T-Scanner motion controller is a standard 4-axis controller with built-in PCU. The front panel of controller enables manual operation by means of an operating axis selector, display axis selector, motor speed and direction control knob. In the controller, the T-scanner axes are designated as:

Axis-01	X-axis
Axis-02	Y-axis
Axis-03	Z-axis
Axis-04	Roll-axis

Table-03: 4-axis T-Scanner motion controller Specifications –

Sr. No.	**Description**	**Specification**
01	No. of Axis to be controlled	All four axes as shown in 3.1.2
02	Axis Configurability	All the four axes are simultaneous / sequentially selectable as per user defined measurement configuration.

Sr. No.	Description	Specification
03	Input Power Supply	Single Phase, 230 Volts AC 50 Hz ±10 % as per Indian standard
04	Motor Details of Axis-01, 02, 03 & 04	DC servo Motors, Voltage Range: 80 – 115 Volt DC, Bi-directional
05	Encoder Details of Axis- 01, 02, 03 & 04	Relative encoder En-DAT Protocol
06	Software limit for all 04 axes	Available

Table-04: 4-axis T-Scanner motion controller Front Panel Specifications –

Sr. No.	Feature	Specifications
1	E-STOP (Emergency Stop)	Latching Emergency Stop Panic-Switch opens the motor Armature Common circuit.
2	Control and Display Window	Segmented LED Display resolution 0.001° (Angular) or 0.001mm (Linear), selectable as per axis.
3	Axis Selection	Axis-1 to Axis-4 is selected via multi position switch/knob as per selected control axis
4	Limit Switch Indicator	LED indication when the active axis reaches the limit of the corresponding direction. CW (forward) or CCW (reverse)
5	Speed & Direction Control	Dual Function Knob/Potentiometer to provide manual velocity control for both Reverse or Forward direction control
6	Panel/Bus (local/remote) Select	Latching Illuminated Pushbutton Switch. Selects either computer control or front panel Control.
7	Power On/ Off Switch	AC Input Power ON/OFF. Illuminated when Unit is Power ON.
8	Dimensions	Compatible for (19”) standard rack maximum 4U chassis, Single Box Solution

Table-05: 4-axis T-Scanner motion controller Rear Panel Interfaces Specifications –

Sr. No.	Feature	Type of Connector
1	Axis-1	MS3474W16-26S Nut Receptacle Panel Connector
2	Axis-2	
3	Axis-3	
4	Axis-4	
5	Local Control Unit	MS3102E-20-29SW
6	E-Stop	JMS 3476W10-6P
7	Trigger Out	BNC (5V trigger pulse)
8	Trigger In	BNC (5V trigger pulse)
9	LAN/CAN	LAN or CAN for programming configuration as well as communication
10	Power Point	3-pin Power point
11	Interlocking	MS3470L10-6S

3.2 Four (4) – axis DUT Positioning System

3.2.1 4-axis DUT Positioner – DUT Positioner is a standard 4-axis positioner having 3-rotational axes and 1-linear axis.

Table-06: Technical specification related to DUT-Positioner

Parameter		**Unit**	**Specifications**
No of axis		04	
Type of Positioner		Roll / Elevation / Azimuth + Linear Slide	
Delivered Torque	Polarization Axis	Kg-m	390
	Elevation Axis	Kg-m	1500
	Azimuth Axis	Kg-m	390
Withstand Torque (Max. DUT weight 200 kg)	Polarization Axis	Kg-m	580
	Elevation Axis	Kg-m	2250
	Azimuth Axis	Kg-m	580
Turntable Diameter		mm	625 mm
Drive Power	Polarization Axis	hp	3/4
	Elevation Axis	hp	3/4
	Azimuth Axis	hp	3/4
	Linear Slide Axis	hp	1/3
Maximum Speed	Polarization Axis	deg/sec	3.0 (0.5 rpm)
	Elevation Axis	deg/sec	0.33 (40^o/min)
	Azimuth Axis	deg/sec	3.0 (0.5 rpm)
	Linear Slide Axis	mm/sec	125
Minimum Speed	Polarization Axis	deg/sec	0.05
	Elevation Axis	deg/sec	0.05
	Azimuth Axis	deg/sec	0.05
	Linear Slide Axis	mm/sec	20
Position Accuracy	Polarization Axis	deg	0.03
	Elevation Axis	deg	0.03
	Azimuth Axis	deg	0.03
	Linear Slide Axis	mm	0.05
Repeatability	Polarization Axis	deg	0.02
	Elevation Axis	deg	0.02
	Azimuth Axis	deg	0.02
	Linear Slide Axis	mm	0.05
Travel Range	Polarization Axis	deg	360^o
	Elevation Axis	deg	-25^o to $+92^o$
	Azimuth Axis	deg	$\pm 200^o$
	Linear Slide Axis	m	± 1.0
Vertical Load	Polarization Axis	kg	1000
	Azimuth Axis	kg	5000
	Linear Slide Axis	kg	2000
Bending Moment	El = 0deg Axis	kg-m	1500

Parameter		Unit	Specifications
	El = 980deg Axis	kg-m	2250
Maximum Backlash	Polarization Axis	deg	0.05
	Elevation Axis	deg	0.05
	Azimuth Axis	deg	0.05
Electromechanical Brakes		In all 03 axes	
Encoder Type	Polarization Axis	Incremental encoders	
	Elevation Axis		
	Azimuth Axis		
	Linear Slide Axis		

Table-07: Technical specifications related to DUT-Positioner axis alignments

Parameters	Unit	Specifications
Parallelism of DUT Roll axis with T-scanner Z-axis	deg	± 0.02
Parallelism of DUT Azimuth axis with DUT Roll axis	deg	± 0.02
Orthogonality between DUT Linear slide axis and DUT azimuth axis	deg	± 0.1
Orthogonality between DUT Azimuth and DUT Elevation axis	deg	± 0.1
Orthogonality between DUT Elevation and DUT Roll axis	deg	± 0.1

3.2.2 4-axis DUT Positioner motion controller – DUT- Positioner motion controller is a standard 4-axis controller with built-in PCU. The front panel of the controller enables operation by means of an operating axis selector, display axis selector, motor speed and direction control knob. In the controller, the DUT Positioner axes are designated as:

Axis-01	Azimuth axis
Axis-02	Elevation axis
Axis-03	DUT Roll axis
Axis-04	DUT Linear Slide axis

Table-08: 4-axis DUT-Positioner motion controller Specifications –

Sr. No.	Description	Specification
01	No. of Axis to be controlled	All four axes as shown in 3.2.2
02	Axis Configurability	All the four axes are simultaneous / sequentially selectable as per user defined measurement configuration
03	Input Power Supply	Single Phase, 230 Volts AC 50 Hz ±10 % as per Indian standard
04	Motor Details of Axis-01, 02, 03 & 04	DC servo Motors, Voltage Range: 80 – 115 Volt DC, Bi-directional
05	Encoder Details of Axis-01, 02, 03, 04	Relative Encoders
06	Software limit for all 04 axis	Available
07	Electromechanical Braking for all 04 axis	Available

Table-09: 4-axis DUT-Positioner motion controller Front Panel Specifications –

Sr. No.	Feature	Specifications
1	E-STOP (Emergency Stop)	Latching Emergency Stop Panic-Switch opens the motor Armature Common circuit.
2	Control and Display Window	Segmented LED Display resolution 0.001° (Angular) or 0.001mm (Linear), selectable as per axis.
3	Axis Selection	Axis-1 to Axis-4 is selected via multi position switch/knob as per selected control axis
4	Limit Switch Indicator	LED indication when the active axis reaches the limit of the corresponding direction. CW (forward) or CCW (reverse)
5	Speed & Direction Control	Dual Function Knob/Potentiometer to provide manual velocity control for both Reverse or Forward direction control
6	Panel/Bus (local/remote) Select	Latching Illuminated Pushbutton Switch. Selects either computer control or front panel Control.
7	Power On/ Off Switch	AC Input Power ON/OFF. Illuminated when Unit is Power ON.
8	Dimensions	Compatible for (19”) standard rack maximum 4U chassis, Single Box Solution

Table-10: 4-axis DUT-Positioner motion controller Rear Panel Interfaces Specifications –

Sr. No.	Feature	Type of Connector
1	Axis-1	MS3474W16-26S Nut Receptacle Panel Connector
2	Axis-2	
3	Axis-3	
4	Axis-4	
5	Local Control Unit	MS3102E-20-29SW
6	E-Stop	JMS 3476W10-6P
7	Trigger Out	BNC (5V trigger pulse)
8	Trigger In	BNC (5V trigger pulse)
9	LAN/CAN	LAN or CAN for programming configuration as well as communication
10	Power Point	3-pin Power point
11	Interlocking	MS3470L10-6S

3.3 Automated test configuration and Data acquisition software

The Automated test configuration and Data acquisition software is developed using low-level language.

Sr. No.	Description	Specification
01	Number of Modules	Data Acquisition Software has three modules namely: 1. Data Acquisition Module 2. Data Analysis Module 3. Data Presentation Module
02	Data Acquisition Module	Data Acquisition module has the following functions– 1. Automatic Scan setup, Computation and optimization of scan parameters. 2. CW, List and Sweep frequency mode measurements. 3. Amplitude and phase data acquisition. 4. Continuous and step mode. 5. Unidirectional & Bidirectional mode. 6. Switch, multiple-channels and multiple-beams control. 7. Provision of Pause and Resume measurement control. 8. **System Configuration save/recall –** Saving of last System Configuration file and recalling any Configuration file saved earlier. Configuration file generally contains– Project & antenna details, frequencies, channel and/or beam definition, transmit power of RF & LO sources, communication details (like IP address), positioner configuration details (free speed, scan speed, acceleration, deceleration etc.). 9. **Real time display –** Amplitude and Phase raw data should be displayed on the screen (intensity plot) in real time to indicate the degree of completion. It should display the scan, step axis range and current position, frequency, quantity that is to be measured, file name etc. (the measurement definition summary). 10. **Parameters overview –** Measurement Parameters overview for main parameters shall be displayed on screen for quick check of all set parameters before measurement starts.
03	Data Analysis Module	Data Analysis/ processing module has the following Functions – 1. Measured raw data files should include the following options– Transformation, Back-projection, Various systematic error correction 2. X/Y/Φ radiation pattern cuts for co and cross polarisation for amplitude and phase. 3. Co and Cross-radiation pattern, Gain, Directivity, Beam pointing. 4. Beam peak, Beamwidth, Side lobes, Null depth with their location. 5. Cross-polar level and Cross-polar isolation etc. 6. Axial ratio (AR) and AR pattern. 7. Phase centre position prediction from measured data. 8. Normalization of data to value and peak.

Sr. No.	Description	Specification
		9. Data conversion and export to ASCII format / Excel format or TICRA compatible format (*.grd & *.cut).
04	Data Presentation Module	Data Presentation module should have following functions – 1. 2D / 3D Plotting options. 2. Cartesian, Intensity, polar, contour, 3D plotting features. 3. Grey scale / Pseudo colour plotting. 4. Flexible plot annotation feature. 5. **Markers / Pointers –** Marker facility (minimum seven) on both sides of plots, Data cursor mode, Zooming, Panning, Cross-hair cursor etc. 6. **Data Import / Export options –** Facility to export plots to *.jpeg, *.bmp, *.png, *.tiff etc. formats.

4. Details of Parts/Components used in Positioning System

4.1 Drive Parts/Components list of 4-axis inverted T-Scanner –

Sr No.	Axis Details	Part	Detailed Specification
1.1	Linear X-axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Callan Technology Make, Tacho 7.0V 4.07Nm, 115 Vdc 11.3 Adc 3000 rpm
1.2		Encoder	FENAC Make, FNC 58B 10630V5000-R5, PPR – 5000 VCC – 5-30V dc, Sr No: 86909D21RDEA446, Turkish Made
1.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 75E3UCH2F, No: 1061000903001/01, (Lubricated by Mobil)
1.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
1.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
1.6		LM Guide ways	LM Hiwin Guideways & Blocks HR45
1.7		Rack & Pinion	Gudel Rack & Pinion Module 5
1.8		Panel Connector	MS3474W16-26S
1.9		Connector for end-1	MS3476W16-26P
1.10		Connector for end-2	MS3476W16-26P
2.1	Linear Y-axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2006D-YY001-142, Callan Technology Make, Sr No: 211129526, Tacho 7.0V 1.6Nm, 115 Vdc 2.8 Adc 2000 rpm
2.2		Encoder	BTH Incremental Rotary Encoder, Model: BI-38H8-2000-L5, Supply: 5V DC Line Driver 2000 PPR
2.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 45E30CH2F, No: 106-1000603002/01 (Lubricated by Mobil)
2.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
2.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
2.6		LM Guide ways	LM Hiwin Guideways & Blocks HR45
2.7		Rack & Pinion	Gudel Rack & Pinion Module 5
2.8		Panel Connector	MS3474W16-26S

Sr No.	Axis Details	Part	Detailed Specification
2.9		Connector for end-1	MS3476W16-26P
2.10		Connector for end-2	MS3476W16-26P
3.1	Linear Z-axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2006D-YY001-142, Sr No: 211129525, Tacho 7.0V 1.6Nm, 115 Vdc 2.8 Adc 2000 rpm, Callan Technology Make
3.2		Encoder	Autonics (Rotary Encoder), Model: E4056-2000-6-L-5 5V dc ± 5%, Lot No. VG08R Made in Korea
3.3		Ball Screw	C3 Precession class Hardened and ground Pitch 5 mm & Diameter 30 mm
3.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
3.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
3.6		LM Guide ways	LM Hiwin Guideways & Blocks HR45
3.7		Ball Screw	PMI 25 x 1000 mm
3.8		Panel Connector	MS3474W16-26S
3.9		Connector for end-1	MS3476W16-26P
3.10		Connector for end-2	MS3476W16-26P
4.1	Roll axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2006D-YY001-142, Sr No: 211129527, Tacho 7.0V 1.6Nm 115 Vdc 2.8 Adc 2000 rpm, Callan Technology Make
4.2		Encoder	BTH Incremental Rotary Encoder, Model: BI-38H8-2000-L5, Supply: 5V DC Line Driver 2000 PPR
4.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 45E30CH2F, No: 106-1000903002/02 (Lubricated by Mobil)
4.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
4.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
4.6		Bearing	SKF make bearing SKF-01
4.7		Panel Connector	MS3474W16-26S
4.8		Connector for end-1	MS3476W16-26P
4.9		Connector for end-2	MS3476W16-26P
5.1		Grease For bearing	Kubler
5.2		Electrical panel wiring	Schneider

Sr No.	Axis Details	Part	Detailed Specification
5.3		Timing Belts	Fenner make

4.2 Drive Parts/Components list of 4-axis T-Scanner motion controller –

Sr No.	Axis Details	Part	Detailed Specification
1.1	Linear X-axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
1.2		SMPS	Siemens Make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
1.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
1.4		Bias Control	Balluff Switch with relay (for Limits)
1.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
1.6		Panel Connector	Amphenol Make MS3474W16-26S
2.1	Linear Y-axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
2.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
2.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
2.4		Bias Control	Balluff Switch with relay (for Limits)
2.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
2.6		Panel Connector	Amphenol Make MS3474W16-26S
3.1	Linear Z-axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
3.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
3.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
3.4		Bias Control	Balluff Switch with relay (for Limits)
3.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
3.6		Panel Connector	Amphenol Make MS3474W16-26S
4.1	Roll axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
4.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
4.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B

Sr No.	Axis Details	Part	Detailed Specification
4.4		Bias Control	Balluff Switch with relay (for Limits)
4.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
4.6		Panel Connector	Amphenol Make MS3474W16-26S
5.1	Other components of T-Scanner Motion Controller	Linear Fast Switching DIO	Lenze Make, Fast Switching Module Part No. El21-24-0010 Galvanic isolated
5.2		Remote IO	Beckhoff Make Part No. Ek1101-0090 Remote Bus Station ID-Switch
5.3		SMPS	Siemens Make Control Power Supply 24/12/5 V DC 10 Amp
5.4		Siemens	Power Filter unit Meanwell for Trigger pulse
5.5		Relay Board	Brake unit for Servo motor Schneider Electric PM-01
5.6		Panel Connector	Amphenol MS3102E20-29SW (LCU Interface)
5.7		Remote IO	Beckhoff Make (custom) Encoder Interface unit for E-bus
5.8		Remote IO	Tacho Feedback unit for 0-10 volt analog in El3xxx
5.9		Relay	Relay Card Siemens Make 220 volt / 5 Amp
5.10		Power Contactor	Schneider Make Part No. Sc10 Power Contactor
5.11		RTOS	Linx Make RT License for Motion controller
5.12		Driver File	DLL for Ethercat Bus to support various hardware (Custom made by OEM)
5.13		Push Buttons	Schneider Make standard
5.14		Potentiometer Knob	Takushi Make

4.3 Drive Parts/Components list of 4-axis DUT-Positioner –

Sr No.	Axis Details	Part	Detailed Specification
1.1	Azimuth axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Sr No: 211129531, Tacho 7.0V 4.07Nm 115 Vdc 11.3 Adc 3000 rpm, Callan Technology Make
1.2		Encoder	FENAC, FNC 58B 10630V5000-R5, PPR – 2000 VCC – 5-30V dc, Sr No: 86904L21AC015, Turkish Made
1.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 75M60CRU1, No: 1168123403/01 (Lubricated by Mobil)
1.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
1.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-

Sr No.	Axis Details	Part	Detailed Specification
			240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
1.6		Bearing	SKF make bearing SKF 816 dia
1.7		Panel Connector	MS3474W16-26S
1.8		Connector for end-1	MS3476W16-26P
1.9		Connector for end-2	MS3476W16-26P
1.10		Brake	Electromechanical Brakes, sure stop Matrix International
2.1	Elevation axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Sr No: 211129532, Tacho 7.0V 4.07Nm 115 Vdc 11.3 Adc 3000 rpm, Callan Technology Make
2.2		Encoder	BTH Incremental Rotary Encoder, Model: BI-38H8-2000-L5, Supply: 5V DC Line Driver 2000 PPR
2.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 75M60CRU1, No: 1168123403/01 (Lubricated by Mobil)
2.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
2.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
2.6		Bearing	SKF make bearing SKF 414 dia external teeth
2.7		Panel Connector	MS3474W16-26S
2.8		Connector for end-1	MS3476W16-26P
2.9		Connector for end-2	MS3476W16-26P
2.10		Brake	Electromechanical Brakes, sure stop Matrix International
3.1	Polarization axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Sr No: 211129529, Tacho 7.0V 4.07Nm 115 Vdc 11.3 Adc 3000 rpm, Callan Technology make
3.2		Encoder	FENAC, FNC 58B 10630V5000-R5, PPR – 2000 VCC – 5-30V dc, Sr No: 86904L21AC018, Turkish Made
3.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 90E90CH2F, No: 1061000068102/01, (Lubricated by Mobil)
3.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-

Sr No.	Axis Details	Part	Detailed Specification
			240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
3.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
3.6		Bearing	SKF make bearing SKF 544 dia internal teeth
3.7		Panel Connector	MS3474W16-26S
3.8		Connector for end-1	MS3476W16-26P
3.9		Connector for end-2	MS3476W16-26P
3.10		Brake	Electromechanical Brakes, sure stop Matrix International
4.1	Linear Slide-axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Sr No: 211129530, Tacho 7.0V 4.07Nm 115 Vdc 11.3 Adc 3000 rpm, Callan Technology make
4.2		Encoder	FENAC, FNC 58B 10630V5000-R5, PPR – 5000 VCC – 5-30V dc, Sr No: 86919J21NA450, Turkish Made
4.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 80E80CH1F, No: 1061000068101/01, (Lubricated by Mobil)
4.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
4.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
4.6		LM Guide ways	LM Hiwin Guideways & Blocks HR45
4.7		Ball Screw	PMI 25 x 1000 mm
4.8		Panel Connector	MS3474W16-26S
4.9		Connector for end-1	MS3476W16-26P
4.10		Connector for end-2	MS3476W16-26P
5.1		Grease For bearing	Kubler
5.2		Electrical wiring	Schneider
5.3		Timing Belts	Fenner make
5.4		Lubrication system	cenlub

4.4 Drive Parts/Components list of 4-axis DUT-Positioner motion controller –

Sr No.	Axis Details	Part	Detailed Specification
1.1	Azimuth axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
1.2		SMPS	Siemens Make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
1.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
1.4		Bias Control	Balluff Switch with relay (for Limits)
1.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
1.6		Panel Connector	Amphenol Make MS3474W16-26S
2.1	Elevation axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
2.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
2.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
2.4		Bias Control	Balluff Switch with relay (for Limits)
2.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
2.6		Panel Connector	Amphenol Make MS3474W16-26S
3.1	Polarization axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
3.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
3.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
3.4		Bias Control	Balluff Switch with relay (for Limits)
3.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
3.6		Panel Connector	Amphenol Make MS3474W16-26S
4.1	Linear Slide-axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
4.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
4.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
4.4		Bias Control	Balluff Switch with relay (for Limits)
4.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
4.6		Panel Connector	Amphenol Make MS3474W16-26S

Sr No.	Axis Details	Part	Detailed Specification
5.1	Other components of DUT-Positioner Motion Controller	Linear Fast Switching DIO	Lenze Make, Fast Switching Module Part No. El21-24-0010 Galvanic isolated
5.2		Remote IO	Beckhoff Make Part No. Ek1101-0090 Remote Bus Station ID-Switch
5.3		SMPS	Siemens Make Control Power Supply 24/12/5 V DC 10 Amp
5.4		Siemens	Power Filter unit Meanwell for Trigger pulse
5.5		Relay Board	Brake unit for Servo motor Schneider Electric PM-01
5.6		Panel Connector	Amphenol MS3102E20-29SW (LCU Interface)
5.7		Remote IO	Beckhoff Make (custom) Encoder Interface unit for E-bus
5.8		Remote IO	Tacho Feedback unit for 0-10 volt analog in El3xxx
5.9		Relay	Relay Card Siemens Make 220 volt / 5 Amp
5.10		Power Contactor	Schneider Make Part No. Sc10 Power Contactor
5.11		RTOS	Linx Make RT License for Motion controller
5.12		Driver File	DLL for Ethercat Bus to support various hardware (Custom made by OEM)
5.13		Push Buttons	Schneider Make standard
5.14		Potentiometer Knob	Tosoku Make

5. Scope of Work

Following is the scope of work, which includes need-based **PREVENTIVE MAINTENANCE**, **BREAKDOWN MAINTENANCE** & **CALIBRATION WORK** and **SPARE PARTS** delivery at NFTR/SAC. The response time for Preventive maintenance /Breakdown maintenance/ Calibration work shall be at most 72 hours (considering working days only) from the day of call or complaint.

5.1 PREVENTIVE MAINTENANCE – Need based

A. Visual Inspection, exterior and interior cleaning, lubrication and adjustment/tuning of axis motion, if needed. Visual Inspection of the electrical and mechanical components, encoder and limit switch check, motors and gear box inspection, counterweight balancing and adjustments, positioners inspection and verifications for smooth operation, including speed test.
B. Visual Inspection, exterior and interior of motion controller. Adjustment / Tuning of axis motion through optimizing the PID parameter in control software.
C. Motion control verification for all 08 axes of 02 different positioners as per **FITP** (**F**unctional **I**nspection **T**est **P**lan).
D. Inspect painted and unpainted surface. If corrosion or damaged paint is discovered, then use steel brush/scotch to clean damaged paint and apply rich zinc epoxy paint 50-60 µm layer thickness and Jotun brand green top dual coat of 50 micron.
E. System safe operation verification for all positioners.
F. Inspection of system cabling and connectors.

Contractor has to provide the plan document related to preventive maintenance and servicing and should carry out the work in accordance to the same. Preventive maintenance work will involve checking and monitoring all the points as per the **FITP**. During the preventive maintenance schedule if any fault is find in positioning system then contractor should take the suitable steps to correct the trouble and bring the system in smooth functioning state.

5.2 BREAKDOWN MAINTENANCE - Breakdown maintenance work will involve trouble shooting of mechanical, electrical, electronic or any other system of the positioning system and solution of any other problem pointed out by SAC engineer, which inhibits the smooth operation and efficiency of the unit. Maintenance / Service engineers should come along with all the necessary tools and instruments in order to eliminate undue delay during the course of breakdown maintenance work.

A. Response time for failure analysis during AMC: After the complaint, the time between the arrival of the technical support personnel and proposal for remedial action shall not exceed 07 working days.
B. Repair time: The time between receipt of written proposal for remedial action and the ability to return the system to a working state shall be less than 14 working days excluding the time required to procure and supply the necessary part(s) at SAC.
C. Immediate online support (telephone, e-mail and internet) shall be provided when required.
D. Vendor should provide the price of all spare parts along with price validity of minimum 03 years with the offer in the prescribed format as given in Annexure-I.

E. Vendor should have their efficient mechanism for arrangement and procurement of branded and genuine spares/components through reputed dealers/stockiest/distributors, available in the market. Responsibility to ensure and endorse the reliability, trueness and legality with regard to source and method of procurement and supply of said items is entirely rest on the Vendor and subject of Vendor. SAC will not be responsible by any way, interfere in any matter or have concern by any means, during said process of procurement, arrangement and supply. Furnishing the details and confirmation in writing in these regards must be attached by the Vendor along with the offer.

F. Contractor will be called for breakdown maintenance visit at SAC and it is his responsibility to manage required spares to operationalize the positioners.

G. Maintenance / services visit charges for above mentioned categories of maintenance under this contract should include; Lump sum amount for service / maintenance charges, to and fro travel charges, lodging, boarding, local conveyance and excess baggage.

5.3 Calibration Work – For calibration work

A. Vendor will arrange all necessary calibration instrumentation.
B. Vendor will arrange all necessary logistic support during calibration activity.
C. Calibration activity of 02 different positioners will perform as per **CTP** (**C**alibration **T**est **P**lan).

5.4 Repair Work–

A. If any component of the positioner is repairable, in such case Contractor has to take prior approval from the SAC official to take the component to their premises for repairing.
B. It is responsibility of Contractor to arrange the collection of defective items for repairing from SAC and safely return to SAC free of charge.
C. After diagnosis, Contractor has to submit the quote and it has to be approved by SAC official.
D. Once SAC official approves the quotation, Contractor may start repairing work of the same. After repair contractor has to give warranty of at least 6 months in any kind of repairs. If the same problem occurs within the warranty period, Contractor has to repair it on their own without any additional charges.
E. Vendor has to furnish **bank guarantee** against the safety and security of the faulty component, which is to be collected and repaired at their premises by the vendor. The value of the said **bank guarantee** will be decided by SAC, based on cost of the component, which is to be repaired. The said **bank guarantee** will only be released after the receipt of the collected component in functional condition to SAC.

5.5 Supply of Spare Parts - The spare parts / components required at the time of maintenance shall be provided by SAC if available in stock. In case the spare parts are to be replaced by contractor, the charges for the same shall be paid extra at actual by SAC.

Contractor must refer the list (Annexure-I) of spare parts / components for commercial offer valid till the end of contract and should agree in writing while giving quotation, for supplying all spares of system listed in Annexure-I.

However, contractor should add items/spares, which they feel necessary for the said breakdown maintenance work. Payment shall be made accordingly if spare parts / components are replaced from list of Annexure-I by Contractor from their stock during Breakdown / Preventive maintenance of the said system.

In case the spare parts / components are to be replaced which are not in the list of Annexure-I, the charges for the same shall be paid at actual by SAC. In addition, category in which the above-referred spare parts/component will fall, be decided by the SAC official. Contractor shall take prior approval from SAC Officials / Division Head / General Manager / Group Director in such case. After completion of maintenance / service work service person of the contractor has to demonstrate the positioners in working condition for breakdown maintenance work he has carried out against the particular breakdown calls and provide the maintenance / service report prepared by him.

In general, following are two categories of spares (as indicated in the List of Annexure-I) may be needed during Preventive, repair and Breakdown maintenance work of the machines:

- **Minor**/ wear & tear or consumable spares: Spares of this category should be arranged in two to three days (excluding Sundays & public holidays) beyond this time limit it should be considered to be delayed delivery of items.
- **Major**/ breakdown Spares: Spares of this category should be arranged in ten to twelve days (excluding Sundays & public holidays) beyond this time limit it should be considered delayed delivery of items.

However, reasons for delay and non-availability of the spares and its genuineness of the situation will be reviewed by SAC official in order to rationalize the above said terms, case to case. However, decision in this regard shall entirely under discretion of SAC official and final, Vendor should abide to the same.

5.6 After completion of maintenance/service/repair work service person of the contractor has to demonstrate the positioner in full working condition and provide the maintenance/service report prepaid by him. However, please note that if subsequent to above work, calibration work is felt needed then the vendor should carry out calibration work to validate the positioning system.

Following table have the detailed scope of work related to every activity to finish the breakdown maintenance, preventive maintenance, repair maintenance and calibration of DUT Positioner and T - Scanners installed at NFTR/SAC.

Sr. No.	Type of work	Frequency	Quantum of work/ Scope of work
1	Breakdown Service visit	as and when required	Service includes: fault diagnosis, functional inspection, dismantling, part replacement, tuning of motion, motion verification, assembly and final test
2			Service includes functional inspection

Sr. No.	Type of work	Frequency	Quantum of work/ Scope of work
	Calibration visit	Once in a year or as and when required	Laser alignment activity includes instrument and technical support staff
			Tuning of motion if required
3	Preventive maintenance visit	Max. Four times in year as and when required	Service includes: functional inspection, cleaning of mechanical parts, greasing and oiling, verification of electrical and control wiring, change the oil seals, Complete visual inspection of positioner, full motion verification with full load and no load condition
4	Spare Parts	as and when required	Identify the spare requirement, procurement and supply of the same to SAC
5	Logistic Support	as and when required	Decide the suitable equipment and arrange the same at SAC.

Promptness for respond: Contractor will have to attend the breakdown calls within **72 hours** after receipt of the calls through telephone / e-mail / fax, excluding the day of communication from SAC officials.

Prior approval: Contractor will have to inform & take prior approval from the SAC official regarding the names with mobile number or other personal required details of visiting service engineers and details of items carrying by them into the SAC campus.

6. Payment Terms:

6.1 Payment of Visit Charges for Breakdown / Preventive / Calibration / Repair work –
Payment will be made on successful completion of each Preventive work and for Calibration /Breakdown /Repair work; it will be paid after successful completion, testing and validation activities. The invoice in duplicate duly certified by the user and approved by Dy. Head/Head of the Division along with Job Completion Voucher (JCV), to the effect that the positioner / system is maintained / serviced satisfactorily, shall be submitted to Accounts Officer, Bills, SAC for releasing payment. Since this is a maintenance service contract no MIRVs will be issued for payment of service charges but End User has to provide satisfactory Job Completion Voucher (JCV) with contractor's invoice to Accounts with the approval of Dy. Head/Head of the Division.

6.2 Payment for Supply of Spares and Consumables –
Spares / components / consumables to be required at the time of servicing / maintenance of the positioner, shall be replaced with prior approval from the SAC Engineer / Division Head/ Group Director. Payment will be made based on original invoice along with the end user certificate duly approved by Head of the Division, that the charges of the spares are reasonable. The worn out / retrieved parts shall be SAC property.

6.3 Payment for Repairing of Positioner Components at Contractors Premises –
Contractor may take defective positioner components, electronics cards, motors, timers, drive and other items fitted in the Positioner to their premises after prior approval from concerned SAC Engineer / Division Head/ Group Director for repairing and charges for the same will be paid extra by SAC. Contractor would submit the estimated repair charges indicating warranty of such repaired/new parts replaced during repairing before starting the repairing work of such parts. Payment will be made after assembly of the repaired parts/spares with the positioner and demonstration of positioner in full working condition. Submission of invoices along with the end user certificate duly approved by Head of the Division that the repairing charges are reasonable is necessary.

It is responsibility of Contractor to arrange the collection of defective items for repairing from SAC and safely return to SAC free of charge.

6.4 Penalty of Rupees 5% of total visit charges per visit shall be deducted in case of delay in response by the contractor beyond 72 hours, excluding the day of communication from SAC officials, seeking the service engineer visit to SAC Ahmadabad. If the total delay in response is beyond Five days from date of communication, penalty of 10% of the visit charges shall be deducted for relevant visit for that particular complaint.

Penalty of Rupees 5% of basic cost of the spare shall be deducted in case of delay in delivery beyond the specified time limit as categorized in section 3.5 & tabulated in Annexure-I.

Penalty of Rupees 10% of visit charges shall be deducted in case of event, where contractor is not able to offer the system in full operational condition within 14 days from the receipt of written proposal for remedial action. This 14 days duration, will include repairing work at vendors facility/factory and testing

& validation time at SAC but excluding the time required to procure and supply the necessary part(s) at SAC.

However, reasons for delay, non- availability of service engineer/spare for maintenance/repair service and genuineness of the situation for such delay, will be reviewed by SAC officials in order to rationalize the above said terms, case to case. However, decision in this regard shall entirely under discretion of SAC officials and final, Contractor should abide by the same.

7. Duration of the Contract:

The contract will be awarded for a period of **36 months** from the date of the contract. The contract may be extended for **further 12 months with last same rates based on satisfactory services** of the Contractor and on mutual consent of both the parties, with same rates and terms and conditions. However, there is no guarantee of any extension or renewal of the contract after expiry of the initial 36 months.

7.1 Monitoring of Contract – SAC reserves the right to review and verify the progress of work at various stages / any time during the positioner maintenance work and adherence by the Contractor to the standards and procedures specified.

7.2 Termination of Contract – SAC reserves the right to terminate the contract if the performance / services of the contractor is not found satisfactory during the period of the contract, by giving one-month notice in writing without any financial implications on either side. SAC reserves the right to enter into parallel contract simultaneously or at any point of time during the period of the said contract with one or more contractors.

8. General Terms & Conditions:

1. Contractor must have suitable facilities like maintenance and calibration kit specifically required for repairing the positioner and must possess all the equipment / tools required at the time of breakdown / preventive maintenance work to be carried-out at SAC for the above positioner.
2. Contractor must have suitable workforce having expertise in Linux and C/C++, to update or modify the PID parameters through the programming software. Contractor can also collaborate with 3rd part having expertise in Linux and C/C++ based motion controller programming.
3. The Contractor's personnel will not be allowed entry into any building or laboratory in SAC other than those specified.
4. The personnel deployed should follow the general guidelines/ rules and work practices of the SAC while working at facility. He should also maintain the office discipline/ decorum during the duty hours at SAC.
5. However, along with the offer, contractor should communicate the name of the authorized person and the name of the service persons along with full communication details like; land line numbers of the office, mobile numbers of the said persons, e-mails and any other communication channel established by the company in order to make efficient communication.
6. The contractor shall be responsible to ensure the credentials of individuals deputed on job under the contract from the security point of view.
7. Vendor has to provide point-by-point compliance as per Annexure-IV.
8. The contract will be valid for a period of three years from the date of issuing the purchase order and can be further extended for maximum upto 01 year from the date of expiry of the current contract.
9. Vendor should deploy competent work force to execute such contract including graduate engineers having degree in Mechanical, Electrical or Mechatronics branch. Any loss, damage or breakage of the system or any loss to the SAC property, directly or indirectly linked to the mishandling or lack of knowledge by the vendor during the preventive maintenance or breakdown call shall be recovered from the vendor.
10. The vendor shall arrange all the required materials including cotton cloth, grease, oil, tools, forklift, crane etc. for carrying out preventive maintenance and attending breakdown calls.
11. Vendor shall carry out maintenance work on a mutually agreed time slot in every quarter.
12. The Vendor shall have to maintain a logbook recording details of the servicing work carried at SAC including replacement of parts, if any and fill the preventive maintenance checklist as specified in Table of Annexure-II.
13. Vendor shall be responsible to maintain the positioning system in good working condition.
14. In case spare part/s is/are not available with SAC, the same will be procured by the Vendor to make the system in working condition. SAC will reimburse cost of such spare part supplied by the Vendor against the bill. The requirements of part/s with cost is to be intimated in advance to SAC and the Vendor should obtain written concurrence before procuring the parts.
15. Only new components are to be supplied as and when required.
16. L1 will be decided based on the overall quoted prices of Preventive maintenance, Calibration and Breakdown. Vendor shall quote separately for AMC and components/parts as per Annexure-I in defined format for price bid.
17. Material handling equipment like Cranes, Forklift truck, etc. has to be arranged by the vendor as and when require.

18. Hydra operator must have accompanied with trained rigger.
19. Vendor should carry valid RTO documents for Hydra and other automobile mounted lifting equipment.
20. Form 10 with dates of validity, ensuring safety inspection of equipment including detail report of inspection carried out at the time of issuance of Form 10.
21. Driving license and training validity certificate of Hydra operator.
22. SAC will not be responsible for injury to vendor's personnel during material handling, dis-assembly, assembly or any other work.
23. Utmost care should be taken by your service persons while carrying out the job and ensure the safety of neighbouring instrument or whatsoever of SAC property.
24. Generally, the maintenance work will be carried out during normal working days (i.e. Monday to Friday) between 9.30 to 18.00 hours, unless otherwise mutually agreed upon to some other time schedule.
25. **INTELLECTUAL PROPERTY RIGHTS & CONFIDENTIALITY:** The Contractor shall not use technical information, reports and other related documents given by SAC during the course of his work for any purpose other than for carrying out the work under Contract to be finalized under this RFP.
26. **COVERAGE / RISK OF THE DEPLOYED SERVICE PERSONS:** Contractor is fully responsible for the safety of his service persons deployed at SAC. The contractor will be entirely held responsible in case of any accident, which leads to minor or major physical injury and loss of life of his personnel during the time of execution of contract at our premises due to natural calamities / accident explosion etc. if any.
27. SAC is not responsible for any kind of accident to the persons deployed by contractor and no provision has been made to provide any financial assistance / any kind of compensation or cost incurred in connection with such kind of incidence.
28. **SECURITY:** Contractor shall produce the identity certificate / card which reveals the details like name of the personnel deployed, his date of birth, etc. with duly signed by the person deployed for the work. However, contractor should be ready for any other formalities, which may be required by competent authority of the SAC at the time of finalization of contract and it should be complied.
29. **ARBITRATION:** Dispute, if any, shall be settled mutually, failing which it shall be referred to a one-man Arbitrator appointed by the Director, SAC Ahmedabad in accordance with Arbitration Act 1996, whose decision shall be final and binding on both the parties.
30. **FALL CLAUSE:** The rates charged by the vendor for the work, shall in no event exceed the lowest rates charged for the work of identical description, to any other party during the validity of the agreed rates. If, at any time during the said period, the Vendor reduces the rates for the work to any other party, he shall forthwith notify such reduction of rates applicable to the undersigned and the rates payable under this contract for the work shall stand correspondingly reduced.

Vendor must perform functional inspection in presence of NFTR engineer and submit the inspection report duly signed by facility In-charge/engineer in the form of printed hard copy

Annexure-I: Price Bid Format

Sr. No	Type of work	Frequency	Quantum of work/ Scope of work	Unit Price valid up to 3 Years	Remarks
1	Breakdown Service visit	as and when require	Service charges per day (including required person for fault diagnosis, functional inspection, dismantling, part replacement, tuning of motion, motion verification, assembly and final test) (Definition of unit = per days)		Definition of Unit Price: per day Though it is per day, the no. of days that will be consumed for breakdown service, will be decided jointly by SAC and Vendor
2	Calibration visit	Max. Once in a year (as and when require)	Service charges includes functional inspection laser alignment activity charges includes instrument and support staff tuning of motion charges if required		Definition of Unit Price: per visit Service charges for calibration visit for two days will be quoted as a lump sum price and will be considered as a unit price for that activity
3	Preventive maintenance visit	Need based (minimum 02 days per visit)	Service charges for two days (including required person for functional inspection, tuning of motion, cleaning of mechanical parts, greasing and oiling, verification of electrical and control wiring, change the oil seals, timing belt tension verification, Complete visual inspection of positioner, full motion verification with and without load)		Definition of Unit Price: per visit Service charges for preventive maintenance visit for two days will be quoted as a lump sum price and will be considered as a unit price for that activity.
4	Logistic Support	as and when require	Crane with operator 12 – 14 Ton Capacity		Definition of Unit price: 24 hours from Logistic support availability at NFTR/SAC
			Forklift with 2 Ton Load Capacity		
			Forklift with 5 Ton Load Capacity		
			Forklift with 10 Ton Load Capacity		
			Lifting Tripod upto 1000 Kg load capacity with Laborer		
			Shifting of any part to vendor premises (without FIM) – required truck upto 25 feet – open		

Spare Part List –

Sr No.	Devices	Detailed specification	Unit Price valid up to 3 Years	Spare/item category
1	Motor	Callan Make Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225 with Tacho		Major
2	Motor	Callan Make Permanent Magnet DC Servomotor Type: M4-2006D-YY001-142 with Tacho		Major
3	Encoder	FENAC Make FNC 58B 10630V5000-R5, PPR – 5000		Major
4	Encoder	BTH Make Incremental Rotary Encoder Model: BI-38H8-2000-L5		Major
5	Encoder	Autonics Make Rotary Incremental Encoder Model: E4056-2000-6-L-5		Major
6	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 75E3UCH2F		Major
7	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 45E30CH2F		Major
8	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 75M60CRU1		Major
9	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 90E90CH2F		Major
10	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 80E80CH1F		Major
11	DC Servo Drive	100 volt 30 Amp ADVANCED Motion Controls Part No. AB30A200I - X		Major
12	Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B		Major
13	Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)		Major
14	Linear Fast Switching DIO	Lenze Make Fast Switching Module Part No. El21-24-0010 Galvanic isolated		Major
15	Remote IO	Beckhoff Make Part No. Ek1101-0090 Remote Bus Station ID-Switch		Major
16	Relay Board	Brake unit for Servo motor Schneider Electric PM-01		Major

Sr No.	Devices	Detailed specification	Unit Price valid up to 3 Years	Spare/item category
17	Remote IO	Beckhoff Make (custom) Encoder Interface unit for E-bus		Major
18	Remote IO	Tacho Feedback unit for 0-10 volt analog in El3xxx		Major
19	RTOS	Linx Make RT License for Motion controller		Major
20	Driver File	DLL for Ethercat Bus to support various hardware (Custom made by OEM)		Major
21	Limit Switch	Telemecanique Make XCE102C, IEC600947 – 5 – 1, Same Polarity only		Minor
22	Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1, Same Polarity only		Minor
23	Panel connector	Amphenol Aero MS3474W16-26S		Minor
24	Connector for end-1	Amphenol Aero MS3476W16-26P		Minor
25	Connector for end-2	Amphenol Aero MS3476W16-26P		Minor
26	Ball Screw	C3 Precision Make ground Pitch 5mm & Diameter 30 mm		Minor
27	SMPS	Siemens Make 50 Amp 90 volt DC Part No. 6EP1336-1LD00		Minor
28	Bias Control	Balluff Switch with relay (for Limits)		Minor
29	Panel Connector	Amphenol Make MS3474W16-26S		Minor
30	SMPS	Siemens Make Control Power Supply 24/12/5 V DC 10 Amp		Minor
31	Siemens	Power Filter unit Meanwell for Trigger pulse		Minor
32	Panel Connector	Amphenol Aero MS3102E20-29SW (LCU Interface)		Minor
33	Relay	Relay Card Siemens Make 220 volt / 5 Amp		Minor
34	Power Contactor	Schneider Make Part No. Sc10 Power Contactor		Minor
35	Push Buttons	Schneider Make standard		Minor
36	Potentiometer Knob	Takushi Make		Minor
37	LM Guideways			Minor
38	Rack & Pinion			Minor
39	Slewing Bearing			Minor

Sr No.	Devices	Detailed specification	Unit Price valid up to 3 Years	Spare/item category
40	Ball Screw			Minor

Annexure-II: Preventive Maintenance Checklist

FITP (**F**unctional **I**nspection **T**est **P**lan)

Format for functional inspection report (to be submitted in every quarter)

Sr No	Positioner and Axis	Parameters	Status	Remarks
1	DUT Positioner	Visual inspection of DUT Positioner		
2		Check Timing belt tension of all axes and adjust if required		
3		Check control cable connections. Clean and secure connectors and cables.		
4	DUT Positioner Controller	Visual inspection of DUT Positioner Controller		
5		Check exterior and interior of motion controller.		
6		Adjustment / Tuning of axis motion through optimizing the PID parameter in control software		
7	DUT – Linear Slide Axis	Verification of movement in forward direction		
8		Verification of movement in reverse direction		
9		Limit to limit movement of linear slide in both direction		
10		Movement verification with fine speed selection		
11		Movement verification with Coarse speed selection		
12		Greasing of Rack & Pinion and Lm Guides		
13		Oiling of Reduction Gear Boxes		
14	DUT – Azimuth Axis	Verification of movement in forward (+) direction		
15		Verification of movement in reverse (-) direction		
16		Limit to limit movement of azimuth axis rotation in both direction		
17		Movement verification with fine speed selection		
18		Movement verification with Coarse speed selection		
19		Functional Verification of Electromechanical brakes		
20		Greasing of Slewing Bearing		
21		Oiling of Reduction Gear Boxes		
22	DUT – Elevation Axis	Verification of movement in forward (+) direction		
23		Verification of movement in reverse (-) direction		
24		Limit to limit movement of elevation axis rotation in both direction		
25		Movement verification with fine speed selection		
26		Movement verification with Coarse speed selection		
27		Functional Verification of Electromechanical brakes		
28		Greasing of Slewing Bearing		

29		Oiling of Reduction Gear Boxes		
30	DUT – Polarization Axis	Verification of movement in forward (CW) direction		
31		Verification of movement in reverse (CCW) direction		
32		Limit to limit movement of polarization axis rotation in both direction		
33		Movement verification with fine speed selection		
34		Movement verification with Coarse speed selection		
35		Functional Verification of Electromechanical brakes		
36		Greasing of Slewing Bearing		
37		Oiling of Reduction Gear Boxes		
38	T-Scanner	Visual inspection of FEED Positioner		
39		Check Timing belt tension of all axes and adjust if required		
40		Check control cable connections. Clean and secure connectors and cables.		
41	T-Scanner Controller	Visual inspection of T-Scanner Controller		
42		Check exterior and interior of motion controller.		
43		Adjustment / Tuning of axis motion through optimizing the PID parameter in control software		
44	T-Scanner – Linear Slide X-axis	Verification of movement in forward (+) direction		
45		Verification of movement in reverse (-) direction		
46		Limit to limit movement of linear slide axis in both direction		
47		Movement verification with fine speed selection		
48		Movement verification with Coarse speed selection		
48		Greasing of Linear Bearings/ Lm Guides		
49		Greasing of Rack & Pinion		
50	T-Scanner – Linear Slide Y-axis	Verification of movement in forward (+) direction		
51		Verification of movement in reverse (-) direction		
52		Limit to limit movement of linear slide axis in both direction		
53		Movement verification with fine speed selection		
54		Movement verification with Coarse speed selection		
55		Greasing of Linear Bearings/ Lm Guides		
56		Greasing of Rack & Pinion		
57	T-Scanner – Linear Slide Z-axis	Verification of movement in forward (+) direction		
58		Verification of movement in reverse (-) direction		
59		Limit to limit movement of azimuth axis rotation in both direction		
60		Movement verification with fine speed selection		
61		Movement verification with Coarse speed selection		

62		Greasing of Slewing Bearing		
63		Oiling of Reduction Gear Boxes		
64	T-Scanner – Roll axis	Verification of movement in forward (CW) direction		
65		Verification of movement in reverse (CCW) direction		
66		Limit to limit movement of polarization axis rotation in both direction		
67		Movement verification with fine speed selection		
68		Movement verification with Coarse speed selection		
69		Greasing of Slewing Bearing		
70		Oiling of Reduction Gear Boxes		
Any Specific remark related to DUT Positioner				
Any Specific remark related to T-Scanner				

Functional Inspection Performed by: _____

Remarks by NFTR - SAC Engineer: _____

_____

SAC Engineer Present During Functional Inspection: _____

Remarks by NFTR Incharge: _____

NFTR Incharge Signature: _____

Annexure-III: Calibration Test Plan

CTP (**C**alibration **T**est **P**lan)

Format for Calibration inspection report (to be submitted in every year)

Sr No.	Description		Units	Required Results	Measured Results
1	**Travel Direction Test**				
	Linear X-Slide axis	FWD		OK	
		REV		OK	
	Linear Y-Slide axis	FWD		OK	
		REV		OK	
	Linear Z- Slide axis	FWD		OK	
		REV		OK	
	Roll axis	FWD		OK	
		REV		OK	
2	**Limit to Limit Travel**				
	Linear X-Slide axis (including homing @ center)		mm	+4500	
			mm	-4500	
	Linear Y-Slide axis (including homing @ center)		mm	+3000	
			mm	-3000	
	Linear Z-Slide axis (including homing @ center)		mm	-125	
			mm	+125	
	Roll axis		deg	360	
3	**Safe Operate Switch Test**				
	SAFE/OPERATE Switch			OK	
	EMERGENCY Stop			OK	
4	**Repeatability Test**				
	Linear X-Slide axis		mm	Less than 0.05	
	Linear Y-Slide axis		mm	Less than 0.05	
	Linear Z-Slide axis		mm	Less than 0.05	
	Roll axis		deg	Less than 0.05	
5	**Positioning Accuracy**				
	Linear X-Slide axis		mm	Less than 0.1	
	Linear Y-Slide axis		mm	Less than 0.1	
	Linear Z-Slide axis		mm	Less than 0.1	
	Roll axis		deg	Less than 0.1	
6	**Overall Planarity**		Less than 0.12 mm over the full 9 m x 6 m Rectangular scan grid		

Parameters	Unit	Required Results	Measured Results

Parallelism between T-scanner Roll axis and Z-axis	deg	± 0.02	
Orthogonality between T-scanner Z-axis and Y-axis	deg	± 0.02	
Orthogonality between T-scanner Y-axis and X-axis	deg	± 0.02	

Sr No.	Description		Units	Required Results	Measured Results
1	**Travel Direction Test**				
	Lower Linear Slide axis	FWD		OK	
		REV		OK	
	Azimuth axis	FWD		OK	
		REV		OK	
	Elevation axis	FWD		OK	
		REV		OK	
	Roll axis	FWD		OK	
		REV		OK	
2	**Limit to Limit Travel**				
	Lower Linear Slide axis (including homing @ center)		mm	+1000	
			mm	-1000	
	Azimuth axis (including homing @ pre-defined position)		deg	+182	
			deg	-182	
	Elevation axis (including homing @ pre-defined position)		deg	-25	
			deg	+92	
	Roll axis		Deg	360	
3	**Safe Operate Switch Test**				
	SAFE/OPERATE Switch			OK	
	EMERGENCY Stop			OK	
4	**Repeatability Test**				
	Linear X-Slide axis		mm	Less than 0.03	
	Azimuth axis		deg	Less than 0.02	
	Elevation axis		deg	Less than 0.02	
	Roll axis		deg	Less than 0.02	
5	**Positioning Accuracy**				
	Linear X-Slide axis		mm	Less than 0.05	
	Azimuth axis		deg	Less than 0.03	
	Elevation axis		deg	Less than 0.03	
	Roll axis		deg	Less than 0.03	

Parameters	Unit	Required Results	Measured Results
Parallelism of DUT Roll axis with T-scanner Z-axis	deg	± 0.02	
Parallelism of DUT Azimuth axis with DUT Roll axis	deg	± 0.02	
Orthogonality between DUT Linear slide axis and DUT azimuth axis	deg	± 0.1	

Orthogonality between DUT Azimuth and DUT Elevation axis	deg	± 0.1	
Orthogonality between DUT Elevation and DUT Roll axis	deg	± 0.1	

Sr No	Positioner and Axis	Parameters	Status	Remarks
1	DUT Positioner	Visual inspection of DUT Positioner		
2		Check Timing belt tension of all axes and adjust if required		
3		Check control cable connections. Clean and secure connectors and cables.		
4	DUT Positioner Controller	Visual inspection of DUT Positioner Controller		
5		Check exterior and interior of motion controller.		
6		Adjustment / Tuning of axis motion through optimizing the PID parameter in control software		
7	DUT – Linear Slide Axis	Verification of movement in forward direction		
8		Verification of movement in reverse direction		
9		Limit to limit movement of linear slide in both direction		
10		Movement verification with fine speed selection		
11		Movement verification with Coarse speed selection		
12		Greasing of Rack & Pinion and Lm Guides		
13		Oiling of Reduction Gear Boxes		
14	DUT – Azimuth Axis	Verification of movement in forward (+) direction		
15		Verification of movement in reverse (-) direction		
16		Limit to limit movement of azimuth axis rotation in both direction		
17		Movement verification with fine speed selection		
18		Movement verification with Coarse speed selection		
19		Functional Verification of Electromechanical brakes		
20		Greasing of Slewing Bearing		
21		Oiling of Reduction Gear Boxes		
22	DUT – Elevation Axis	Verification of movement in forward (+) direction		
23		Verification of movement in reverse (-) direction		
24		Limit to limit movement of elevation axis rotation in both direction		
25		Movement verification with fine speed selection		
26		Movement verification with Coarse speed selection		
27		Functional Verification of Electromechanical brakes		

28		Greasing of Slewing Bearing		
29		Oiling of Reduction Gear Boxes		
30	DUT – Polarization Axis	Verification of movement in forward (CW) direction		
31		Verification of movement in reverse (CCW) direction		
32		Limit to limit movement of polarization axis rotation in both direction		
33		Movement verification with fine speed selection		
34		Movement verification with Coarse speed selection		
35		Functional Verification of Electromechanical brakes		
36		Greasing of Slewing Bearing		
37		Oiling of Reduction Gear Boxes		
38	T-Scanner	Visual inspection of FEED Positioner		
39		Check Timing belt tension of all axes and adjust if required		
40		Check control cable connections. Clean and secure connectors and cables.		
41	T-Scanner Controller	Visual inspection of T-Scanner Controller		
42		Check exterior and interior of motion controller.		
43		Adjustment / Tuning of axis motion through optimizing the PID parameter in control software		
44	T-Scanner – Linear Slide X-axis	Verification of movement in forward (+) direction		
45		Verification of movement in reverse (-) direction		
46		Limit to limit movement of linear slide axis in both direction		
47		Movement verification with fine speed selection		
48		Movement verification with Coarse speed selection		
48		Greasing of Linear Bearings/ Lm Guides		
49		Greasing of Rack & Pinion		
50	T-Scanner – Linear Slide Y-axis	Verification of movement in forward (+) direction		
51		Verification of movement in reverse (-) direction		
52		Limit to limit movement of linear slide axis in both direction		
53		Movement verification with fine speed selection		
54		Movement verification with Coarse speed selection		
55		Greasing of Linear Bearings/ Lm Guides		
56		Greasing of Rack & Pinion		
57	T-Scanner – Linear Slide	Verification of movement in forward (+) direction		
58		Verification of movement in reverse (-) direction		

59	Z-axis	Limit to limit movement of azimuth axis rotation in both direction		
60		Movement verification with fine speed selection		
61		Movement verification with Coarse speed selection		
62		Greasing of Slewing Bearing		
63		Oiling of Reduction Gear Boxes		
64	T-Scanner – Roll axis	Verification of movement in forward (CW) direction		
65		Verification of movement in reverse (CCW) direction		
66		Limit to limit movement of polarization axis rotation in both direction		
67		Movement verification with fine speed selection		
68		Movement verification with Coarse speed selection		
69		Greasing of Slewing Bearing		
70		Oiling of Reduction Gear Boxes		
Any Specific remark related to DUT Positioner				
Any Specific remark related to T-Scanner				

Functional Inspection Performed by: _____

Remarks by NFTR - SAC Engineer: _____

_____

SAC Engineer Present During Functional Inspection: _____

Remarks by NFTR Incharge: _____

NFTR Incharge Signature: _____

Annexure-IV: Compliance against RFP

Sr. No.	Description	Compliance / Remarks
1		

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Contents

3

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

1. System Overview

Near Field Test Range (NFTR) automated antenna positioning system consists of –

1. Simultaneously operated 4-axis inverted T-scanner with motion controller
2. Simultaneously operated 4-axis DUT positioner with motion controller
3. Automated test configuration and Data acquisition software

The SAC NFTR is operational for frequency range from 1.0 GHz to 40.0 GHz used for characterization of planar antenna systems.

The antenna positioning system of NFTR is having multi-axis, simultaneously operated, highly precise, heavy-duty positioners for accurate and precise characterization of antenna systems in near field by scanning in different formats viz. *Rectangular, Plane-polar, Bi-polar, Cylindrical* and *Spherical scans*.

The positioning system axis details are as per below –

(i) *4-axis inverted T-Scanner* (**Roll** over **Lin-Z** over **Lin-Y** over **Lin-X** axis)
(ii) *4-axis Device Under Test (DUT) Positioner* (**Pol** axis over **Rot El** axis over **Rot Az** axis over **Lin. Slide** axis)

This positioning system is used to support and position test devices, antennas, model towers, etc. for antenna measurements. Measurement software is required to configure the axis motion profiles for fully automated antenna measurement.

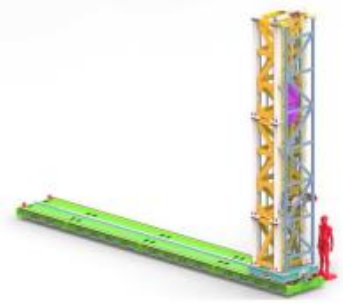
4

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

2. Antenna Positioning System to be included for AMC

2.1 Simultaneously operated 4-axis inverted T-scanner with motion controller

2.1.1 4-axis inverted T-scanner – T-Scanner is a standard 4-axis positioner having 3-linear axes and 1-rotational axis. The linear travel axes are X, Y, Z & rotational axis is Roll axis. T-Scanner makes possible the scanning of DUT antenna mounted over the DUT positioner in different configuration. It carries the probe antenna required for DUT characterization. The drive mechanism of the slide axes are rack and pinion type. The driving unit is a DC servomotor with sufficient performance rating in order to operate at the required loads, velocities and accelerations. Slide motion is accomplished by the gear-motor, to ensure the required torque for machine operations. The reduction worm gear drives a pinion connected to the reduction worm gear. The pinion is engaging with a rack gear, which is located between bearing rails. The rack and bearings rails are mounted on a positioner surface.

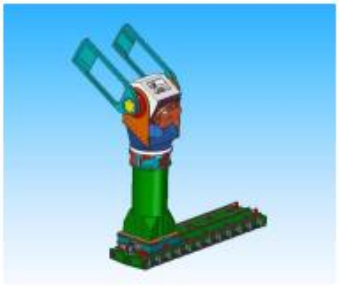


2.1.2 4-axis motion controller with Local Control Unit – T-Scanner motion controller is a standard 4-axis controller with built-in PCU. The front panel of controller enables manual operation by means of an operating axis selector, display axis selector, motor speed and direction control knob. A portable hand-held unit connected with motion controller through a cable and being used for controlling the motion of all independent axes in a sequential manner. Also indicates the axis limits in Forward (CW) / Reverse (CCW) direction. It incorporates a rotary switch for selecting one axis at a time.

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

2.2 Simultaneously operated 4-axis DUT positioner with motion controller

2.2.1 4-axis DUT positioner – DUT Positioner is a standard 4-axis positioner having 3-rotational axis and 1-linear slide axis. The rotational travel axes are Polarization, Elevation, Azimuth & Linear axis is DUT linear slide. DUT Positioner makes possible the measurement of antennas radiation characteristics of satellite, ground and various development models. The drive mechanism of DUT Positioner is very much similar to T-Scanner. The additional safety features offered by DUT Positioner are Tacho output from DC servomotors and electromechanical braking system in all rotational axis.



5

2.2.2 4-axis motion controller – DUT-Positioner motion controller is a standard 4-axis controller with built-in PCU. The front panel of controller enables manual operation by means of an operating axis selector, display axis selector, motor speed and direction control knob. A portable hand-held unit connected with motion controller through a cable and being used for controlling the motion of all independent axes in a sequential manner. Also indicates the axis limits in Forward (CW) / Reverse (CCW) direction. It incorporates a rotary switch for selecting one axis at a time.

2.3 Automated test configuration and Data acquisition software

The Automated test configuration and Data Acquisition (DAQ) software initializes, controls, configures the RF instruments and the positioning system. It defines the measurement configurations as per user requirement and performs the acquisition. It also has data processing and analysis module to process the raw measured data to compute the far field and near field characteristics of the AUT.

6

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

3. System Specifications

3.1 Four (4) – axis inverted T-scanner System

3.1.1 4-axis inverted T-scanner – T-Scanner is a standard 4-axis positioner having 3-linear axes and 1-rotational axis.

Table-01: Technical specifications related to T-Scanner

Parameters		X-axis	Y-axis	Z-axis	Roll-axis
Travel Range		9.0 m	6.0 m	0.25 m	360 deg
Travel Load over axis		1750 kg	350 kg	60 kg	30 kg
Structure Material		Cast Iron / Steel			
Velocity	min	250 mm/sec	250 mm/sec	12 mm/sec	5 deg/sec
	max	500 mm/sec	500 mm/sec	20 mm/sec	12 deg/sec
Mechanical System Planarity		< 0.12 mm RMS			
Motor Drive Power		3/4 hp	3/4 hp	1/3 hp	1/20 hp
Axis Accuracy RMS		0.07+X(m)/300	0.07+Y(m)/300	0.05+Z(m)/300	0.1deg
Repeatability		< 0.05 mm	< 0.05 mm	< 0.05 mm	<0.03 deg
Positioning Accuracy		< 0.1 mm	< 0.1 mm	< 0.1 mm	<0.06 deg
Readout Resolution		< 0.005 mm	< 0.005 mm	< 0.005 mm	<0.001 deg
Operational movement must be without jerking, no position hunting, and noise free smooth operation.					

Table-02: Technical specifications related to T-Scanner axis alignments

Parameters	Unit	Specifications
Parallelism between T-scanner Roll axis and Z-axis	deg	± 0.02
Orthogonality between T-scanner Z-axis and Y-axis	deg	± 0.02
Orthogonality between T-scanner Y-axis and X-axis	deg	± 0.02

3.1.2 4-axis T-scanner motion controller – T-Scanner motion controller is a standard 4-axis controller with built-in PCU. The front panel of controller enables manual operation by means of an operating axis selector, display axis selector, motor speed and direction control knob. In the controller, the T-scanner axes are designated as:

Axis-01	X-axis
Axis-02	Y-axis
Axis-03	Z-axis
Axis-04	Roll-axis

Table-03: 4-axis T-Scanner motion controller Specifications –

Sr. No.	Description	Specification
01	No. of Axis to be controlled	All four axes as shown in 3.1.2
02	Axis Configurability	All the four axes are simultaneous / sequentially selectable as per user defined measurement configuration.

7

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr. No.	Description	Specification
03	Input Power Supply	Single Phase, 230 Volts AC 50 Hz ±10 % as per Indian standard
04	Motor Details of Axis-01, 02, 03 & 04	DC servo Motors, Voltage Range: 80 – 115 Volt DC, Bi-directional
05	Encoder Details of Axis- 01, 02, 03 & 04	Relative encoder En-DAT Protocol
06	Software limit for all 04 axes	Available

Table-04: 4-axis T-Scanner motion controller Front Panel Specifications –

Sr. No.	Feature	Specifications
1	E-STOP (Emergency Stop)	Latching Emergency Stop Panic-Switch opens the motor Armature Common circuit.
2	Control and Display Window	Segmented LED Display resolution 0.001° (Angular) or 0.001mm (Linear), selectable as per axis.
3	Axis Selection	Axis-1 to Axis-4 is selected via multi position switch/knob as per selected control axis
4	Limit Switch Indicator	LED indication when the active axis reaches the limit of the corresponding direction. CW (forward) or CCW (reverse)
5	Speed & Direction Control	Dual Function Knob/Potentiometer to provide manual velocity control for both Reverse or Forward direction control
6	Panel/Bus (local/remote) Select	Latching Illuminated Pushbutton Switch. Selects either computer control or front panel Control.
7	Power On/ Off Switch	AC Input Power ON/OFF. Illuminated when Unit is Power ON.
8	Dimensions	Compatible for (19") standard rack maximum 4U chassis, Single Box Solution

Table-05: 4-axis T-Scanner motion controller Rear Panel Interfaces Specifications –

Sr. No.	Feature	Type of Connector
1	Axis-1	MS3474W16-26S Nut Receptacle Panel Connector
2	Axis-2	
3	Axis-3	
4	Axis-4	
5	Local Control Unit	MS3102E-20-29SW
6	E-Stop	JMS 3476W10-6P
7	Trigger Out	BNC (5V trigger pulse)
8	Trigger In	BNC (5V trigger pulse)
9	LAN/CAN	LAN or CAN for programming configuration as well as communication
10	Power Point	3-pin Power point
11	Interlocking	MS3470L10-6S

3.2 Four (4) – axis DUT Positioning System

8

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

3.2.1 4-axis DUT Positioner – DUT Positioner is a standard 4-axis positioner having 3-rotational axes and 1-linear axis.

Table-06: Technical specification related to DUT-Positioner

Parameter		Unit	Specifications
No of axis		04	
Type of Positioner		Roll / Elevation / Azimuth + Linear Slide	
Delivered Torque	Polarization Axis	Kg-m	390
	Elevation Axis	Kg-m	1500
	Azimuth Axis	Kg-m	390
Withstand Torque (Max. DUT weight 200 kg)	Polarization Axis	Kg-m	580
	Elevation Axis	Kg-m	2250
	Azimuth Axis	Kg-m	580
Turntable Diameter		mm	625 mm
Drive Power	Polarization Axis	hp	3/4
	Elevation Axis	hp	3/4
	Azimuth Axis	hp	3/4
	Linear Slide Axis	hp	1/3
Maximum Speed	Polarization Axis	deg/sec	3.0 (0.5 rpm)
	Elevation Axis	deg/sec	0.33 (40°/min)
	Azimuth Axis	deg/sec	3.0 (0.5 rpm)
	Linear Slide Axis	mm/sec	125
Minimum Speed	Polarization Axis	deg/sec	0.05
	Elevation Axis	deg/sec	0.05
	Azimuth Axis	deg/sec	0.05
	Linear Slide Axis	mm/sec	20
Position Accuracy	Polarization Axis	deg	0.03
	Elevation Axis	deg	0.03
	Azimuth Axis	deg	0.03
	Linear Slide Axis	mm	0.05
Repeatability	Polarization Axis	deg	0.02
	Elevation Axis	deg	0.02
	Azimuth Axis	deg	0.02
	Linear Slide Axis	mm	0.05
Travel Range	Polarization Axis	deg	360°
	Elevation Axis	deg	-25° to +92°
	Azimuth Axis	deg	±200°
	Linear Slide Axis	m	± 1.0
Vertical Load	Polarization Axis	kg	1000
	Azimuth Axis	kg	5000
	Linear Slide Axis	kg	2000
Bending Moment	El = 0deg Axis	kg-m	1500

Parameter		Unit	Specifications
Maximum Backlash	El = 980deg Axis	kg-m	2250
	Polarization Axis	deg	0.05
	Elevation Axis	deg	0.05
	Azimuth Axis	deg	0.05
Electromechanical Brakes		In all 03 axes	
Encoder Type	Polarization Axis	Incremental encoders	
	Elevation Axis		
	Azimuth Axis		
	Linear Slide Axis		

Table-07: Technical specifications related to DUT-Positioner axis alignments

Parameters	Unit	Specifications
Parallelism of DUT Roll axis with T-scanner Z-axis	deg	± 0.02
Parallelism of DUT Azimuth axis with DUT Roll axis	deg	± 0.02
Orthogonality between DUT Linear slide axis and DUT azimuth axis	deg	± 0.1
Orthogonality between DUT Azimuth and DUT Elevation axis	deg	± 0.1
Orthogonality between DUT Elevation and DUT Roll axis	deg	± 0.1

9

3.2.2 4-axis DUT Positioner motion controller – DUT- Positioner motion controller is a standard 4-axis controller with built-in PCU. The front panel of the controller enables operation by means of an operating axis selector, display axis selector, motor speed and direction control knob. In the controller, the DUT Positioner axes are designated as:

Axis-01	Azimuth axis
Axis-02	Elevation axis
Axis-03	DUT Roll axis
Axis-04	DUT Linear Slide axis

Table-08: 4-axis DUT-Positioner motion controller Specifications –

Sr. No.	Description	Specification
01	No. of Axis to be controlled	All four axes as shown in 3.2.2
02	Axis Configurability	All the four axes are simultaneous / sequentially selectable as per user defined measurement configuration
03	Input Power Supply	Single Phase, 230 Volts AC 50 Hz ±10 % as per Indian standard
04	Motor Details of Axis-01, 02, 03 & 04	DC servo Motors, Voltage Range: 80 – 115 Volt DC, Bi-directional
05	Encoder Details of Axis-01, 02, 03, 04	Relative Encoders
06	Software limit for all 04 axis	Available
07	Electromechanical Braking for all 04 axis	Available

10

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Table-09: 4-axis DUT-Positioner motion controller Front Panel Specifications –

Sr. No.	Feature	Specifications
1	E-STOP (Emergency Stop)	Latching Emergency Stop Panic-Switch opens the motor Armature Common circuit.
2	Control and Display Window	Segmented LED Display resolution 0.001° (Angular) or 0.001mm (Linear), selectable as per axis.
3	Axis Selection	Axis-1 to Axis-4 is selected via multi position switch/knob as per selected control axis
4	Limit Switch Indicator	LED indication when the active axis reaches the limit of the corresponding direction. CW (forward) or CCW (reverse)
5	Speed & Direction Control	Dual Function Knob/Potentiometer to provide manual velocity control for both Reverse or Forward direction control
6	Panel/Bus (local/remote) Select	Latching Illuminated Pushbutton Switch. Selects either computer control or front panel Control.
7	Power On/ Off Switch	AC Input Power ON/OFF. Illuminated when Unit is Power ON.
8	Dimensions	Compatible for (19") standard rack maximum 4U chassis, Single Box Solution

Table-10: 4-axis DUT-Positioner motion controller Rear Panel Interfaces Specifications –

Sr. No.	Feature	Type of Connector
1	Axis-1	MS3474W16-26S Nut Receptacle Panel Connector
2	Axis-2	
3	Axis-3	
4	Axis-4	
5	Local Control Unit	MS3102E-20-29SW
6	E-Stop	JMS 3476W10-6P
7	Trigger Out	BNC (5V trigger pulse)
8	Trigger In	BNC (5V trigger pulse)
9	LAN/CAN	LAN or CAN for programming configuration as well as communication
10	Power Point	3-pin Power point
11	Interlocking	MS3470L10-6S

3.3 Automated test configuration and Data acquisition software

The Automated test configuration and Data acquisition software is developed using low-level language.

11

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr. No.	Description	Specification
01	Number of Modules	Data Acquisition Software has three modules namely: 1. Data Acquisition Module 2. Data Analysis Module 3. Data Presentation Module
02	Data Acquisition Module	Data Acquisition module has the following functions– 1. Automatic Scan setup, Computation and optimization of scan parameters. 2. CW, List and Sweep frequency mode measurements. 3. Amplitude and phase data acquisition. 4. Continuous and step mode. 5. Unidirectional & Bidirectional mode. 6. Switch, multiple-channels and multiple-beams control. 7. Provision of Pause and Resume measurement control. 8. **System Configuration save/recall –** Saving of last System Configuration file and recalling any Configuration file saved earlier. Configuration file generally contains– Project & antenna details, frequencies, channel and/or beam definition, transmit power of RF & LO sources, communication details (like IP address), positioner configuration details (free speed, scan speed, acceleration, deceleration etc.). 9. **Real time display –** Amplitude and Phase raw data should be displayed on the screen (intensity plot) in real time to indicate the degree of completion. It should display the scan, step axis range and current position, frequency, quantity that is to be measured, file name etc. (the measurement definition summary). 10. **Parameters overview –** Measurement Parameters overview for main parameters shall be displayed on screen for quick check of all set parameters before measurement starts.
03	Data Analysis Module	Data Analysis/ processing module has the following Functions – 1. Measured raw data files should include the following options– Transformation, Back-projection, Various systematic error correction 2. X/Y/Φ radiation pattern cuts for co and cross polarisation for amplitude and phase. 3. Co and Cross-radiation pattern, Gain, Directivity, Beam pointing. 4. Beam peak, Beamwidth, Side lobes, Null depth with their location. 5. Cross-polar level and Cross-polar isolation etc. 6. Axial ratio (AR) and AR pattern. 7. Phase centre position prediction from measured data. 8. Normalization of data to value and peak.

12

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr. No.	Description	Specification
		9. Data conversion and export to ASCII format / Excel format or TICRA compatible format (*.grd & *.cut).
04	Data Presentation Module	Data Presentation module should have following functions – 1. 2D / 3D Plotting options. 2. Cartesian, Intensity, polar, contour, 3D plotting features. 3. Grey scale / Pseudo colour plotting. 4. Flexible plot annotation feature. 5. **Markers / Pointers –** Marker facility (minimum seven) on both sides of plots, Data cursor mode, Zooming, Panning, Cross-hair cursor etc. 6. **Data Import / Export options –** Facility to export plots to *.jpeg, *.bmp, *.png, *.tiff etc. formats.

13

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

4. Details of Parts/Components used in Positioning System

4.1 Drive Parts/Components list of 4-axis inverted T-Scanner –

Sr No.	Axis Details	Part	Detailed Specification
1.1	Linear X-axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Callan Technology Make, Tacho 7.0V 4.07Nm, 115 Vdc 11.3 Adc 3000 rpm
1.2		Encoder	FENAC Make, FNC 58B 10630V5000-R5, PPR – 5000 VCC – 5-30V dc, Sr No: 86909D21RDEA446, Turkish Made
1.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 75E3UCH2F, No: 1061000903001/01, (Lubricated by Mobil)
1.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
1.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
1.6		LM Guide ways	LM Hiwin Guideways & Blocks HR45
1.7		Rack & Pinion	Gudel Rack & Pinion Module 5
1.8		Panel Connector	MS3474W16-26S
1.9		Connector for end-1	MS3476W16-26P
1.10		Connector for end-2	MS3476W16-26P
2.1	Linear Y-axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2006D-YY001-142, Callan Technology Make, Sr No: 211129526, Tacho 7.0V 1.6Nm, 115 Vdc 2.8 Adc 2000 rpm
2.2		Encoder	BTH Incremental Rotary Encoder, Model: BI-38H8-2000-L5, Supply: 5V DC Line Driver 2000 PPR
2.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 45E30CH2F, No: 106-1000603002/01 (Lubricated by Mobil)
2.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
2.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
2.6		LM Guide ways	LM Hiwin Guideways & Blocks HR45
2.7		Rack & Pinion	Gudel Rack & Pinion Module 5
2.8		Panel Connector	MS3474W16-26S

14

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr No.	Axis Details	Part	Detailed Specification
2.9		Connector for end-1	MS3476W16-26P
2.10		Connector for end-2	MS3476W16-26P
3.1	Linear Z-axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2006D-YY001-142, Sr No: 211129525, Tacho 7.0V 1.6Nm, 115 Vdc 2.8 Adc 2000 rpm, Callan Technology Make
3.2		Encoder	Autonics (Rotary Encoder), Model: E4056-2000-6-L-5 5V dc ± 5%, Lot No. VG08R Made in Korea
3.3		Ball Screw	C3 Precession class Hardened and ground Pitch 5 mm & Diameter 30 mm
3.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
3.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
3.6		LM Guide ways	LM Hiwin Guideways & Blocks HR45
3.7		Ball Screw	PMI 25 x 1000 mm
3.8		Panel Connector	MS3474W16-26S
3.9		Connector for end-1	MS3476W16-26P
3.10		Connector for end-2	MS3476W16-26P
4.1	Roll axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2006D-YY001-142, Sr No: 211129527, Tacho 7.0V 1.6Nm 115 Vdc 2.8 Adc 2000 rpm, Callan Technology Make
4.2		Encoder	BTH Incremental Rotary Encoder, Model: BI-38H8-2000-L5, Supply: 5V DC Line Driver 2000 PPR
4.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 45E30CH2F, No: 106-1000903002/02 (Lubricated by Mobil)
4.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
4.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
4.6		Bearing	SKF make bearing SKF-01
4.7		Panel Connector	MS3474W16-26S
4.8		Connector for end-1	MS3476W16-26P
4.9		Connector for end-2	MS3476W16-26P
5.1		Grease For bearing	Kubler
5.2		Electrical panel wiring	Schneider

15

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr No.	Axis Details	Part	Detailed Specification
5.3		Timing Belts	Fenner make

4.2 Drive Parts/Components list of 4-axis T-Scanner motion controller –

Sr No.	Axis Details	Part	Detailed Specification
1.1	Linear X-axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
1.2		SMPS	Siemens Make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
1.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
1.4		Bias Control	Balluff Switch with relay (for Limits)
1.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
1.6		Panel Connector	Amphenol Make MS3474W16-26S
2.1	Linear Y-axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
2.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
2.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
2.4		Bias Control	Balluff Switch with relay (for Limits)
2.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
2.6		Panel Connector	Amphenol Make MS3474W16-26S
3.1	Linear Z-axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
3.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
3.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
3.4		Bias Control	Balluff Switch with relay (for Limits)
3.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
3.6		Panel Connector	Amphenol Make MS3474W16-26S
4.1	Roll axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
4.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
4.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B

16

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr No.	Axis Details	Part	Detailed Specification
4.4		Bias Control	Balluff Switch with relay (for Limits)
4.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
4.6		Panel Connector	Amphenol Make MS3474W16-26S
5.1	Other components of T-Scanner Motion Controller	Linear Fast Switching DIO	Lenze Make, Fast Switching Module Part No. El21-24-0010 Galvanic isolated
5.2		Remote IO	Beckhoff Make Part No. Ek1101-0090 Remote Bus Station ID-Switch
5.3		SMPS	Siemens Make Control Power Supply 24/12/5 V DC 10 Amp
5.4		Siemens	Power Filter unit Meanwell for Trigger pulse
5.5		Relay Board	Brake unit for Servo motor Schneider Electric PM-01
5.6		Panel Connector	Amphenol MS3102E20-29SW (LCU Interface)
5.7		Remote IO	Beckhoff Make (custom) Encoder Interface unit for E-bus
5.8		Remote IO	Tacho Feedback unit for 0-10 volt analog in El3xxx
5.9		Relay	Relay Card Siemens Make 220 volt / 5 Amp
5.10		Power Contactor	Schneider Make Part No. Sc10 Power Contactor
5.11		RTOS	Linx Make RT License for Motion controller
5.12		Driver File	DLL for Ethercat Bus to support various hardware (Custom made by OEM)
5.13		Push Buttons	Schneider Make standard
5.14		Potentiometer Knob	Takushi Make

4.3 Drive Parts/Components list of 4-axis DUT-Positioner –

Sr No.	Axis Details	Part	Detailed Specification
1.1	Azimuth axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Sr No: 211129531, Tacho 7.0V 4.07Nm 115 Vdc 11.3 Adc 3000 rpm, Callan Technology Make
1.2		Encoder	FENAC, FNC 58B 10630V5000-R5, PPR – 2000 VCC – 5-30V dc, Sr No: 86904L21AC015, Turkish Made
1.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 75M60CRU1, No: 1168123403/01 (Lubricated by Mobil)
1.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
1.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-

17

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr No.	Axis Details	Part	Detailed Specification
			240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
1.6		Bearing	SKF make bearing SKF 816 dia
1.7		Panel Connector	MS3474W16-26S
1.8		Connector for end-1	MS3476W16-26P
1.9		Connector for end-2	MS3476W16-26P
1.10		Brake	Electromechanical Brakes, sure stop Matrix International
2.1	Elevation axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Sr No: 211129532, Tacho 7.0V 4.07Nm 115 Vdc 11.3 Adc 3000 rpm, Callan Technology Make
2.2		Encoder	BTH Incremental Rotary Encoder, Model: BI-38H8-2000-L5, Supply: 5V DC Line Driver 2000 PPR
2.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 75M60CRU1, No: 1168123403/01 (Lubricated by Mobil)
2.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
2.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
2.6		Bearing	SKF make bearing SKF 414 dia external teeth
2.7		Panel Connector	MS3474W16-26S
2.8		Connector for end-1	MS3476W16-26P
2.9		Connector for end-2	MS3476W16-26P
2.10		Brake	Electromechanical Brakes, sure stop Matrix International
3.1	Polarization axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Sr No: 211129529, Tacho 7.0V 4.07Nm 115 Vdc 11.3 Adc 3000 rpm, Callan Technology make
3.2		Encoder	FENAC, FNC 58B 10630V5000-R5, PPR – 2000 VCC – 5-30V dc, Sr No: 86904L21AC018, Turkish Made
3.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 90E90CH2F, No: 1061000068102/01, (Lubricated by Mobil)
3.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-

18

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr No.	Axis Details	Part	Detailed Specification
			240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
3.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
3.6		Bearing	SKF make bearing SKF 544 dia internal teeth
3.7		Panel Connector	MS3474W16-26S
3.8		Connector for end-1	MS3476W16-26P
3.9		Connector for end-2	MS3476W16-26P
3.10		Brake	Electromechanical Brakes, sure stop Matrix International
4.1	Linear Slide-axis	Motor	Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225, Sr No: 211129530, Tacho 7.0V 4.07Nm 115 Vdc 11.3 Adc 3000 rpm, Callan Technology make
4.2		Encoder	FENAC, FNC 58B 10630V5000-R5, PPR – 5000 VCC – 5-30V dc, Sr No: 86919J21NA450, Turkish Made
4.3		Gear Box	DYNABOX EXPERT, Girard Transmissions Type: 80E80CH1F, No: 1061000068101/01, (Lubricated by Mobil)
4.4		Limit Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
4.5		Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1 GB/T140485, Ui: 300V Uimp: 4KV Ith: 10A, AC: 15-240V AC 3A DC: 13-22V DC 0.3A IP65 Same Polarity only
4.6		LM Guide ways	LM Hiwin Guideways & Blocks HR45
4.7		Ball Screw	PMI 25 x 1000 mm
4.8		Panel Connector	MS3474W16-26S
4.9		Connector for end-1	MS3476W16-26P
4.10		Connector for end-2	MS3476W16-26P
5.1		Grease For bearing	Kubler
5.2		Electrical wiring	Schneider
5.3		Timing Belts	Fenner make
5.4		Lubrication system	cenlub

19

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

4.4 Drive Parts/Components list of 4-axis DUT-Positioner motion controller –

Sr No.	Axis Details	Part	Detailed Specification
1.1	Azimuth axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
1.2		SMPS	Siemens Make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
1.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
1.4		Bias Control	Balluff Switch with relay (for Limits)
1.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
1.6		Panel Connector	Amphenol Make MS3474W16-26S
2.1	Elevation axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
2.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
2.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
2.4		Bias Control	Balluff Switch with relay (for Limits)
2.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
2.6		Panel Connector	Amphenol Make MS3474W16-26S
3.1	Polarization axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
3.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
3.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
3.4		Bias Control	Balluff Switch with relay (for Limits)
3.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
3.6		Panel Connector	Amphenol Make MS3474W16-26S
4.1	Linear Slide-axis	DC Servo Drive	100 volt 30 ampere, ADVANCED Motion Controls Part No. AB30A200I - X
4.2		SMPS	Siemens make 50 Amp 90 volt DC Part No. 6EP1336-1LD00
4.3		Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B
4.4		Bias Control	Balluff Switch with relay (for Limits)
4.5		Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)
4.6		Panel Connector	Amphenol Make MS3474W16-26S

20

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr No.	Axis Details	Part	Detailed Specification
5.1	Other components of DUT-Positioner Motion Controller	Linear Fast Switching DIO	Lenze Make, Fast Switching Module Part No. El21-24-0010 Galvanic isolated
5.2		Remote IO	Beckhoff Make Part No. Ek1101-0090 Remote Bus Station ID-Switch
5.3		SMPS	Siemens Make Control Power Supply 24/12/5 V DC 10 Amp
5.4		Siemens	Power Filter unit Meanwell for Trigger pulse
5.5		Relay Board	Brake unit for Servo motor Schneider Electric PM-01
5.6		Panel Connector	Amphenol MS3102E20-29SW (LCU Interface)
5.7		Remote IO	Beckhoff Make (custom) Encoder Interface unit for E-bus
5.8		Remote IO	Tacho Feedback unit for 0-10 volt analog in El3xxx
5.9		Relay	Relay Card Siemens Make 220 volt / 5 Amp
5.10		Power Contactor	Schneider Make Part No. Sc10 Power Contactor
5.11		RTOS	Linx Make RT License for Motion controller
5.12		Driver File	DLL for Ethercat Bus to support various hardware (Custom made by OEM)
5.13		Push Buttons	Schneider Make standard
5.14		Potentiometer Knob	Tosoku Make

21

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

5. Scope of Work

Following is the scope of work, which includes need-based **PREVENTIVE MAINTENANCE**, **BREAKDOWN MAINTENANCE** & **CALIBRATION WORK** and **SPARE PARTS** delivery at NFTR/SAC. The response time for Preventive maintenance /Breakdown maintenance/ Calibration work shall be at most 72 hours (considering working days only) from the day of call or complaint.

5.1 PREVENTIVE MAINTENANCE – Need based

A. Visual Inspection, exterior and interior cleaning, lubrication and adjustment/tuning of axis motion, if needed. Visual Inspection of the electrical and mechanical components, encoder and limit switch check, motors and gear box inspection, counterweight balancing and adjustments, positioners inspection and verifications for smooth operation, including speed test.

B. Visual Inspection, exterior and interior of motion controller. Adjustment / Tuning of axis motion through optimizing the PID parameter in control software.

C. Motion control verification for all 08 axes of 02 different positioners as per **FITP** (**F**unctional **I**nspection **T**est **P**lan).

D. Inspect painted and unpainted surface. If corrosion or damaged paint is discovered, then use steel brush/scotch to clean damaged paint and apply rich zinc epoxy paint 50-60 µm layer thickness and Jotun brand green top dual coat of 50 micron.

E. System safe operation verification for all positioners.

F. Inspection of system cabling and connectors.

Contractor has to provide the plan document related to preventive maintenance and servicing and should carry out the work in accordance to the same. Preventive maintenance work will involve checking and monitoring all the points as per the **FITP**. During the preventive maintenance schedule if any fault is find in positioning system then contractor should take the suitable steps to correct the trouble and bring the system in smooth functioning state.

5.2 BREAKDOWN MAINTENANCE - Breakdown maintenance work will involve trouble shooting of mechanical, electrical, electronic or any other system of the positioning system and solution of any other problem pointed out by SAC engineer, which inhibits the smooth operation and efficiency of the unit. Maintenance / Service engineers should come along with all the necessary tools and instruments in order to eliminate undue delay during the course of breakdown maintenance work.

A. Response time for failure analysis during AMC: After the complaint, the time between the arrival of the technical support personnel and proposal for remedial action shall not exceed 07 working days.

B. Repair time: The time between receipt of written proposal for remedial action and the ability to return the system to a working state shall be less than 14 working days excluding the time required to procure and supply the necessary part(s) at SAC.

C. Immediate online support (telephone, e-mail and internet) shall be provided when required.

D. Vendor should provide the price of all spare parts along with price validity of minimum 03 years with the offer in the prescribed format as given in Annexure-I.

22

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

E. Vendor should have their efficient mechanism for arrangement and procurement of branded and genuine spares/components through reputed dealers/stockiest/distributors, available in the market. Responsibility to ensure and endorse the reliability, trueness and legality with regard to source and method of procurement and supply of said items is entirely rest on the Vendor and subject of Vendor. SAC will not be responsible by any way, interfere in any matter or have concern by any means, during said process of procurement, arrangement and supply. Furnishing the details and confirmation in writing in these regards must be attached by the Vendor along with the offer.

F. Contractor will be called for breakdown maintenance visit at SAC and it is his responsibility to manage required spares to operationalize the positioners.

G. Maintenance / services visit charges for above mentioned categories of maintenance under this contract should include; Lump sum amount for service / maintenance charges, to and fro travel charges, lodging, boarding, local conveyance and excess baggage.

5.3 Calibration Work – For calibration work

A. Vendor will arrange all necessary calibration instrumentation.
B. Vendor will arrange all necessary logistic support during calibration activity.
C. Calibration activity of 02 different positioners will perform as per **CTP** (**C**alibration **T**est **P**lan).

5.4 Repair Work–

A. If any component of the positioner is repairable, in such case Contractor has to take prior approval from the SAC official to take the component to their premises for repairing.
B. It is responsibility of Contractor to arrange the collection of defective items for repairing from SAC and safely return to SAC free of charge.
C. After diagnosis, Contractor has to submit the quote and it has to be approved by SAC official.
D. Once SAC official approves the quotation, Contractor may start repairing work of the same. After repair contractor has to give warranty of at least 6 months in any kind of repairs. If the same problem occurs within the warranty period, Contractor has to repair it on their own without any additional charges.
E. Vendor has to furnish **bank guarantee** against the safety and security of the faulty component, which is to be collected and repaired at their premises by the vendor. The value of the said **bank guarantee** will be decided by SAC, based on cost of the component, which is to be repaired. The said **bank guarantee** will only be released after the receipt of the collected component in functional condition to SAC.

5.5 Supply of Spare Parts - The spare parts / components required at the time of maintenance shall be provided by SAC if available in stock. In case the spare parts are to be replaced by contractor, the charges for the same shall be paid extra at actual by SAC.
Contractor must refer the list (Annexure-I) of spare parts / components for commercial offer valid till the end of contract and should agree in writing while giving quotation, for supplying all spares of system listed in Annexure-I.

23

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

However, contractor should add items/spares, which they feel necessary for the said breakdown maintenance work. Payment shall be made accordingly if spare parts / components are replaced from list of Annexure-I by Contractor from their stock during Breakdown / Preventive maintenance of the said system.

In case the spare parts / components are to be replaced which are not in the list of Annexure-I, the charges for the same shall be paid at actual by SAC. In addition, category in which the above-referred spare parts/component will fall, be decided by the SAC official. Contractor shall take prior approval from SAC Officials / Division Head / General Manager / Group Director in such case. After completion of maintenance / service work service person of the contractor has to demonstrate the positioners in working condition for breakdown maintenance work he has carried out against the particular breakdown calls and provide the maintenance / service report prepared by him.

In general, following are two categories of spares (as indicated in the List of Annexure-I) may be needed during Preventive, repair and Breakdown maintenance work of the machines:

- **Minor/** wear & tear or consumable spares: Spares of this category should be arranged in two to three days (excluding Sundays & public holidays) beyond this time limit it should be considered to be delayed delivery of items.
- **Major/** breakdown Spares: Spares of this category should be arranged in ten to twelve days (excluding Sundays & public holidays) beyond this time limit it should be considered delayed delivery of items.

However, reasons for delay and non-availability of the spares and its genuineness of the situation will be reviewed by SAC official in order to rationalize the above said terms, case to case. However, decision in this regard shall entirely under discretion of SAC official and final, Vendor should abide to the same.

5.6 After completion of maintenance/service/repair work service person of the contractor has to demonstrate the positioner in full working condition and provide the maintenance/service report prepaid by him. However, please note that if subsequent to above work, calibration work is felt needed then the vendor should carry out calibration work to validate the positioning system.

Following table have the detailed scope of work related to every activity to finish the breakdown maintenance, preventive maintenance, repair maintenance and calibration of DUT Positioner and T - Scanners installed at NFTR/SAC.

Sr. No.	Type of work	Frequency	Quantum of work/ Scope of work
1	Breakdown Service visit	as and when required	Service includes: fault diagnosis, functional inspection, dismantling, part replacement, tuning of motion, motion verification, assembly and final test
2			Service includes functional inspection

24

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr. No.	Type of work	Frequency	Quantum of work/ Scope of work
	Calibration visit	Once in a year or as and when required	Laser alignment activity includes instrument and technical support staff
			Tuning of motion if required
3	Preventive maintenance visit	Max. Four times in year as and when required	Service includes: functional inspection, cleaning of mechanical parts, greasing and oiling, verification of electrical and control wiring, change the oil seals, Complete visual inspection of positioner, full motion verification with full load and no load condition
4	Spare Parts	as and when required	Identify the spare requirement, procurement and supply of the same to SAC
5	Logistic Support	as and when required	Decide the suitable equipment and arrange the same at SAC.

Promptness for respond: Contractor will have to attend the breakdown calls within **72 hours** after receipt of the calls through telephone / e-mail / fax, excluding the day of communication from SAC officials.

Prior approval: Contractor will have to inform & take prior approval from the SAC official regarding the names with mobile number or other personal required details of visiting service engineers and details of items carrying by them into the SAC campus.

25

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

6. Payment Terms:

6.1 Payment of Visit Charges for Breakdown / Preventive / Calibration / Repair work –
Payment will be made on successful completion of each Preventive work and for Calibration /Breakdown /Repair work; it will be paid after successful completion, testing and validation activities. The invoice in duplicate duly certified by the user and approved by Dy. Head/Head of the Division along with Job Completion Voucher (JCV), to the effect that the positioner / system is maintained / serviced satisfactorily, shall be submitted to Accounts Officer, Bills, SAC for releasing payment. Since this is a maintenance service contract no MIRVs will be issued for payment of service charges but End User has to provide satisfactory Job Completion Voucher (JCV) with contractor's invoice to Accounts with the approval of Dy. Head/Head of the Division.

6.2 Payment for Supply of Spares and Consumables –
Spares / components / consumables to be required at the time of servicing / maintenance of the positioner, shall be replaced with prior approval from the SAC Engineer / Division Head/ Group Director. Payment will be made based on original invoice along with the end user certificate duly approved by Head of the Division, that the charges of the spares are reasonable. The worn out / retrieved parts shall be SAC property.

6.3 Payment for Repairing of Positioner Components at Contractors Premises –
Contractor may take defective positioner components, electronics cards, motors, timers, drive and other items fitted in the Positioner to their premises after prior approval from concerned SAC Engineer / Division Head/ Group Director for repairing and charges for the same will be paid extra by SAC. Contractor would submit the estimated repair charges indicating warranty of such repaired/new parts replaced during repairing before starting the repairing work of such parts. Payment will be made after assembly of the repaired parts/spares with the positioner and demonstration of positioner in full working condition. Submission of invoices along with the end user certificate duly approved by Head of the Division that the repairing charges are reasonable is necessary.

It is responsibility of Contractor to arrange the collection of defective items for repairing from SAC and safely return to SAC free of charge.

6.4 Penalty of Rupees 5% of total visit charges per visit shall be deducted in case of delay in response by the contractor beyond 72 hours, excluding the day of communication from SAC officials, seeking the service engineer visit to SAC Ahmadabad. If the total delay in response is beyond Five days from date of communication, penalty of 10% of the visit charges shall be deducted for relevant visit for that particular complaint.

Penalty of Rupees 5% of basic cost of the spare shall be deducted in case of delay in delivery beyond the specified time limit as categorized in section 3.5 & tabulated in Annexure-I.

Penalty of Rupees 10% of visit charges shall be deducted in case of event, where contractor is not able to offer the system in full operational condition within 14 days from the receipt of written proposal for remedial action. This 14 days duration, will include repairing work at vendors facility/factory and testing

26

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

& validation time at SAC but excluding the time required to procure and supply the necessary part(s) at SAC.
However, reasons for delay, non- availability of service engineer/spare for maintenance/repair service and genuineness of the situation for such delay, will be reviewed by SAC officials in order to rationalize the above said terms, case to case. However, decision in this regard shall entirely under discretion of SAC officials and final, Contractor should abide by the same.

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

7. Duration of the Contract:

The contract will be awarded for a period of **36 months** from the date of the contract. The contract may be extended for **further 12 months with last same rates based on satisfactory services** of the Contractor and on mutual consent of both the parties, with same rates and terms and conditions. However, there is no guarantee of any extension or renewal of the contract after expiry of the initial 36 months.

7.1 Monitoring of Contract – SAC reserves the right to review and verify the progress of work at various stages / any time during the positioner maintenance work and adherence by the Contractor to the standards and procedures specified.

7.2 Termination of Contract – SAC reserves the right to terminate the contract if the performance / services of the contractor is not found satisfactory during the period of the contract, by giving one-month notice in writing without any financial implications on either side. SAC reserves the right to enter into parallel contract simultaneously or at any point of time during the period of the said contract with one or more contractors.

27

28

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

8. General Terms & Conditions:

1. Contractor must have suitable facilities like maintenance and calibration kit specifically required for repairing the positioner and must possess all the equipment / tools required at the time of breakdown / preventive maintenance work to be carried-out at SAC for the above positioner.
2. Contractor must have suitable workforce having expertise in Linux and C/C++, to update or modify the PID parameters through the programming software. Contractor can also collaborate with 3rd part having expertise in Linux and C/C++ based motion controller programming.
3. The Contractor's personnel will not be allowed entry into any building or laboratory in SAC other than those specified.
4. The personnel deployed should follow the general guidelines/ rules and work practices of the SAC while working at facility. He should also maintain the office discipline/ decorum during the duty hours at SAC.
5. However, along with the offer, contractor should communicate the name of the authorized person and the name of the service persons along with full communication details like; land line numbers of the office, mobile numbers of the said persons, e-mails and any other communication channel established by the company in order to make efficient communication.
6. The contractor shall be responsible to ensure the credentials of individuals deputed on job under the contract from the security point of view.
7. Vendor has to provide point-by-point compliance as per Annexure-IV.
8. The contract will be valid for a period of three years from the date of issuing the purchase order and can be further extended for maximum upto 01 year from the date of expiry of the current contract.
9. Vendor should deploy competent work force to execute such contract including graduate engineers having degree in Mechanical, Electrical or Mechatronics branch. Any loss, damage or breakage of the system or any loss to the SAC property, directly or indirectly linked to the mishandling or lack of knowledge by the vendor during the preventive maintenance or breakdown call shall be recovered from the vendor.
10. The vendor shall arrange all the required materials including cotton cloth, grease, oil, tools, forklift, crane etc. for carrying out preventive maintenance and attending breakdown calls.
11. Vendor shall carry out maintenance work on a mutually agreed time slot in every quarter.
12. The Vendor shall have to maintain a logbook recording details of the servicing work carried at SAC including replacement of parts, if any and fill the preventive maintenance checklist as specified in Table of Annexure-II.
13. Vendor shall be responsible to maintain the positioning system in good working condition.
14. In case spare part/s is/are not available with SAC, the same will be procured by the Vendor to make the system in working condition. SAC will reimburse cost of such spare part supplied by the Vendor against the bill. The requirements of part/s with cost is to be intimated in advance to SAC and the Vendor should obtain written concurrence before procuring the parts.
15. Only new components are to be supplied as and when required.
16. L1 will be decided based on the overall quoted prices of Preventive maintenance, Calibration and Breakdown. Vendor shall quote separately for AMC and components/parts as per Annexure-I in defined format for price bid.
17. Material handling equipment like Cranes, Forklift truck, etc. has to be arranged by the vendor as and when require.

PROPRIETARY NOTICE – This material is the property of Space Applications Centre (ISRO) Ahmedabad and contains proprietary information of SAC. The contents are for confidential use only and are not to be disclosed to any others in any manner, in whole or in part, except with the express written approval of Space Applications Centre (ISRO) Ahmedabad

29

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

18. Hydra operator must have accompanied with trained rigger.
19. Vendor should carry valid RTO documents for Hydra and other automobile mounted lifting equipment.
20. Form 10 with dates of validity, ensuring safety inspection of equipment including detail report of inspection carried out at the time of issuance of Form 10.
21. Driving license and training validity certificate of Hydra operator.
22. SAC will not be responsible for injury to vendor's personnel during material handling, dis-assembly, assembly or any other work.
23. Utmost care should be taken by your service persons while carrying out the job and ensure the safety of neighbouring instrument or whatsoever of SAC property.
24. Generally, the maintenance work will be carried out during normal working days (i.e. Monday to Friday) between 9.30 to 18.00 hours, unless otherwise mutually agreed upon to some other time schedule.
25. **INTELLECTUAL PROPERTY RIGHTS & CONFIDENTIALITY:** The Contractor shall not use technical information, reports and other related documents given by SAC during the course of his work for any purpose other than for carrying out the work under Contract to be finalized under this RFP.
26. **COVERAGE / RISK OF THE DEPLOYED SERVICE PERSONS:** Contractor is fully responsible for the safety of his service persons deployed at SAC. The contractor will be entirely held responsible in case of any accident, which leads to minor or major physical injury and loss of life of his personnel during the time of execution of contract at our premises due to natural calamities / accident explosion etc. if any.
27. SAC is not responsible for any kind of accident to the persons deployed by contractor and no provision has been made to provide any financial assistance / any kind of compensation or cost incurred in connection with such kind of incidence.
28. **SECURITY:** Contractor shall produce the identity certificate / card which reveals the details like name of the personnel deployed, his date of birth, etc. with duly signed by the person deployed for the work. However, contractor should be ready for any other formalities, which may be required by competent authority of the SAC at the time of finalization of contract and it should be complied.
29. **ARBITRATION:** Dispute, if any, shall be settled mutually, failing which it shall be referred to a one-man Arbitrator appointed by the Director, SAC Ahmedabad in accordance with Arbitration Act 1996, whose decision shall be final and binding on both the parties.
30. **FALL CLAUSE:** The rates charged by the vendor for the work, shall in no event exceed the lowest rates charged for the work of identical description, to any other party during the validity of the agreed rates. If, at any time during the said period, the Vendor reduces the rates for the work to any other party, he shall forthwith notify such reduction of rates applicable to the undersigned and the rates payable under this contract for the work shall stand correspondingly reduced.

Vendor must perform functional inspection in presence of NFTR engineer and submit the inspection report duly signed by facility In-charge/engineer in the form of printed hard copy

30

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Annexure-I: Price Bid Format

Sr. No	Type of work	Frequency	Quantum of work/ Scope of work	Unit Price valid up to 3 Years	Remarks
1	Breakdown Service visit	as and when require	Service charges per day (including required person for fault diagnosis, functional inspection, dismantling, part replacement, tuning of motion, motion verification, assembly and final test) (Definition of unit = per days)		Definition of Unit Price: per day Though it is per day, the no. of days that will be consumed for breakdown service, will be decided jointly by SAC and Vendor
2	Calibration visit	Max. Once in a year (as and when require)	Service charges includes functional inspection laser alignment activity charges includes instrument and support staff tuning of motion charges if required		Definition of Unit Price: per visit Service charges for calibration visit for two days will be quoted as a lump sum price and will be considered as a unit price for that activity
3	Preventive maintenance visit	Need based (minimum 02 days per visit)	Service charges for two days (including required person for functional inspection, tuning of motion, cleaning of mechanical parts, greasing and oiling, verification of electrical and control wiring, change the oil seals, timing belt tension verification, Complete visual inspection of positioner, full motion verification with and without load)		Definition of Unit Price: per visit Service charges for preventive maintenance visit for two days will be quoted as a lump sum price and will be considered as a unit price for that activity.
4	Logistic Support	as and when require	Crane with operator 12 – 14 Ton Capacity		Definition of Unit price: 24 hours from Logistic support availability at NFTR/SAC
			Forklift with 2 Ton Load Capacity		
			Forklift with 5 Ton Load Capacity		
			Forklift with 10 Ton Load Capacity		
			Lifting Tripod upto 1000 Kg load capacity with Laborer		
			Shifting of any part to vendor premises (without FIM) – required truck upto 25 feet – open		

31

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Spare Part List –

Sr No.	Devices	Detailed specification	Unit Price valid up to 3 Years	Spare/item category
1	Motor	Callan Make Permanent Magnet DC Servomotor, Type: M4-2952A-YY0Y3-225 with Tacho		Major
2	Motor	Callan Make Permanent Magnet DC Servomotor Type: M4-2006D-YY001-142 with Tacho		Major
3	Encoder	FENAC Make FNC 58B 10630V5000-R5, PPR – 5000		Major
4	Encoder	BTH Make Incremental Rotary Encoder Model: BI-38H8-2000-L5		Major
5	Encoder	Autonics Make Rotary Incremental Encoder Model: E4056-2000-6-L-5		Major
6	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 75E3UCH2F		Major
7	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 45E30CH2F		Major
8	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 75M60CRU1		Major
9	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 90E90CH2F		Major
10	Gear box	DYNABOX EXPERT Make Girard Transmissions Type: 80E80CH1F		Major
11	DC Servo Drive	100 volt 30 Amp ADVANCED Motion Controls Part No. AB30A200I - X		Major
12	Remote IO	Selector Card 8-16 Beckhoff Make Part No. XB6cd226B		Major
13	Remote IO	Remote I/o Beckhoff 40 input 24 output Part No. RIO-PM-00E (Ethercat Remote IO)		Major
14	Linear Fast Switching DIO	Lenze Make Fast Switching Module Part No. El21-24-0010 Galvanic isolated		Major
15	Remote IO	Beckhoff Make Part No. Ek1101-0090 Remote Bus Station ID-Switch		Major
16	Relay Board	Brake unit for Servo motor Schneider Electric PM-01		Major

32

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr No.	Devices	Detailed specification	Unit Price valid up to 3 Years	Spare/item category
17	Remote IO	Beckhoff Make (custom) Encoder Interface unit for E-bus		Major
18	Remote IO	Tacho Feedback unit for 0-10 volt analog in El3xxx		Major
19	RTOS	Linx Make RT License for Motion controller		Major
20	Driver File	DLL for Ethercat Bus to support various hardware (Custom made by OEM)		Major
21	Limit Switch	Telemecanique Make XCE102C, IEC600947 – 5 – 1, Same Polarity only		Minor
22	Homing Switch	Telemecanique XCE102C, IEC600947 – 5 – 1, Same Polarity only		Minor
23	Panel connector	Amphenol Aero MS3474W16-26S		Minor
24	Connector for end-1	Amphenol Aero MS3476W16-26P		Minor
25	Connector for end-2	Amphenol Aero MS3476W16-26P		Minor
26	Ball Screw	C3 Precision Make ground Pitch 5mm & Diameter 30 mm		Minor
27	SMPS	Siemens Make 50 Amp 90 volt DC Part No. 6EP1336-1LD00		Minor
28	Bias Control	Balluff Switch with relay (for Limits)		Minor
29	Panel Connector	Amphenol Make MS3474W16-26S		Minor
30	SMPS	Siemens Make Control Power Supply 24/12/5 V DC 10 Amp		Minor
31	Siemens	Power Filter unit Meanwell for Trigger pulse		Minor
32	Panel Connector	Amphenol Aero MS3102E20-29SW (LCU Interface)		Minor
33	Relay	Relay Card Siemens Make 220 volt / 5 Amp		Minor
34	Power Contactor	Schneider Make Part No. Sc10 Power Contactor		Minor
35	Push Buttons	Schneider Make standard		Minor
36	Potentiometer Knob	Takushi Make		Minor
37	LM Guideways			Minor
38	Rack & Pinion			Minor
39	Slewing Bearing			Minor

33

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Sr No.	Devices	Detailed specification	Unit Price valid up to 3 Years	Spare/item category
40	Ball Screw			Minor

34

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Annexure-II: Preventive Maintenance Checklist

FITP (Functional Inspection Test Plan)

Format for functional inspection report (to be submitted in every quarter)

Sr No	Positioner and Axis	Parameters	Status	Remarks
1	DUT Positioner	Visual inspection of DUT Positioner		
2		Check Timing belt tension of all axes and adjust if required		
3		Check control cable connections. Clean and secure connectors and cables.		
4	DUT Positioner Controller	Visual inspection of DUT Positioner Controller		
5		Check exterior and interior of motion controller.		
6		Adjustment / Tuning of axis motion through optimizing the PID parameter in control software		
7	DUT – Linear Slide Axis	Verification of movement in forward direction		
8		Verification of movement in reverse direction		
9		Limit to limit movement of linear slide in both direction		
10		Movement verification with fine speed selection		
11		Movement verification with Coarse speed selection		
12		Greasing of Rack & Pinion and Lm Guides		
13		Oiling of Reduction Gear Boxes		
14	DUT – Azimuth Axis	Verification of movement in forward (+) direction		
15		Verification of movement in reverse (-) direction		
16		Limit to limit movement of azimuth axis rotation in both direction		
17		Movement verification with fine speed selection		
18		Movement verification with Coarse speed selection		
19		Functional Verification of Electromechanical brakes		
20		Greasing of Slewing Bearing		
21		Oiling of Reduction Gear Boxes		
22	DUT – Elevation Axis	Verification of movement in forward (+) direction		
23		Verification of movement in reverse (-) direction		
24		Limit to limit movement of elevation axis rotation in both direction		
25		Movement verification with fine speed selection		
26		Movement verification with Coarse speed selection		
27		Functional Verification of Electromechanical brakes		
28		Greasing of Slewing Bearing		

35

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

29		Oiling of Reduction Gear Boxes		
30	DUT – Polarization Axis	Verification of movement in forward (CW) direction		
31		Verification of movement in reverse (CCW) direction		
32		Limit to limit movement of polarization axis rotation in both direction		
33		Movement verification with fine speed selection		
34		Movement verification with Coarse speed selection		
35		Functional Verification of Electromechanical brakes		
36		Greasing of Slewing Bearing		
37		Oiling of Reduction Gear Boxes		
38	T-Scanner	Visual inspection of FEED Positioner		
39		Check Timing belt tension of all axes and adjust if required		
40		Check control cable connections. Clean and secure connectors and cables.		
41	T-Scanner Controller	Visual inspection of T-Scanner Controller		
42		Check exterior and interior of motion controller.		
43		Adjustment / Tuning of axis motion through optimizing the PID parameter in control software		
44	T-Scanner – Linear Slide X-axis	Verification of movement in forward (+) direction		
45		Verification of movement in reverse (-) direction		
46		Limit to limit movement of linear slide axis in both direction		
47		Movement verification with fine speed selection		
48		Movement verification with Coarse speed selection		
48		Greasing of Linear Bearings/ Lm Guides		
49		Greasing of Rack & Pinion		
50	T-Scanner – Linear Slide Y-axis	Verification of movement in forward (+) direction		
51		Verification of movement in reverse (-) direction		
52		Limit to limit movement of linear slide axis in both direction		
53		Movement verification with fine speed selection		
54		Movement verification with Coarse speed selection		
55		Greasing of Linear Bearings/ Lm Guides		
56		Greasing of Rack & Pinion		
57	T-Scanner – Linear Slide Z-axis	Verification of movement in forward (+) direction		
58		Verification of movement in reverse (-) direction		
59		Limit to limit movement of azimuth axis rotation in both direction		
60		Movement verification with fine speed selection		
61		Movement verification with Coarse speed selection		

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

62		Greasing of Slewing Bearing		
63		Oiling of Reduction Gear Boxes		
64	T-Scanner – Roll axis	Verification of movement in forward (CW) direction		
65		Verification of movement in reverse (CCW) direction		
66		Limit to limit movement of polarization axis rotation in both direction		
67		Movement verification with fine speed selection		
68		Movement verification with Coarse speed selection		
69		Greasing of Slewing Bearing		
70		Oiling of Reduction Gear Boxes		
Any Specific remark related to DUT Positioner				
Any Specific remark related to T-Scanner				

Functional Inspection Performed by: _____

Remarks by NFTR - SAC Engineer: _____

_____

SAC Engineer Present During Functional Inspection: _____

Remarks by NFTR Incharge: _____

NFTR Incharge Signature: _____

36

37

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Annexure-III: Calibration Test Plan

CTP (Calibration Test Plan)

Format for Calibration inspection report (to be submitted in every year)

Sr No.	Description		Units	Required Results	Measured Results
1	**Travel Direction Test**				
	Linear X-Slide axis	FWD		OK	
		REV		OK	
	Linear Y-Slide axis	FWD		OK	
		REV		OK	
	Linear Z- Slide axis	FWD		OK	
		REV		OK	
	Roll axis	FWD		OK	
		REV		OK	
2	**Limit to Limit Travel**				
	Linear X-Slide axis		mm	+4500	
	(including homing @ center)		mm	-4500	
	Linear Y-Slide axis		mm	+3000	
	(including homing @ center)		mm	-3000	
	Linear Z-Slide axis		mm	-125	
	(including homing @ center)		mm	+125	
	Roll axis		deg	360	
3	**Safe Operate Switch Test**				
	SAFE/OPERATE Switch			OK	
	EMERGENCY Stop			OK	
4	**Repeatability Test**				
	Linear X-Slide axis		mm	Less than 0.05	
	Linear Y-Slide axis		mm	Less than 0.05	
	Linear Z-Slide axis		mm	Less than 0.05	
	Roll axis		deg	Less than 0.05	
5	**Positioning Accuracy**				
	Linear X-Slide axis		mm	Less than 0.1	
	Linear Y-Slide axis		mm	Less than 0.1	
	Linear Z-Slide axis		mm	Less than 0.1	
	Roll axis		deg	Less than 0.1	
6	**Overall Planarity**		Less than 0.12 mm over the full 9 m x 6 m Rectangular scan grid		

Parameters	Unit	Required Results	Measured Results

38

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Parallelism between T-scanner Roll axis and Z-axis		deg	± 0.02	
Orthogonality between T-scanner Z-axis and Y-axis		deg	± 0.02	
Orthogonality between T-scanner Y-axis and X-axis		deg	± 0.02	

Sr No.	Description		Units	Required Results	Measured Results
1	**Travel Direction Test**				
	Lower Linear Slide axis	FWD		OK	
		REV		OK	
	Azimuth axis	FWD		OK	
		REV		OK	
	Elevation axis	FWD		OK	
		REV		OK	
	Roll axis	FWD		OK	
		REV		OK	
2	**Limit to Limit Travel**				
	Lower Linear Slide axis (including homing @ center)		mm	+1000	
			mm	-1000	
	Azimuth axis (including homing @ pre-defined position)		deg	+182	
			deg	-182	
	Elevation axis (including homing @ pre-defined position)		deg	-25	
			deg	+92	
	Roll axis		Deg	360	
3	**Safe Operate Switch Test**				
	SAFE/OPERATE Switch			OK	
	EMERGENCY Stop			OK	
4	**Repeatability Test**				
	Linear X-Slide axis		mm	Less than 0.03	
	Azimuth axis		deg	Less than 0.02	
	Elevation axis		deg	Less than 0.02	
	Roll axis		deg	Less than 0.02	
5	**Positioning Accuracy**				
	Linear X-Slide axis		mm	Less than 0.05	
	Azimuth axis		deg	Less than 0.03	
	Elevation axis		deg	Less than 0.03	
	Roll axis		deg	Less than 0.03	

Parameters	Unit	Required Results	Measured Results
Parallelism of DUT Roll axis with T-scanner Z-axis	deg	± 0.02	
Parallelism of DUT Azimuth axis with DUT Roll axis	deg	± 0.02	
Orthogonality between DUT Linear slide axis and DUT azimuth axis	deg	± 0.1	

39

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

Orthogonality between DUT Azimuth and DUT Elevation axis	deg	± 0.1	
Orthogonality between DUT Elevation and DUT Roll axis	deg	± 0.1	

Sr No	Positioner and Axis	Parameters	Status	Remarks
1	DUT Positioner	Visual inspection of DUT Positioner		
2		Check Timing belt tension of all axes and adjust if required		
3		Check control cable connections. Clean and secure connectors and cables.		
4	DUT Positioner Controller	Visual inspection of DUT Positioner Controller		
5		Check exterior and interior of motion controller.		
6		Adjustment / Tuning of axis motion through optimizing the PID parameter in control software		
7	DUT – Linear Slide Axis	Verification of movement in forward direction		
8		Verification of movement in reverse direction		
9		Limit to limit movement of linear slide in both direction		
10		Movement verification with fine speed selection		
11		Movement verification with Coarse speed selection		
12		Greasing of Rack & Pinion and Lm Guides		
13		Oiling of Reduction Gear Boxes		
14	DUT – Azimuth Axis	Verification of movement in forward (+) direction		
15		Verification of movement in reverse (-) direction		
16		Limit to limit movement of azimuth axis rotation in both direction		
17		Movement verification with fine speed selection		
18		Movement verification with Coarse speed selection		
19		Functional Verification of Electromechanical brakes		
20		Greasing of Slewing Bearing		
21		Oiling of Reduction Gear Boxes		
22	DUT – Elevation Axis	Verification of movement in forward (+) direction		
23		Verification of movement in reverse (-) direction		
24		Limit to limit movement of elevation axis rotation in both direction		
25		Movement verification with fine speed selection		
26		Movement verification with Coarse speed selection		
27		Functional Verification of Electromechanical brakes		

40

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

28		Greasing of Slewing Bearing		
29		Oiling of Reduction Gear Boxes		
30	DUT – Polarization Axis	Verification of movement in forward (CW) direction		
31		Verification of movement in reverse (CCW) direction		
32		Limit to limit movement of polarization axis rotation in both direction		
33		Movement verification with fine speed selection		
34		Movement verification with Coarse speed selection		
35		Functional Verification of Electromechanical brakes		
36		Greasing of Slewing Bearing		
37		Oiling of Reduction Gear Boxes		
38	T-Scanner	Visual inspection of FEED Positioner		
39		Check Timing belt tension of all axes and adjust if required		
40		Check control cable connections. Clean and secure connectors and cables.		
41	T-Scanner Controller	Visual inspection of T-Scanner Controller		
42		Check exterior and interior of motion controller.		
43		Adjustment / Tuning of axis motion through optimizing the PID parameter in control software		
44	T-Scanner – Linear Slide X-axis	Verification of movement in forward (+) direction		
45		Verification of movement in reverse (-) direction		
46		Limit to limit movement of linear slide axis in both direction		
47		Movement verification with fine speed selection		
48		Movement verification with Coarse speed selection		
48		Greasing of Linear Bearings/ Lm Guides		
49		Greasing of Rack & Pinion		
50	T-Scanner – Linear Slide Y-axis	Verification of movement in forward (+) direction		
51		Verification of movement in reverse (-) direction		
52		Limit to limit movement of linear slide axis in both direction		
53		Movement verification with fine speed selection		
54		Movement verification with Coarse speed selection		
55		Greasing of Linear Bearings/ Lm Guides		
56		Greasing of Rack & Pinion		
57	T-Scanner – Linear Slide	Verification of movement in forward (+) direction		
58		Verification of movement in reverse (-) direction		

41

	Space Applications Centre Indian Space Research Organisation Ahmedabad – 380015	RFP Document Ver 1.4

59	Z-axis	Limit to limit movement of azimuth axis rotation in both direction		
60		Movement verification with fine speed selection		
61		Movement verification with Coarse speed selection		
62		Greasing of Slewing Bearing		
63		Oiling of Reduction Gear Boxes		
64	T-Scanner – Roll axis	Verification of movement in forward (CW) direction		
65		Verification of movement in reverse (CCW) direction		
66		Limit to limit movement of polarization axis rotation in both direction		
67		Movement verification with fine speed selection		
68		Movement verification with Coarse speed selection		
69		Greasing of Slewing Bearing		
70		Oiling of Reduction Gear Boxes		
Any Specific remark related to DUT Positioner				
Any Specific remark related to T-Scanner				

Functional Inspection Performed by: _____

Remarks by NFTR - SAC Engineer: _____

_____

SAC Engineer Present During Functional Inspection: _____

Remarks by NFTR Incharge: _____

NFTR Incharge Signature: _____

