

## SECTION - C

### **TECHNICAL SPECIFICATIONS OF STORES AND DRAWINGS.**

#### **Technical Specifications for RF Coaxial Switches and Bi-directional Coupler**

##### **INTRODUCTION:**

In ADITYA Upgrade (ADITYA-U) machine it was proposed to increase the ICRH power level from the present 200 kW to up to 500 kW. For this it was decided to use two separate ICRH transmission line and antenna system to inject power from two separate locations (R15 and R20 ports) of the ADITYA-U machine. The ICRH antenna, which is placed inside the vacuum vessel is fed by set of rigid transmission line sections with help of coaxial switches to divert power to Port R15 or Port R20.

In order to get best optimized Tx-line layout to feed RF power to both Aditya and SST1 ICRH systems, we require one additional 9-3/16 inch coaxial switch, one 9-3/16 Bi-directional coupler (DC) and one 6 1/8 inch coaxial switch.

The vendors are requested to study it in detail and offer best of their quotations. The vendor is supposed to be competent enough to deal in RF transmission component fabrication, handling and testing and does necessarily required to have an expertise in high power RF transmission technology.

##### **ITEMS:**

##### **(1) 9-3/16 inch Coaxial RF switch (4-Port)**

Quantity: 1 No.

##### **RF POWER SPECIFICATIONS**

Average Power Handling: 500 kW

Pulse Length: 2000 Sec. (CW)

##### **DESCRIPTION**

Size: 9-3/16 inch standard

Material: Aluminium Alloy / Copper

Connector: Std. Anchor (Male Type)

Style: DPDT (2- Way Switch)

Operation: Motorized (remote operation) with manual override.

Actuation voltage : to be specified (preferably 12-24 VDC)

Switching time : < 1 min.

Switching Life (Cycle) : > 10,000 operations

##### **ELECTRICAL SPECIFICATIONS**

Frequency: 20-70 MHz

Impedance: 50 Ohms

Insertion Loss:  $\leq 0.1$  dB  
Isolation:  $>60$  dB  
VSWR:  $\leq 1:05:1$   
Operating Voltage: 230 VAC  $\pm 10$  %, 50 Hz

**OTHER SPECIFICATIONS**

Ambient temperature:  $+10$  °C  $\leq \vartheta \leq +50$  °C  
Motor controller for the switch (remote operation): software shall be provided.  
Design need to be compact.  
Powder Coated/Painted on the outer surface of the item.  
For switch position, visual indicator is required.  
Size and Weight : To be specified by vendor  
Note: for any other requirements, vendor need to specify clearly.

**(2) 6-1/8 inch Coaxial RF switch (4-Port)**

Quantity: 1 No.

**RF POWER SPECIFICATIONS**

Average Power Handling: 200 kW  
Pulse Length: 2000 sec. (CW)

**DESCRIPTION:**

Size: 6-1/8 inch EIA standard  
Material: Aluminium Alloy / Copper  
Connector: Std. Anchor (Male Type)  
Style: DPDT (2- Way Switch)  
Operation: Motorized (remote operation) with manual override  
Actuation voltage : to be specified (preferably 12-24 VDC)  
Switching time :  $< 1$  min.  
Switching Life (Cycle) :  $> 10,000$  operations

**ELECTRICAL SPECIFICATIONS**

Frequency: 20-70 MHz  
Impedance: 50 Ohms  
Insertion Loss:  $\leq 0.1$  dB  
Isolation:  $>60$  dB  
VSWR:  $\leq 1:05:1$   
Operating Voltage: 230 VAC  $\pm 10$  %, 50 Hz

**OTHER SPECIFICATIONS**

Ambient temperature:  $+10$  °C  $\leq \vartheta \leq +50$  °C  
Motor controller for the switch (remote operation): Software shall be provided.  
Design need to be compact.  
Powder Coated/Painted on outer surface of the item.  
For switch position, visual indicator is required.

Size and Weight : To be specified by vendor  
Note: for any other requirements, vendor need to specify clearly.

**(3) 9-3/16 Coaxial Bi-directional Coupler**

Quantity: 1 No.

**POWER SPECIFICATIONS**

Input power: 500 kW  
Pulse Length: 2000 Sec. (CW)

**DESCRIPTION**

Size: 9-3/16 inch standard  
Material: Aluminium Alloy / Copper  
Connector: Std. Anchor (Male Type)  
Style: Vestigial Loop Type

**ELECTRICAL SPECIFICATIONS**

Frequency: 20-70 MHz  
Impedance: 50 Ohms  
Insertion Loss: < 0.1 dB  
Isolation: > 60 dB  
VSWR: ≤ 1:05:1  
Forward & Reverse Coupling: 50-60 dB +/- 1 dB of Nominal  
(Provide coupling curve along with offer)  
Directivity: > 25 dB Nominal

**OTHER SPECIFICATIONS:**

Ambient temperature:  $+10\text{ }^{\circ}\text{C} \leq \theta \leq +50\text{ }^{\circ}\text{C}$   
Design need to be compact.  
Powder Coated/Painted on outer surface of the item.  
Size and Weight : To be specified by vendor  
Note: for any other requirements, vendor need to specify clearly.

**General Note for All the Items**

- 1) Compliance statement shall be provided along with the quotation. Numerical values must be specified in the statement.
- 2) RF leakage from the component shall be less than 1 mW/cm<sup>2</sup> at 10 cm distance. A certificate of conformity shall be provided.
- 3) Materials/Alloys to be used should be specified.
- 4) The drawings including dimensions should be provided.
- 5) The Switch actuating voltage/current and motor details along with control circuit shall be provided. The control circuit electronics hardware should be provided for the switch actuation.

- 6) Mating connectors (for electrical/rf connections) with part details shall be provided.
- 7) Operating manual and service manual shall be provided.
- 8) Average power V/s frequency plot to be provided by the vendor.
- 9) The order can be splitted if required.

**General conditions for the acceptance:**

The components shall be tested as per following conditions for acceptance at factory as well at IPR.

An acceptance test procedure is to be prepared by the vendor and submitted to IPR for review and approval, 30 days prior to start of acceptance test. As a minimum, the test procedure shall include a description of the test method and equipment setup, a list of test instrument, a test data section showing all data entries for acceptance.

**Factory Acceptance Test (FAT):**

The following tests shall be carried out at vendor's site by the vendor to establish the functional requirements of above listed items.

**(a) Coaxial RF switch(s)**

- 1) Dimensions check as per engineering drawing/s. User end flange(s) drawings and overall dimensional drawings shall be provided.
- 2) Measurement of the low power rf parameters: Following low power rf measurement should be carried out using Vector Network Analyzer (VNA) for entire frequency range. The results shall be recorded and submit to IPR for approval.
  - (i) Insertion loss
  - (ii) VSWR
  - (iii) Isolation
  - (iv) Impedance
- 3) Switching position movement: Manual and with motor
- 4) Pneumatic pressure test (if applicable): The test for switch shall be carried out by pressurizing the switch with the gas (N2 or dry air). The gas pressure test up to 1.1 times the working pressure during 8 hours.

**(b) Coaxial Bi-directional Coupler**

- 5) Dimensions check as per engineering drawing/s. User end flange(s) drawings and overall dimensional drawings shall be provided.
- 6) Measurement of low power rf parameters: Following low power rf measurement should be carried out using Vector Network Analyzer for entire frequency range. The results shall be recorded and same shall be submitted to IPR for approval.
  - (v) Insertion loss

- (vi) VSWR
- (vii) Isolation
- (viii) Directivity
- (ix) Coupling
- (x) Impedance

**Acceptance test at IPR**

All the tests mentioned in Test at Factory (FAT) shall also be carried out at IPR (Presence of Vendor's representative not required).

Additionally high power rf test shall be carried out at IPR to check the high power handling capabilities of the coaxial RF switch(es) and Bi-directional coupler.

Final acceptance shall be given after completing all the tests successfully.

**General Condition**

**Delivery Schedule :-** Within 120 days from the date of purchase order/contract.

**Dispatch:** Material should be dispatched to IPR only after getting the dispatch clearance certificate from IPR.

**Packing:** Deliverable items need to be packed with proper standard soft material to avoid damages. All items should be packed in suitable wooden boxes. Flanges shall be masked with proper covers to avoid damage during handling and transportation. Packing should be sturdy and rigid enough to withstand shocks and vibrations during transportation. Any damage to deliverable items during transportation or any other cause, will not be accepted and damaged item(s) will be returned back to the vendor site at vendor's cost and after repair/modification item(s) should be re-shipped to IPR with time frame agreed mutually.

**Warranty:** 12 months warranty against the manufacturing defect from the date of acceptance of material at IPR.

**Performance Guarantee:**

**For ITEM (1)** Party has to guarantee 9-3/16 inch Coaxial RF switch operation under matched load at 20-70 MHz, 500 kW [2000 sec. (CW)]. Certificate of compliance should be provided for the specified duration and power level.

**For ITEM (2)** Party has to guarantee 6-1/8 inch Coaxial RF switch operation under matched load at 20-70 MHz, 200 kW [2000 sec. (CW)]. Certificate of compliance should be provided for the specified duration and power level.

**For ITEM (3)** Party has to guarantee 9-3/16 inch Bi-directional coupler operation under matched load at 20-70 MHz, 500 kW [2000 sec. (CW)]. Certificate of compliance should be provided for the specified duration and power level.

## Compliance Sheet

<b>ITEM (1) Technical Compliance Sheet [9-3/16 inch Coaxial RF switch (4-Port)]</b>		
<b>IPR Specifications</b>	<b>Vendor's Specification</b>	<b>Comply (Y/N)</b>
Quantity: 1 No.		
<b>RF POWER SPECIFICATIONS</b>		
Average Power Handling: 500 kW		
Pulse Length: 2000 Sec. (CW)		
<b>DESCRIPTION</b>		
Size: 9-3/16 inch standard		
Material: Aluminium Alloy / Copper		
Connector: Std. Anchor (Male Type)		
Style: DPDT (2- Way Switch)		
Operation: Motorized (remote operation) with manual override.		
Actuation voltage: to be specified (preferably 12-24 VDC)		
Switching time: < 1 min.		
Switching Life (Cycle) : > 10,000 operations		
<b>ELECTRICAL SPECIFICATIONS</b>		
Frequency: 20-70 MHz		
Impedance: 50 Ohms		
Insertion Loss: ≤ 0.1 dB		
Isolation: >60 dB		
VSWR: ≤ 1:05:1		
Operating Voltage: 230 VAC ± 10 %, 50 Hz		
<b>OTHER SPECIFICATIONS</b>		
Ambient temperature: +10 °C ≤ θ ≤ +50 °C		
Motor controller for the switch (remote operation): software shall be provided (if applicable).		
Powder Coated/Painted on the outer surface of the item.		
For switch position, visual indicator is required.		
Size and Weight : To be specified by vendor		

Factory Acceptance Test: The test results shall be submitted to IPR for approval (Agreed/Not Agreed)		
Site Acceptance Test: Final approval after SAT (Agreed/Not Agreed)		
Performance Guarantee: Certificate of compliance for rf power handling (duration and power level) shall be provided		
RF leakage from the component shall be less than 1 mW/cm <sup>2</sup> at 10 cm distance (A certificate of compliance shall be provided)		
<b>ITEM (2) Technical Compliance Sheet [6-1/8 inch Coaxial RF switch (4-Port)]</b>		
IPR Specifications	Vendor's Specifications	Comply (Y/N)
Quantity: 1 No.		
<b>RF POWER SPECIFICATIONS</b>		
Average Power Handling: 200 kW		
Pulse Length: 2000 Sec. (CW)		
<b>DESCRIPTION</b>		
Size: 6-1/8 inch EIA standard		
Material: Aluminium Alloy / Copper		
Connector: Std. Anchor (Male Type)		
Style: DPDT (2- Way Switch)		
Operation: Motorized (remote operation) with manual override		
Actuation voltage: to be specified (preferably 12-24 VDC)		
Switching time: < 1 min.		
Switching Life (Cycle) : > 10,000 operations		
<b>ELECTRICAL SPECIFICATIONS</b>		
Frequency: 20-70 MHz		
Impedance: 50 Ohms		
Insertion Loss: ≤ 0.1 dB		
Isolation: >60 dB		
VSWR: ≤ 1:05:1		
Operating Voltage: 230 VAC ± 10 %, 50 Hz		
<b>OTHER SPECIFICATIONS</b>		
Ambient temperature: +10 °C ≤ θ ≤ +50 °C		
Motor controller for the switch (remote operation): software shall be provided (if applicable).		
Powder Coated/Painted on the outer surface of		

the item		
For switch position, visual indicator is required		
Size and Weight : To be specified by vendor		
Factory Acceptance Test: The test results shall be submitted to IPR for approval (Agreed/Not Agreed)		
Site Acceptance Test: Final approval after SAT (Agreed/Not Agreed)		
Performance Guarantee: Certificate of compliance for rf power handling (duration and power level)		
RF leakage from the component shall be less than 1 mW/cm <sup>2</sup> at 10 cm distance (A certificate of compliance shall be provided)		

<b>ITEM (3) Technical Compliance Sheet [9-3/16 Coaxial Bi-directional Coupler]</b>		
<b>IPR Specifications</b>	<b>Vendor's Specifications</b>	<b>Comply (Y/N)</b>
Quantity: 1 No.		
<b>RF POWER SPECIFICATIONS</b>		
Average Power Handling: 500 kW		
Pulse Length: 2000 Sec. (CW)		
<b>DESCRIPTION</b>		
Size: 9-3/16 inch standard		
Material: Aluminium Alloy / Copper		
Connector: Std. Anchor (Male Type)		
Style: Vestigial Loop Type		
<b>ELECTRICAL SPECIFICATIONS</b>		
Frequency: 20-70 MHz		
Impedance: 50 Ohms		
Insertion Loss: ≤ 0.1 dB		
Isolation: >60 dB		
VSWR: ≤ 1:05:1		
Forward & Reverse Coupling: 50-60 dB +/- 1 dB of Nominal		
Directivity: > 25 dB Nominal		



<b>OTHER SPECIFICATIONS</b>		
Ambient temperature: $+10\text{ }^{\circ}\text{C} \leq \theta \leq +50\text{ }^{\circ}\text{C}$		
Powder Coated/Painted on the outer surface of the item.		
For switch position, visual indicator is required		
Size and Weight : To be specified by vendor		
Factory Acceptance Test: The test results shall be submitted to IPR for approval (Agreed/Not Agreed)		
Site Acceptance Test: Final approval after SAT (Agreed/Not Agreed)		
Performance Guarantee: Certificate of compliance for rf power handling (duration and power level)		
RF leakage from the component shall be less than $1\text{ mW/cm}^2$ at 10 cm distance (A certificate of compliance shall be provided)		