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**Detailed Technical Specifications for ECVT Multiphase Flow System**

One Multi-dimensional ECVT system for 3D imaging in applications ranging from multiphase flows (water-steam two-phase flows, liquid nitrogen-vapor nitrogen cryogenic two-phase flows, three-phase flows, granular flows, slurry bubble column, fluidized bed, bubble column) to combustion studies.

**The Multidimensional ECVT system should have the following capabilities/features:**

1. 3D imaging of the various phases in the process under study. For example, 3D imaging of water and steam distribution in a water-steam two-phase flow process.
2. Measurement of Volume fraction of various phases with at least 1% sensitivity.
3. Flow velocity measurement.
4. Velocimetry of objects.
5. Cross-section imaging (at least 20 slices on each axis or better).
6. Spatial resolution of 2% of the volume or better.
7. High-speed imaging at maximum possible spatial resolution. The maximum imaging speeds upto ~ 800 fps to 1000 fps should be achievable with the system.
8. The system should be scalable for use on a 25mm to 1500 mm diameter pipe. The pipe diameters for which ECVT sensors are required as part of the current requirement are given in Table 1.
9. Data analysis using MATLAB built toolbox.

**ECVT Sensor Specifications:**

Six ECVT sensors required for use with pipes of diameters given in Table 1. All ECVT Sensors must be usable in both horizontal and vertical pipe orientations.

Table 1: Pipe diameters for ECVT clamp-on style sensors

SI No	Pipe Outer Diameter, mm
1	25
2	50
3	100
4	150
5	200
6	250

The system should be capable of imaging the process over an axial length of at least in the range 200 mm to 300 mm.

**Process Conditions and Operating Environment:**

The ECVT system is required for applications ranging from multiphase flows to combustion studies.

Table 2: Process Conditions

Process pressure	1 - 100 bar
Process temperature	-200 °C (73K) to 1000 °C (1273K)

Table 3: Operating Environment

Location	Indoor
Temperature	20 - 30 °C
Pressure	1 atm
Humidity	50 - 80 %
Available Power Supply	220 VAC, Single phase, 50Hz. Indian standard

**Data Acquisition System (DAS) and Data Analytics Software Specifications:**

One standard multi-dimensional ECVT DAS including cables, power cord, data acquisition and analytics software to be provided as part of the ECVT system. The cables from DAS to the sensors should be of appropriate length to enable remote analysis of the process under study. The data acquisition and analytics software should have the following features:

- A. Compatibility with MATLAB. At least one license for Matlab toolbox to be provided.
- B. One high end workstation with latest configurations pre-loaded with the data acquisition and analytics software.
- C. The software should have the following real time features:

Raw data view

Normalized data view

ECVT data collection

- D. Post Processing features should include:

A. Raw data view

B. Normalized data view

C. Full 3D Reconstruction and Viewing Options

D. Viewing Plane Manipulation

- E. The software should have direct as well as iterative reconstruction techniques, viz., Linear Back Projection (LBP) Reconstruction Technique, Landweber (iterative Linear Back Projection) Reconstruction Technique and Neural Network Multi-Criterion Optimization Imaging Reconstruction Technique.

**Customer support and training:**

- A. Customer support (Annual maintenance for three (03) years subsequent to the warranty period) should be provided.
- B. Commissioning & training (remote/onsite) should be provided.
- C. Warranty of at least one year (01) on the multidimensional ECVT system (from the date of installation of the system at IIT Bombay) with provision of extended warranty.