Prospect / Retrospect

Gearing up for IMCS

The concept of Integrated Motor Control System (IMCS) is already established in the process industry such as refineries, fertilizer plants, cement plants and steel plants in Europe and Middle East.

Worldwide the system designers and integrators are aiming at improving the operational efficiency of the process plants. This includes facilitating the operations and plant monitoring with minimum number of people and simultaneous data availability at multiple locations. Attempts are also made to simplify the complex requirements by reducing the device count and integrating comprehensive functionality in single device. In order to expedite the commissioning activity, the communication capability of microprocessor based intelligent devices is exploited. This not only reduces the control cabling, but also reduces the hardware required at DCS and SCADA.

Indian industry is also moving towards IMCS concept in the phased manner. Present specifications for switchboard are already switched over to Intelligent Electronic Devices (IEDs) having protection, metering and control with communication facility. Different levels of upward integration on the serial link are implemented in different plants. However, to derive the maximum advantages of the IMCS concept, it is imperative that the IEDs and the data-bus networking requirements are defined comprehensively from specifications stage itself.

L&T’s type TQ MCC with Supervision series IEDs totally comply with the international specifications of IMCS. Such systems have been in use now worldwide. In the foregoing article, we have compiled the typical specifications for IMCS. These specifications are at par with international requirements.
Introduction

The terminology called IMCS is a very widely accepted concept in the international market. This concept takes care of intelligence building in the Power Distribution and Control System (PDCS). An insight into the specifications followed by the international industry regarding Intelligent Switchgear will clearly indicate the guidelines to be followed and the basic pre-requisites of the system that governs huge process plants, material handling plants etc. without interruption and with the best of the efficiency.

Terminology used in IMCS:

Before going into the details of the specifications, lets get familiar with the terminologies used in this system.

- **Motor Control Unit (MCU)**
  Motor Control Unit is a microprocessor based device with integrated control, monitoring and protection functions and communication facility serving a single motor starter.

- **Feeder Control Unit (FCU)**
  Feeder Control Unit is a microprocessor based device with integrated control, monitoring and protection functions and communication facility serving a single contactor, circuit breaker or fused feeder.

- **Central Control Unit (CCU)**
  Central Control Unit is a microprocessor based interface used to monitor and control a number of MCUs and FCUs via a serial bus and enabling communication with a higher level of control system.

- **Integrated Motor Control System (IMCS)**
  A system comprising MCUs, FCUs, CCUs, a serial bus connecting the MCUs and FCUs to the CCU and a serial communication facility enabling connection of CCU to a Distributed Control System (DCS) and/or a Supervisory Control and Data Acquisition System (SCADA).

Specifications:

The IMCS specifications deal with various aspects of IMCS starting from technical requirement to inspection & testing. We will discuss some of the critical requirements of IMCS.

Protection & Measurement

An MCU/FCU shall be capable of:

- exercising control on the feeder
- giving maximum protection to a motor / feeder
- carry out comprehensive metering
- fault and alarm annunciation
- communicating all the information on serial link to a supervisory software and DCS.

![IMCS System Architecture](image-url)
The MCU shall offer complete control and be a self-sufficient protection system. Irrespective of the type of motor starter, the MCU shall have minimum of the following protections:

- Overload
- Unbalance
- Earth Fault
- Thermal
- Stalling protection
- Under voltage
- Locked rotor
- Self supervision
- Undervoltage
- Unbalance
- Single phase
- Local and serial control
- Under voltage auto re-start
- Reset of all fault from local keypad or serially with proper authentication
- Configurable digital input and output

Similarly, the FCU must give protections like:

- Over current
- Under voltage
- Over voltage
- Earth Fault
- Local and serial control
- Reset of all fault from local keypad or serially with proper authentication
- Configurable digital input and output

Auto bus transfer for Incomer & Buscoupler logic should be built into the FCU with a facility to check synchronisation.

The MCU/FCU must be capable of giving information in a very user-friendly manner. IMCS demands maintenance related data, statistical data and analytical data. The following list makes it clear:

- Maintenance Data
  - No of Operations
  - Total Hours run
  - Hours since last start
- Statistical Data
  - Peak Demand
  - Energy
  - Total no of starts
- Analytical data
  - Starting Time
  - Starting Current
  - Thermal Capacity
  - Motor Load
  - Last Trip cause with time and date stamping
  - Last Alarm cause with time and date stamping
  - Last Start source with time and date stamping
  - Last Stop source with time and date stamping
  - Pre trip data
  - Motor/Feeder status (available / inhibit / running / tripped)
  - Unbalance
  - Graphical display of Starting curve of the motor
  - Graphical display of Fault
  - Fault Disturbance record

Features like the fault disturbance recording display, starting curve of the motor and facility of storing the curve for future reference etc. on the MCU/FCU make the units truly informative. These details can help in on the spot analysis without using any additional tools/hardware. The time stamped fault history along with complete system disturbance information helps in quick analysis of tripping.

**Main Set-up**

The MCUs and FCUs will be mounted in the starter/feeder compartment and arrangement will be made to provide a CCU (per substation) for linking these MCUs and FCUs for that substation. The CCU shall be able to be connected to at least one EWS with separate serial connections to the plant DCS and SCADA systems.

This requires the CCU to be capable of handling multiple MCUs and FCUs simultaneously and be a self-sufficient protection system like DCS, EDMS simultaneously, in addition to an Engineering Work Station.

Each of these systems have different functions to perform in the entire plant. The plant DCS efficiently exercises controls, whereas the EDMS will mainly manage the power distribution looking at the load management systems. On the other hand the Engineering Work Station needs to maintain all electrical data including the maintenance related statistics which will help take proactive actions. This necessitates the CCU to be capable of giving different type of data to different systems on priority.

**Technical Requirements**

Each motor circuit and outgoing feeder shall be controlled by the MCU and FCU which serves to perform its functions of measurement, control and protection. It constitutes a complete and self-sufficient protection system with a non-volatile memory of all specific pre-programmed parameters.

The necessity of non-volatile memory in the MCU/FCU is to hold the programmed parameters like relay settings, fault data, statistics etc.; thus making it independent of availability of power supply. Battery backed up memory is not reliable in such application.

In the event of a failure of an individual MCU/FCU module, it shall be possible to replace it and download the drive/feeder parameters from the earlier unit via EWS or HHT (Hand Held Terminal).

The simpler the replacement, the faster is the restoration of the system. This replacement also includes uploading the settings or statistical data of earlier unit into the new one either through EWS or through Smart Card. This technology does not require any separate HHT and is extremely easy to implement, thus restoring of settings in the fastest possible time.
Dual Redundant Configuration

In case of a requirement of 100% system availability of the IMCS, a dual redundant CCU needs to be provided. This arrangement is required to be a Master – Slave, hot standby system, such that in the event of failure of one unit, the second unit shall take over the control in a bumpless fashion.

The redundancy level is desired at the following levels:

- MCU/FCU LAN (data bus)
- Processor level of the Data concentrator or CCU
- Power supply level of the Data concentrator or CCU

In order to achieve 100% dual redundancy, the arrangement necessarily should have a hot standby CCU. In normal circumstances, both the Master and the Slave CCUs will be a part of the communication bus. Master will be active and Slave will be inactive. When interruption of communication is detected by the Master, the Slave will automatically take over the monitoring to offer a bumpless transfer. There are some systems in which two processors are put in a system and one processor takes care of 50% of the MCUs/FCUs and the other takes care of 50%. In such case, failure of one processor causes losing of 50% IEDs on the communication network. This is not considered as a redundant system.

**Engineering Work Station**

The EWS should be able to set parameters and to monitor the operating status of any connected drive or feeder. Access to change the operating parameters shall be restricted by means of a password or key.

The Engineering Work Station, should have various features that will help monitor and control the various MCUs/FCUs connected to it through a CCU. They are:

- Graphical Single Line Diagram (with on line feeder status)
- Analog parameters
- Digital parameters
- Control
- Alarm annunciation
- Fault indication/description with pre-trip data
- Logic diagram
- On-line trending
- Reports

In addition to this, the EWS must also have a facility to change the MCU/FCU settings on the serial link. The MCU/FCU parameter settings; whether from the unit itself or from the serial link; must have restricted access with proper authentication. The IMCS software requires at least 3 level of securities, viz.

- for view only
- for setting and reset
- for configuration.

**Conclusion**:

The elaborate specification of IMCS has three basic elements; IEDs (MCU/FCU), Data Concentrator (CCU) and EWS. If attention is paid to these elements, the user will get an ideal intelligent system for the plant operation.