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	TECHNICAL SPECIFICATION ON TRAVELLING IN-CORE PROBE (TIP) SYSTEM	PAGE NO 1 OF 9 REV. NO. : 1

1.0 SCOPE

This specification establishes the requirements for preparation of detail drawings, manufacturing, inspection, testing, packing, delivery at site, installation and commissioning, integration with other systems at plant and guarantee of Travelling In-core Probe (TIP) system for 700MWe PHWR Projects. This specification also covers the requirements of integration and commissioning of TIP detector, associated amplifiers, movable panel, TIP drive mechanism and demonstration of the intended functionality. The TIP system shall meet all the requirements specified here in this specification.

2.0 CONTENTS


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3.0 APPLICABLE DRAWINGS & SPECIFICATION

3.1 Applicable Specifications

Applicable specifications for various components/subsystems of TIP system are given below. Each specification specifies applicable codes, standards for respective components.

Applicable Documents	Description
PC-E-780 :	Miniature fission chamber for Travelling In-core Probe (TIP) detector.
PC-E-781 :	Travelling In-core Probe Amplifier for 700MWe PHWRs.
PC-E-1119 :	Travelling In-Core Probe (TIP) Drive Mechanism.

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3.2 Applicable Drawings

The applicable conceptual / schematic drawings for various components/subsystems of TIP system are covered in respective specifications as listed in section-3.1

4.0 MATERIAL AND WORKMANSHIP

Materials and components which are necessary for fulfillment of this specification shall be of good quality and in accordance with good industrial practices. Materials and components shall be as per specifications & standards listed in section-3.1. The details of material used for each component should be noted in drawings submitted for approval prior to fabrication/production. Prior intimation and acceptance shall be obtained from NPCIL regarding selection of material. Each item shall have identification and marking.

The process and workmanship shall be in accordance with high grade practice to ensure satisfactory operation and service life in accordance with the provisions of this specification. All materials, parts and components shall be new.

The machines and processes used for manufacture shall ensure consistent surface finish and dimensional tolerances specified in the component drawings. All parts shall be free of sharp edges, sharp corners, burrs, nicks, cuts, scratches and other visible defects.

5.0 GENERAL DESCRIPTION OF SYSTEM:

The TIP System is required for the measurement of neutron flux inside the reactor core during initial Phase-B experiment after reactor start-up at low power i.e. 10^{-6} FP (i.e. 0.0001%FP) to 10^{-3} FP (i.e. 0.1%FP). The system consists of Travelling Incore Probe (TIP) detector, Amplifiers, TIP drive mechanism and movable panel for mounting required hardware as shown in Fig-1 typically for one drive. Movable panel shall include all the eight drive electronics for its operation.

The TIP system is required to position TIP detector in Reactor core through Vertical/Horizontal Flux Unit (VFU/HFU). The TIP detector will be installed in drive mechanism and moved inside the reactor core through Central Carrier Tube (CCT) of VFU/HFU by operating the TIP Drive mechanism through movable panel or from remote location Low Power Flux Logging (LPFL) node. The TIP system will be used in six preferred VFU locations out of twenty six VFU locations, namely as VFU# 6, 8, 10, 17, 19, 21 and two out of nine HFU locations.

The TIP system shall be interfaced with the LPFL node which is located at Control Equipment Room (CER) 111MEL to facilitate the recording of TIP flux signals and the TIP positions signals. Also there shall be provision to give local commands and remote commands to control the movement of the TIP drive mechanism.

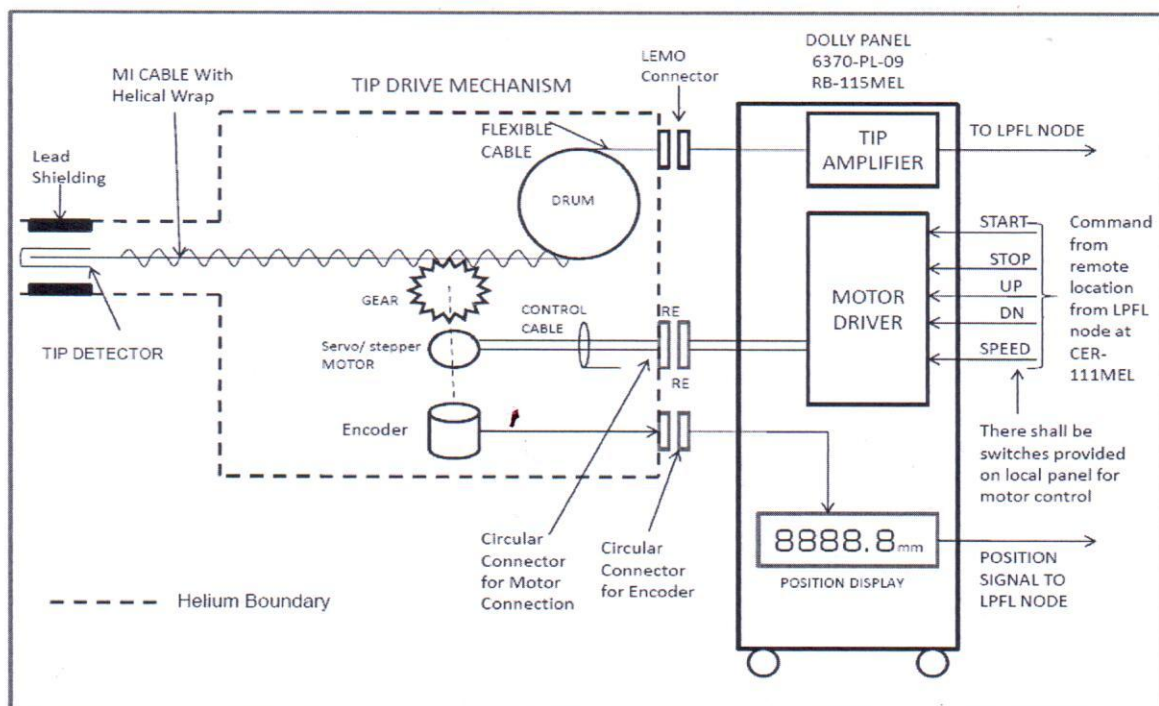


Fig-1 TIP System Block Diagram (one TIP Typ.)


5.1 Travelling In-core Probe (TIP) detector:

The Travelling In-Core Probe (TIP) is a Miniature Fission Chamber Detector having helical wire wrap MI cable and associated connectors. The helical wire wrap MI cable is used to move the TIP detector in and out inside the reactor core through a gear mechanism for positioning. The use of helical wrap allows better positioning as compared to friction based push-pull arrangement. The one end of helical wrap MI cable is connected to detector while the other end is terminated to connector. The flexible co-axial cable is used for the extension of signals up to amplifier through matching connector. The TIP detector shall meet the manufacturing details, testing and functional requirement as specified in PC-E-780.

5.2 TIP Drive Mechanism:

The Drive mechanism shall be placed over VFU/HFU unit after removing the cover plate maintaining helium environment as indicated in Fig-1. Also it shall have the arrangement for pushing and pulling the helical wire wrap TIP Probe. This shall be achieved by providing a helical gear matching the pitch of helical wire wrap and is driven with suitable motor, motor driver circuits and position sensors and indicators.

The required motor drive and the position sensing electronics shall be located in movable panel. There shall be provision for suitable connectors to interface the drive mechanism to the movable panel which will be located about 50 meters away from the

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mechanism at RB-115MEL. The requirements for mechanism are specified in PC-E-1119.

5.3 TIP Amplifier and Movable Panel:

The TIP amplifier will be used to amplify the current signal representing neutron flux received from TIP detector (i.e. fission chamber) in the reactor power range from 10^{-6} FP (i.e. 0.0001%FP) to 10^{-3} FP (i.e. 0.1%FP) . The mounting arrangement for TIP amplifiers shall be as specified in PC-E-781.

The 6370-PL-09 movable panel is a movable panel which will be located at RB-115MEL on temporary basis and removed after the phase-B experiment is over. This movable panel shall be easily connected or disconnected with the drive mechanism. For this purpose suitable connectors and cables shall be provided to interface movable panel and TIP drive mechanism. A schematic drawing KAPP-3&4-63715/2022/GA is specified in PC-E-781 for the manufacturing the movable panel, however the manufacturer shall engineer suitable layout of movable panel to accommodate the hardware like amplifier bins, motor driver circuits, encoder circuits, position indicators isolation transformer and MCB unit, etc.

The cable laying between LPFL node and movable panel will be in NPCIL's scope. All required connectors and their termination at movable panel, commissioning of amplifiers, motor driver/controllers and display/ recording at movable panel will be in supplier's scope.

5.4 TIP Drive Mock-up arrangement

The Mock-up Set-up for the TIP-Drive Mechanism shall be done as specified in PC-E-1119.


6.0 DESIGN REQUIREMENT

The TIP detector and amplifier shall meet the requirement as specified in PC-E-780 and PC-E-781 respectively. The detector shall be compatible with the amplifier and interfaced with drive mechanism.

The drive mechanisms shall be manufactured by considering entire requirement like position accuracy, speed, helium boundary, connectorization, interfacing, etc. as specified in PC-E-781 and PC-E-1119.

The Motor driver shall provide the following features:

- The motor driver shall have the local control command on movable panels and shall be controlled remotely from LPFL node located at CER-111MEL.
- "Power Supply ON and OFF" indication.
- Selection for forward and backward movement of TIP detector along with

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indicator.

- TIP system shall be designed for variable speed 1 to 100mm/sec for insertion and retrieval of detector and particularly for fast (50mm/sec), slow (5mm/sec), jog (1mm/sec) modes selectable directly.
- Option of inching movement.
- Positioning of the TIP at Parking position, Home position and Starting point position, Stop position, Fully In position and emergency Stop as defined in PC-E-1119.

During initial installation and commissioning, individually each TIP drive mechanism shall be operated or controlled for calibration and setting the TIP detector position, while during operation in phase-B each drive shall have provision to operate the drive mechanism individually and selectively. The TIP system shall provide a positioning accuracy as specified in PC-E-1119.

There shall be separate stopper provision made to prevent excess movement of TIP detector from fully in/ out position. It could be either mechanical or limit switch.

There shall be provision in the drive mechanism for determining the actual position of the TIP detector attached to the helical wrapped cable. The vertical downward movement indication and distance traversed by the TIP detector shall be indicated on position indicator located on the movable panel.

The position indicator shall have provision to generate proportional analog signal for remote recording to facilitate recording and storing position signal.

The incoming and outgoing signal connections shall be provided through suitable Circular Connectors. The Input/output connections shall be suitably identified. Power and Control signals shall be provided on separate connectors.


7.0 DETAILED SCOPE OF WORK

7.1. Design of the TIP system:

The Supplier shall carry out design and manufacturing of the system to perform the function and meet the design requirement as indicated in Clause 6.0 and to the various requirements specified in specifications referred in section-3.1 shall be to the satisfaction of NPCIL. The equipment shall be complete with all details required for mounting, cabling, calibration, operation and maintenance requirement.

7.2. Procurement of Raw Materials, Proprietary items and Standard items

The supplier shall procure the raw materials, proprietary items and standard items including spares required for manufacturing / fabrication and assembly of the equipment.

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7.3. Supply of the Equipment

The Supplier shall fabricate, perform the trials & testing, after inspection & qualification, pack and deliver the TIP system, along with spares in accordance with the requirement cleared by the Purchaser and other requirements specified in this specification referred in section-3.1, all to the satisfaction of NPCIL.

7.4. Commissioning , Testing and Demonstration at site

The system is common for the KAPP-3&4 and RAPS-7&8. The supplier shall commission the TIP system at KAPP-3 site and demonstrate the functioning of the system. The supplier should also train site personnel for operation and maintenance of the System.

8.0 INSPECTION, TEST AND REPORTS

The supplier shall perform the entire test as specified in PC-E-780, PC-E-781 and PC-E-1119 and shall provide document indicating various steps for inspection & testing to NPCIL and prior approval of NPCIL for the same shall be obtained. If deemed necessary NPCIL will have right to specify additional inspection / testing other than specified in this specification and drawings and cost of such tests/inspection will be borne by NPCIL.

NPCIL or authorized representative shall have access in the manufacturer's shop and inspection room at all time during manufacture, inspection and testing.

The supplier shall examine all the components and assemblies for full compliance with the drawings and specifications. All the reports (5 copies) 3 hard copies and 2 soft copies are to be given to Purchaser.


9.0 TESTING & QUALIFICATION

Testing and qualification of the TIP detector and amplifiers and TIP Drive mechanism shall be carried out as specified in respective specifications listed in section-3.1.

The supplier shall submit the certificate of compliance for the bought out components to be used in system manufacturing.

Step by step procedure for functional test of the components and system shall be submitted for NPCIL approval before test. The component/system will be tested as per the procedure in conformity to the specification requirements. The purchaser before the dispatch of the system will carry out quality surveillance inspection.

A quality assurance plan indicating the schedule shall be submitted for NPCIL

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approval before starting the job. Inspection and hold points shall be defined in the quality assurance plan.

9.1. Test Requirements

The supplier shall demonstrate the required test specified in referred section-3.1. Testing procedure meeting the above requirement shall be submitted to NPCIL for approval. Within guarantee period, if the equipment on deployment on VFU/HFU in-situ at site indicates any functional difficulty, the supplier shall rectify and do necessary correction with NPCIL approval before test.

9.2. Performance Test

The required test for the detector and the amplifiers shall be done as per respective specifications listed in section-3.1.

10.0 DEMONSTRATION OF THE TIP SYSTEM

The supplier shall demonstrate the working of the first TIP system at their workshop by placing it on the top surface of the mock-up. This system shall be operated from the movable panel as well as remotely from LPFL node for this shall simulate the LPFL node for demonstration.

The supplier shall also demonstrate the working of the TIP system at site by placing it on the top surface of the VFU/HFU locations. The supplier shall demonstrate the operation of TIP system from movable panel and from remote location LPFL node at site.

11.0 QUALITY ASSURANCE


Supplier shall prepare detailed Quality Assurance Plan (QAP) for manufacture and fabrication, inspection, testing, and performance qualification of the TIP Drive TIP Drive mechanism and shall submit for approval to NPCIL and prior approval shall be taken before start of actual job. Sample QAP is given below as Annexure-1.

12.0 PACKING, SHIPPING AND GUARANTEE

The packing shall be carried out properly and identification labels shall be put on each package. A copy of the shipping release and one set of history docket shall be kept inside the packing.


The design of TIP drive mechanism shall be modular so that the whole drive can be disconnected and suitable for transportation by standard vehicle/truck.

The assemblies shall not be dispatched unless Shipping Release from NPCIL is

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obtained. The supplier shall be responsible for shipping the system along with various components including spares.

The equipment shall be guaranteed against defects arising out of faulty design, materials and workmanship at least for a period of one year after commissioning or eighteen months from the date of dispatch whichever is earlier.

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ANNEXURE-1

SAMPLE QUALITY ASSURANCE PLAN (QAP)

The following Quality Assurance Plan (QAP) for the work is for the guidance of supplier and details the minimum requirements for achieving the Quality Assurance required for the assemblies. The separate QAP for major items like detector, amplifiers and TIP Drive mechanisms is given in respective specification as listed in section-3.1 the supplier shall follow the procedure while manufacturing the items.

A detailed QAP along with manufacturing process plan shall be prepared and submitted by the supplier for purchaser's approval before start of actual job. Final QAP, as approved by Purchaser, shall be used during manufacture.

Sr.No.	Control and Tests	Quantum of Check Action by Supplier	Quality Surveillance by Purchaser or his authorized representative
1.0	Submission of Manufacturing drawings	I	R, H
2.0	Material Inspection	I	R
3.0	Manufacturer's compliance certificate for bought out items	I	R
4.0	Final Inspection and Testing of TIP system	I	R, W
5.0	Detailed Test Procedure	I	R
6.0	Functional Test of TIP System as per Procedure	I	R, W, H
7.0	Test Reports	I	R
8.0	Final Mfg. Drawings / Procedure and inspection History Docket	I	R
9.0	Packing and shipment	I	R, W
10.0	Issue of shipping release	--	By purchaser or his authorised representative

Legend:

- I - Complete action and inspection by supplier
- R - Review of test records, test reports, procedures, test certificates, records of process parameters etc. by Purchaser
- W - Checking the actual component or witnessing the inspection / testing activity on a suitable percentage / random basis by Purchaser
- H - Hold point