सत्यमेव जयते

Report of Committee on "Formulation of Trajectory of Indigenisation of SCADA System"

केविप्रा cea

Central Electricity Authority
Ministry of Power

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1. Background

1.1. During the Hon'ble Prime Minister's sectoral review meeting held on 03.12.2025, indigenisation of SCADA systems, which are presently being imported, was identified as an important action point for enhancing self-reliance and cyber-resilience of the power system.

1.2. Ministry of Power, vide communication dated 12.12.2025 (copy attached as **Annexure I)** informed the decision of Secretary (Power) that SCADA system is not to be imported beyond 2030 and efforts have to be initiated for Indigenisation of SCADA system. In this regard, CEA was requested to suggest trajectory of SCADA indigenisation after consultations with the concerned stakeholders.

1.3. Accordingly, with the approval of competent authority vide order dated 16.12.2025 (Attached as **Annexure II**), a committee was constituted under the Chairmanship of Member (Planning), Central Electricity Authority, to formulate the "Trajectory of Indigenisation of SCADA System". The composition of Committee was as follows:

Sr. no.	Representative from	Role in the Committee
1.	Member (Planning), CEA	Chairperson
2.	Chief Engineer (ET&I), CEA	Member
3.	Chief Engineer (DP&T), CEA	Member
4.	Chief Engineer (PCD), CEA	Member
5.	Chief Engineer (PSE&TD), CEA	Member
6.	Chief Engineer (Cyber Security), CEA	Member
7.	Director (ET&I), CEA	Convener
8.	Representative from MNRE	Member
9.	Representative from DRDO	Member
10.	Representative from SLDC Rajasthan	Member
11.	Representative from SLDC Maharashtra	Member
12.	Representative from SLDC Tamil Nadu	Member
13.	Representative from PowerGrid	Member
14.	Representative from Grid India	Member
15.	Representative from C-DAC	Member
16.	Representative from IEEMA	Member

Committee may co-opt expert Members as deemed fit.

1.4. The Terms of the Reference of the Committee are given below:

(i). Formulation of the "Trajectory of Indigenisation of SCADA system"
(ii). The Committee shall submit its report with actionable recommendations to the Ministry of Power within one month from the date of its constitution.

1.5. Following Expert members were special invitees during the meetings of the Committee:

1. Chief Engineer (IT Cell and Procurement), CEA;
2. Sh. Mohd. Mahamood, Senior GM (Retd.), PGCIL;
3. Sh. M. K. Ramesh, ED I/c, SRLDC;
4. Sh. B.B. Mehta, Director, OPTCL

2. Brief of SCADA System:

2.1. Power System:

2.1.1. Power system generates, transmits and distributes electricity or power to the consumer in real-time. Power demand is not exactly known at any point of time in advance. It is not easy or cost effective to store power and distribute the same to the consumers at the time of requirement. Requirements of the consumers are to be met in real-time. This makes the power system one of the most complex systems to operate.

2.1.2. Power System is divided into three functional areas for easy management: Generation, Transmission and Distribution. Each functional area consists of its own equipment and personnel to manage them and in India, these functions are carried out by the respective State or Central or Private owned companies - GENCO, TRANSCO and DISCOM.

2.2. SCADA:

2.2.1. A system is required to monitor and control the power system in generation, transmission, and distribution functional areas. The system is known as Supervisory Control and Data Acquisition (SCADA for short). In addition to power industries, this SCADA system is also employed in oil, gas, and water industries.

2.2.2. Supervisory control is defined as the ability to exercise control over a specific device, and to confirm its performance in accordance with the directed action. A system is in the supervisory control category when the distance between the controlling location and the controlled device is such that direct-wire control is impractical.

2.2.3. SCADA system is thought of as a system that gathers and sends information to remote locations. It is supervisory in nature because it is not solely responsible for the primary control functions. In most instances, some other system is implementing the primary control at field, and the SCADA system simply monitors and logs activity; it also interfaces with primary controllers by sending set points or calculated values or control commands.

2.2.4. The SCADA system shall be implemented by Field Instrumentation, Communication and Master station facilities (***Fig.1 SCADA Components***). The filed instrumentation acquires various signals from filed devices and transmits the same to the Master station situated far away from the field using various communication media. The signals received are captured by Front End Server and then send to SCADA HMI where these are analyzed by the operator at the Master station and appropriate action is taken if necessary. The actions may involve sending control signals to the field devices over communication media.

2.2.5. Supervisory control means no direct control that is indirect control. The operator at the Master station is carrying out the control of the field devices through another human operator or computer system at the field i.e. power plants and substations.

2.2.6. An operator at a Master station can cause operations such as the opening and closing of breakers, the starting and stopping of condensers, and the changing of the taps on transformers. The operators can receive an indication that the operation has been completed. Communication between Sub-stations and Control centers is done primarily using OPGW.

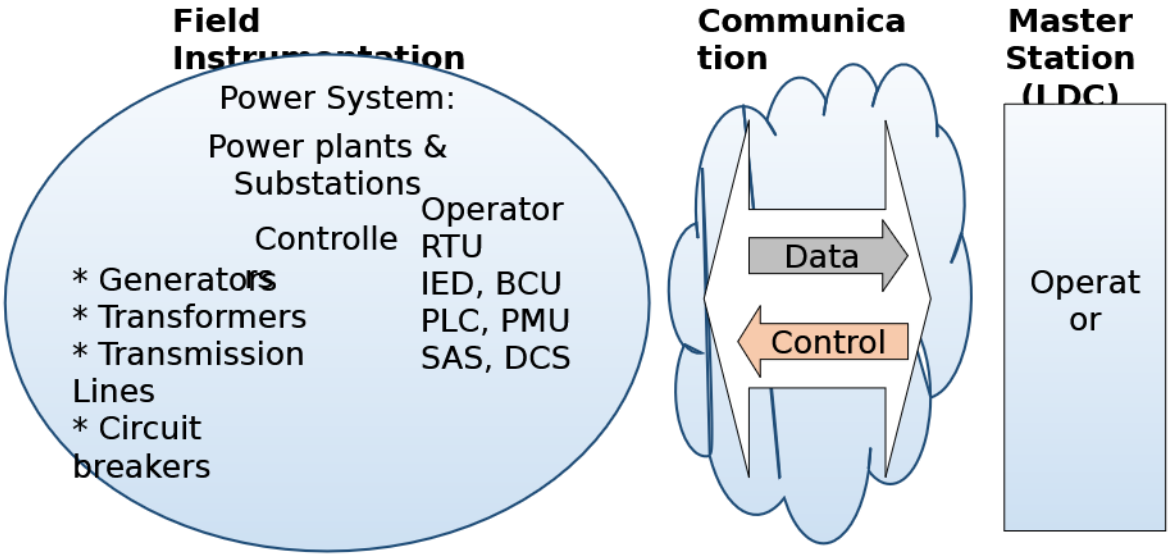

Fig. 1 SCADA Components

2.2.7. Power System Automation: The generation and transmission systems are automated by a computer-based system known as Energy Management System (EMS) and the distribution is by Distribution Management System (DMS). Both of these systems use SCADA as a front end or an interface to the field devices for monitoring and control. These concepts are depicted in ***Fig. 2 Power System Automation.***

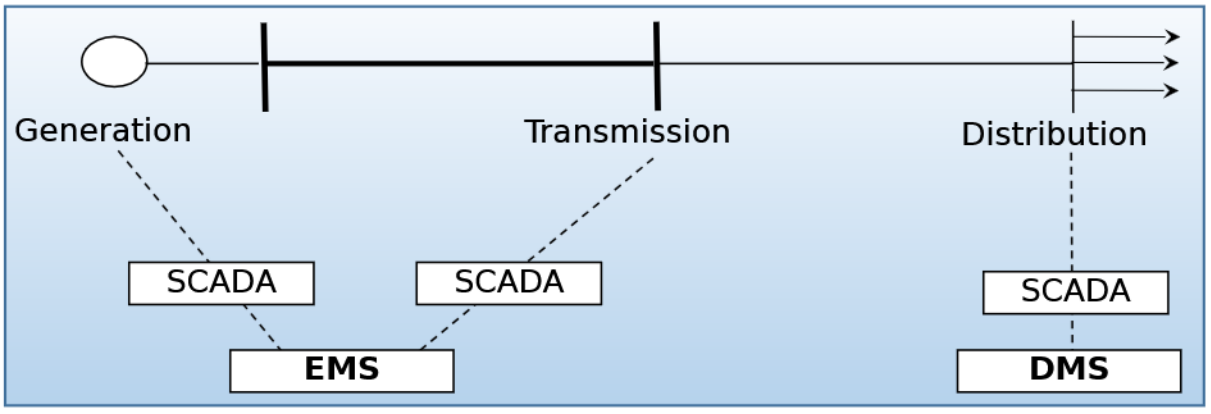

Fig.2 Power System Automation

2.3. Field Instrumentation

2.3.1. Equipment at substation switchyard of generation or transmission system, is modularly arranged into bays which are interconnected by bus-bars. For example, a substation may have bays for incoming lines, bays for Inter-connecting Transformer (ICT) and bays for outgoing lines.

2.3.2. Each bay is equipped with voltage and current transformers, switching devices - circuit breakers, isolators, & earth-switches. Voltage and current transformers will step-down the high voltage and high current handled by transmission lines and transformers into low voltage and low current for measurement and other purposes. Switching devices in each bay is also telemetered in SCADA to indicate whether, the equipment in the bay is either closed/connected or opened/ disconnected.

2.3.3. At the field substation, these stepped-down values of voltage & current and status of the switching devices form the basic input data of the SCADA system. These values and status are taken to Control & Relay (C&R) panels and field devices located in the substation control room or at the bay itself for processing and further course of action. These filed devices include **RTU** (Remote Terminal Unit), **IED** (Intelligent Electronic Device), **PLC** (Programmable Logic Controller), **PMU** (Phasor Measurement Unit), **BCU** (Bay Control Unit), **SAS** (Substation Automation System), power plant **DCS** (Distributed Control System) and others.

2.3.4. RTU, IED and other modern field devices are microprocessor-based which is like a computer and they have processor, memory and peripheral & communication ports. For handling switching devices, RTU is equipped with Digital Input (DI) card for reading status (i.e. ON or OFF) and Digital Output (DO) card for controlling them (i.e. open or close). Similarly, Analog Input (AI) cards for reading voltage and current values and Analog Output (AO) cards for set-points & continuous control signals.

2.3.5. Within the substation, these C&R panels and field devices connected with each other through various hardware ports (RS 422, RS-485, RJ-45, fibre-optic, etc.) using protocols (i.e. IEC 61850, Modbus, IEC 60870-5-104, etc.). RTU collects data from field devices and transmits to Master station on receipt of command. The input data are forwarded periodically at a specified time interval (e.g. 4-5 secs) to the Master station for the purpose of remote monitoring/control.

2.3.6. Time-stamping of the various switch events is generally done at the substation RTU end using the clock. The clock at substation may be driven by local GPS receiver at substation or time-synchronized by Master station with its GPS receiver. Time-stamping is very essential for SOE (Sequence of Events) recorder, Disturbance recorder, relay operations, etc.

2.4. Communication

2.4.1. The measured field data are to be transmitted to Master station on receipt of command. At a substation, any field device (i.e. RTU, IED, PLC, etc.) with communication facility can transmit the field data to Master station and generally, this job is done by RTU.

2.4.2. Depending on the requirement of time interval & quantum of data from each substation, various communication media/technologies are employed for connecting RTU and Master station. Often, hundreds of RTUs at State SLDC level and thousands of RTUs at regional level are connected to Master station. A number of topologies such as multi-drop, star, point to point, etc. are employed to arrange RTUs and connect them to Master station.

2.4.3. The connection between RTU and Master station may be through various communication media/technologies such as fibre optic, PLCC, V-SAT, microwave, radio, etc. using different protocols such as IEC 60870-5-101, IEC 60870-5-104, Modbus, etc.

2.5. Master Station

2.5.1. Master station (or LDC or Control Centre) is very important part of the SCADA system. It is housing a number of computer servers for various purposes and power system applications. Remotely, it periodically receives various field inputs from the substations located in the control area (at State or regional level), and performs any control action through the communication links to RTUs. Master station details are given in ***Fig.3. Architecture of a Master station***.

2.5.1.1. **Front-End-Processor (FEP)** server collects data from substation field RTUs, one by one, periodically and the collected data are placed on the local area network (i.e. LAN) and shared with other servers.

2.5.1.2. **SCADA servers** construct the real-time image/network topology of the power system with collected filed values of voltage, current, frequency, active power, reactive power, and status of switching devices. Field values are monitored and alarms are generated in case of violation. Any control action is required for a field equipment, it is communicated to substation.

2.5.1.3. **User Interface server** presents the power system view in a variety of ways including single line diagram. The periodically read/scanned data from RTUs are mapped on to the respective substation and transmission lines on the single line diagram and given to operator consoles and wall display (i.e. video projection system).

2.5.1.4. The collected real-time data are transferred to **Historian** server for further processing and analyzing by other servers.

2.5.1.5. Collectively the various functions of power system automation system at a Master Station is called Energy Management System (EMS). There are functions or applications like State Estimator, Automatic Generation Control (AGC), Power Flow Studies, Economic Despatch, Unit Commitment, Contingency Analysis, Security Assessment, Despatcher Training Simulator, etc. These applications are performed by **EMS server or Application server**. Separate servers may be employed for AGC application and Security Assessment application.

2.5.1.6. For developing new stations or modifying existing database, there may be exclusive servers known as **Program Development System (PDS)** server with

associated software. These applications may be hosted on a single or multiple servers.

2.5.1.7. Also, there is a **Despatcher Training Simulator (DTS)** server for the purpose of system operator training.

2.5.1.8. The number and type of applications may vary for national, regional, State, Discom, Transmission and generation level Master stations.

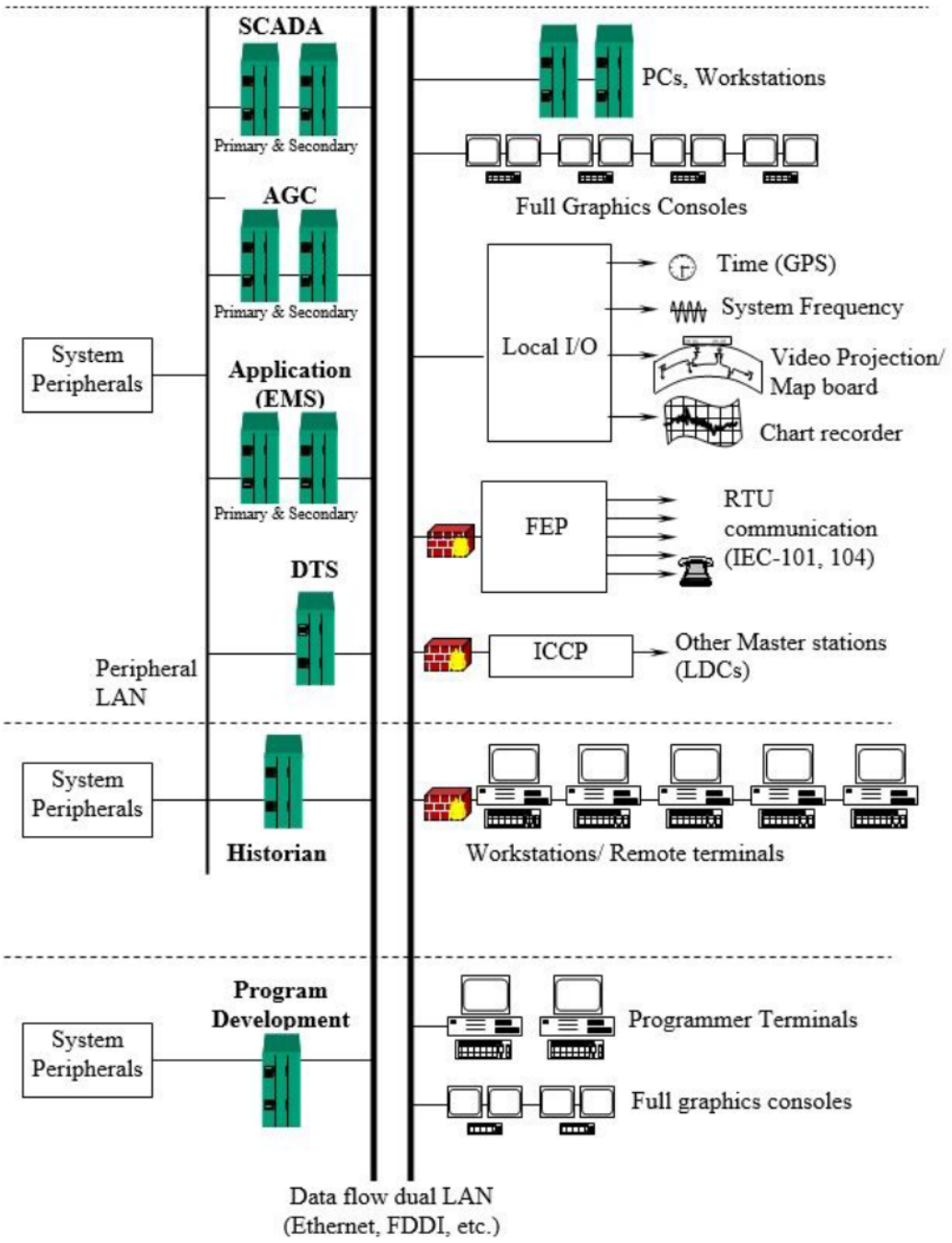

Fig.3 Architecture of a Master station

2.5.2. Hardware & software requirement:

2.5.2.1. The servers in the Master station are high end computer systems with high-speed multi-core CPUs, higher RAM capacity, mass-storage devices with fault-tolerant feature and backup storage systems. Operator console, wall display system, program development terminals, and networking devices such as firewall, gateways, routers, LAN switches all require highly reliable systems. Operating system may be variants of Unix/Linux system or Windows or a mix of these. Databases with fast storing, updating and retrieving features are required.

2.5.2.2. Within Master station, communication protocols such as IEC-61970 (for EMS), IEC-61968 (for DMS) are used for exchanging information between servers and power system applications. Between Master station or Control Centres or LDCs, IEC-60870-6 (Inter Control Centre Protocol -ICCP) is used. Other protocols may be used to interconnect servers and networking infrastructure.

2.5.2.3. For the purpose of providing cyber security to SCADA/ EMS system and preventing outside interferences, networking devices such as firewalls, anti-APT, NAC, routers and switches are employed. For better security, an air gap between OT system (SCADA/EMS) and IT system is very essential, i.e. the computer network systems meant for these two distinct purposes (i.e. OT & IT) to be separate and not to have any physical contact.

2.5.3. **Power Supply:** Often redundant computer network and power supply arrangement is required for Master Station. Reliable power supply feeders from local DISCOM, UPS and back up DG-set are essential requirement for the Master station computers, servers and networking devices.

2.6. Hierarchical structure of Master Stations

2.6.1. Master Station is also known as Control Centre or Load Despatch Centre (LDC). Both IEEE and BIS standards on SCADA use the phrase 'Master Station' to denote 'Control Centre' or 'LDC'. All three names – Master station, LDC and Control centre are synonymous.

2.6.2. **SLDC:** Master station is connected to multiple field substations or power plants, may be in hundreds at regional level. In India, Master station is known as Load Despatch Centre (LDC) or Control Centre. Geographically, power system in each State forms a control area with its own LDC, known as State Load Despatch Centre (SLDC). For better system management, many States also have one or more sub-LDC or area-LDC which are connected to the SLDC.

2.6.3. **RLDC:** Further, overall power system (or grid) in the country is divided into Northern, Western, Southern, Eastern and North-Eastern control areas consisting of many State control areas (i.e. SLDCs). Regional control area is equipped with its own LDC known as Regional LDC (RLDC) and thus there are five RLDCs in the country. They are Northern RLDC at New Delhi (NRLDC), Western RLDC at Mumbai (WRLDC), Southern RLDC at Banglaore (SRLDC), Eastern RLDC at Kolkata (ERLDC) and North-Eastern RLDC at Shillong (NERLDC).

2.6.4. **NLDC:** At all India level, there is National Load Despatch Centre (NLDC) at New

Delhi controlling all the five RLDCs.

2.6.5. **Data flow:** Field data from power plants and substation owned or controlled by Central Govt. and Inter-state Generating Stations (ISGS) in the region are sent to RLDCs for monitoring and supervisory control. Similarly, field data from State owned or controlled power plants and substations are sent to respective SLDC. RLDC is connected to all the SLDCs in the region and further RLDC is connected to NLDC. It is a hierarchical control setup and there is no lateral connection/ communication between SLDCs or between RLDCs. RLDC is acting like a regional hub connecting SLDCs and similarly NLDC is acting like a national hub connecting RLDCs.

2.6.6. **Function:** Main function of an LDC is to balance the load (demand) and generation in real-time in the control area and also to maintain the tie-line flow (export or import) commitments to other control areas. In real-time, LDC is responsible for maintaining system parameters such as frequency, voltage, active power and reactive power within the specified limits. Power system is required to be operated securely, reliably and economically at State, regional and national levels.

3. Challenges with existing systems

3.1. OEM-dependent database architectures have resulted in non-uniform naming conventions, network model synchronization challenges, and data inconsistencies across SCADA/EMS deployments. Although the Common Information Model (CIM) is intended to support standardized information exchange, CIM-based model exchanges generated by different OEMs are often not interoperable due to variation in implementation, thereby limiting seamless exchange of network models among SLDCs, RLDCs, and NLDC. Database modifications and model updates frequently require OEM intervention because of proprietary database structures and vendor controlled engineering tools, restricting customization and increasing vendor dependence. Integration of third-party applications is further complicated by inconsistent identifiers and data models. In addition, the time deployment of security patches, software upgrades, and configuration changes may be constrained in OEM-controlled environments, creating challenges in addressing evolving cybersecurity requirements.

3.2. To address these challenges, it is essential to develop and maintain a CIM-based information model and database architecture in accordance with IEC 61970/61968 standards. To ensure long-term flexibility, interoperability, and vendor independence, critical applications such as Inter-Control Centre Communication Protocol (ICCP), State Estimation (SE), Power Flow (PF), Real-Time Contingency Analysis (RTCA), Automatic Generation Control (AGC), Dynamic Security Assessment (DSA), and other advanced operational applications should be implemented as modular and independently deployable components. These applications should be integrated through standardized APIs, CIM-aligned network models, and uniform naming conventions. The architecture should support plug-and-play integration and deployment, enabling applications to be upgraded, replaced, or expanded with minimal impact on overall system operations, thereby enhancing modularity, reducing

downtime, and facilitating future technology upgrades

4. Need for Indigenisation

4.1. The rapid evolution of power systems necessitates periodic upgrades of SCADA system due to the obsolescence of hardware and software, shortage of spares, and emerging requirements for enhanced visualization, data storage, analytics and cybersecurity. SCADA systems serve as the central nervous system of the National Power Grid—enabling the "One Nation, One Grid, One Frequency" framework through real-time monitoring and control. However, heavy dependence on foreign OEMs with proprietary technologies results in interoperability constraints, delays in customization, limited flexibility in system enhancements, and dependence on external support services.

4.2. In an increasingly complex geo-political landscape, such dependence poses potential risks to national energy security. Reliance on foreign technologies for critical infrastructure may expose utilities to supply chain disruptions, technology access constraints, delayed availability of upgrades and support, and limited transparency associated with proprietary or "black box" systems.

4.3. Consequently, indigenous development under Make in India and Atmanirbhar Bharat is a strategic imperative to reduce external dependence and strengthen national self-reliance in critical power sector technologies. The development and deployment of indigenous SCADA/EMS/DMS solutions will enable greater customization to meet utility specific requirements, facilitate timely modernization and upgrades of SLDC systems, enhance interoperability across the power sector, and support the implementation of cybersecurity measures tailored to India's operational and security requirements. Such an approach will contribute to the long-term resilience, sustainability, and security of the National Power Grid.

5. Overview of Previous Works done for Indigenisation of the SCADA

5.1. Previously, Ministry of Power, vide order dated 20.10.2020, constituted a Team under the Chairmanship of Member (Power System), CEA with representatives from Central Electricity Authority (CEA), Governments of Andhra Pradesh, Gujarat, Maharashtra, POWERGRID and POSOCO and team co-opted members from C DAC and additional CEA officers, to explore possibilities of indigenous development of SCADA software for power system management in support of the Atmanirbhar Bharat campaign. The Ministry gave an extension of time up to 31.08.2021 to the team, which over a period of ten months, held four formal meetings, obtained inputs from 35 utilities (STUs, LDCs, DISCOMs) on issues with existing SCADA systems, interacted with identified Indian developers, and carried out structured analysis of their capabilities, preparedness, willingness and challenges and submitted its report on “Possibilities of indigenous development of SCADA software for Power System Management” to Ministry of Power vide letter dated 01.09.2021.

5.2. The report submitted by the earlier team recommends that India should develop an indigenous, end to end SCADA/EMS/DMS solution through a consortium/SPV of Indian developers with a designated lead entity responsible for overall system integration, layered/open architecture, and built in interoperability and cyber security. Key recommendations of the report includes: standardizing SCADA database models, data exchange and naming (CIM based) across NLDC, RLDCs, SLDCs and distribution utilities; specifying open, standardized communication protocols and interfaces in future projects; promoting and supporting Indian vendors through suitable qualification criteria relaxations, funding (e.g. scheme/PSDF support) and pilot implementations; preparing standard technical specifications and bid documents that explicitly facilitate indigenous solutions; and involving utilities, academia and R&D institutions (such as IITs and CPRI) in requirement finalization, validation, testing and continuous improvement so that the indigenous solution becomes sustainable and replicable at national scale.

6. Proceedings of the Committee:

6.1. First Meeting of the Committee: (Held on 24.12.2025)

6.1.1. The committee recognized the importance of SCADA as a critical infrastructure technology and thus requiring strategic indigenisation in both hardware and software domains. The requirement of Indigenisation, and the scope of the committee was discussed and it was emphasized that the committee's mandate extends beyond meeting minimum local content requirement and the aim is to eliminate import dependence by ensuring SCADA systems are made available by the Indian entities. It was finalized that indigenisation should be viewed in a phased and modular manner, distinguishing between short-term, medium term achievable components and long-term strategic technologies (e.g., processors, RTOS).

6.1.2. The committee reviewed the findings of the 2021 CEA report on indigenous SCADA development, which identified capabilities, gaps, and challenges such as vendor lock-in, interoperability issues, and dependence on foreign OEMs. Members agreed on a modular and phased approach to indigenisation with 1-year, 3-year, and 5-year targets, promoting open standards, indigenous software ownership, pilot projects at selected SLDCs/substations, and support through R&D funding and ecosystem development for Indian vendors.

6.1.3. Based on deliberations key upcoming actions were:

a. Identification of hardware and software parts/modules/components of proposed SCADA system.

b. Re-assessment of current domestic capabilities of Indian vendors and R&D institutions/ Academia, considering developments since 2021.

c. Additionally, C-DAC was tasked with evaluating the use of "Rudra" servers for control centers and exploring the development of indigenous chipsets and real-time operating systems.

d. To validate these indigenous solutions before a national roll-out, the committee will identify specific pilot projects at selected SLDCs and substations.

6.1.4. The Minutes of meeting attached as **Annexure III A.**

6.2. Second Meeting of the Committee (Held on 06.03.2026)

6.2.1. Based on the inputs received from the Grid India, the information was collected from vendors regarding their present capabilities and future plans to develop the various software and hardware modules of SCADA system. The detailed inputs of the manufacturers/vendors regarding the capabilities and timelines for development of modules is attached as **Appendix.** To deliberate on the received inputs, the second meeting of the committee was held on 06.03.2026.

6.2.2. The meeting focused on establishing a comprehensive roadmap for the indigenisation of SCADA systems by 2030, noting that based on the information collected from the vendors/developer's software modules can be developed within 24–36 months, and hardware development will follow a more gradual trajectory. The IT Hardware components come under the purview of MeitY and Department of Telecommunication (DoT) and shall follow indigenisation trajectory finalized by these Ministries in their Make in India orders, as the size of order for these components, in respect of SCADA system, is small volume. Current assessments reveal that although software accounts for approximately 25% of costs whereas Hardware components constitute 75%. Further, even though MLC content of 50 % has been mentioned for SCADA system in MoP PPP-MII order, the local content in grid SCADA remains below 20% and exemptions have been given in the past by MoP considering the same. A "National SCADA Mission"/ a Working Group to drive implementation may be constituted. It was highlighted that 36 out of 38 software modules are developable in the short term, though real-time testing and validation via digital twins and parallel SLDC systems remain the primary challenges.

6.2.3. To support this transition, technical inputs from C-DAC and SLDC Odisha pointed to the potential of the Rudra server platform, BOSS OS, and proven academic software from IIT Bombay for EMS development. On the hardware front, 16 out of 25 essential items are expected to be ready within two years. In substation SCADA hardware is supported by 2 to 3 existing indigenous RTU vendors. Crucially, CPRI and CSIRT-Power underscored the need for advanced security protocols and streamlined STQC certification to ensure cybersecurity and reliability. Ultimately, the success of the roadmap depends on phased execution—moving from core data acquisition to complex EMS add-ons—while relaxing tender norms for domestic players to foster a robust indigenous ecosystem.

6.2.4. To gather the inputs regarding the hardware components of the SCADA system it was decided that a list of indigenous vendors for SCADA hardware components, including IT hardware, will be shared by Powergrid and a meeting may be organized to assess their capabilities.

6.2.5. Minutes of meeting attached as **Annexure III B.**

6.3. Third Meeting of the Committee (Held on 18.04.2026)

6.3.1. The Committee, in its third meeting held on 18.04.2026, undertook a detailed review of the consolidated trajectory for indigenisation of SCADA system software and hardware modules. After deliberations, the Committee agreed to rationalize the draft timeline by replacing specific month-wise milestones with financial year-wise milestones for greater clarity and practicality. The Committee noted that some vendors are already ready at baseline level and others may require additional time for compliance with GRID-India specifications and system integration. With incorporation of some of the updation suggested in the meeting, the Committee concurred with the proposed software and hardware timelines.

6.3.2. On the issue of hardware indigenisation, the Committee noted that several items such as workstations, printers, storage devices and laptops are generally available domestically, while certain core chips and embedded components still require indigenous development. It was also noted that telecom and IT networking equipment are largely covered under the Make in India framework of MeitY/DoT, as the power sector is only a small user of such equipment. The committee agreed that India should explore indigenous processor/ASIC-based solutions for SCADA.

6.3.3. The Committee, while deliberating on the way forward for indigenisation of SCADA systems, noted the divergent but complementary views of members on the institutional framework and development model. Chief Engineer (ET&I), CEA suggested establishment of a National SCADA Mission on the lines of other national missions, whereas Member (Planning), CEA and the C-DAC representative observed that a Working Group approach would be more appropriate, considering that SCADA indigenisation involves leveraging existing capabilities at a relatively higher technology readiness level. Powergrid, STQC and DRDO, however, emphasized the usefulness of a mission-like structure for ensuring time-bound architecture finalization, coordination and implementation. After deliberations, the Committee decided to recommend both the Mission Mode and Working Group options in the report, leaving the final decision to the Ministry.

6.3.4. On the development model, Powergrid and GRID-India supported a nomination-based approach, citing the procedural complexity and time constraints of the competitive bidding route, while PRDC suggested a model involving limited EOI, techno-commercial evaluation and grant-based support to selected capable entities. DRDO highlighted the Lead System Integrator concept adopted in defense projects, and M/s. Kalkitech proposed a consortium/collaboration model involving system operators as co-developers for creation of a minimum viable product, along with provision for seed funding and a future-ready solution incorporating advanced cybersecurity and AI features. GRID-India emphasized that indigenisation must mean 100% indigenous development, including source code, architecture and lifecycle support, without dependence on foreign vendors for routine modifications, and this view was endorsed by the

Chair. The Committee accordingly agreed to include both the Nomination basis and Consortium/Collaboration basis in the report, with the final decision to be taken by the Ministry.

6.3.5. The Committee also noted that financial support from the Government would be necessary for development of indigenous SCADA systems, and that PSDF may be considered as a possible source of support.

6.3.6. On testing and certification, the Committee noted the capabilities of STQC, CPRI and other institutions for cybersecurity assessment, certification, and end-to-end testing. It was agreed that a dedicated testing platform for indigenous SCADA modules, including cybersecurity validation, should be established within two years with Government funding, and that real-life pilot testing under SLDC/RLDC/NLDC is essential. SLDC Odisha volunteered to provide a testing environment for such pilot implementation.

6.3.7. The Committee also took note of the concerns raised regarding lack of timely inputs from IEEMA and directed that any additional suggestions be submitted in writing within a week, so that the final report could be completed without delay.

6.3.8. Overall, the Committee concluded that the country has the technical capability to indigenize SCADA systems within the 2026-27-to-2028-29-time window, subject to appropriate funding, testing ecosystem, and implementation support.

6.3.9. The minutes of the meeting are attached as **Annexure III C.**

6.4. In addition to the meetings of the Committee, Considering the action points emerged in the Committee meetings, three meetings were held with the developers/vendors/testing agencies (on 07.01.2026, 11.03.2026 and 13.03.2026) for assessment of present domestic capabilities, and future possibilities to develop the various software and hardware modules of SCADA system. The compiled brief of the deliberations held in the meetings and minutes of meetings are attached under **Annexure IV.** Also, a team of CEA officials visited National Load Dispatch Centre (NLDC) to understand the structural details of the SCADA system.

6.5. An effort was also made for identification of the testing infrastructure available and the cyber-security requirements for the SCADA system. The details of testing facilities available with CPRI and STQC and the testing requirements in respect of Cyber security aspect is attached as **Annexure V.**

6.6. In addition to the inputs for finalization of trajectory for indigenisation of Power sector SCADA system, inputs of stakeholders were also sought regarding the approach of development of the SCADA system, their capabilities, support required for development etc. The brief of Inputs of Vendors/Developers of the SCADA system Modules is attached as **Annexure VI** and the detailed inputs are attached as **Annexure VI A.**

7. Recommendations of the Committee:

Based on above analysis the following timeline has been finalized for the list

of software (38 modules) and hardware (25 modules) shared by Grid India:

7.1. For Software Modules:

S.no.	Item Description	2026-27	2027-28	2028-29
1.	SCADA	√		
2.	ICCP Communication	√		
3.	CFE Communication	√		
4.	Historian (Information Storage & retrieval) System along-with GUI as per TS requirement of Historian.	√		
5.	Web Server Application - Software for Data Replica	√		
6.	Web Server Application - Software for Web Server	√		
7.	Web Server Application - Web Historian and Reporting System	√		
8.	SMS & Email Interface	√		
9.	EMS Functions - State Estimator		√	
10.	EMS Functions- Contingency Analysis		√	
11.	EMS Functions - Security Enhancement		√	
12.	EMS Functions - Optimal Power Flow		√	
13.	EMS Functions - Short Circuit Analysis		√	
14.	EMS Functions - Automatic Generation Control (AGC)		√	
15.	EMS Functions - Transmission Line/Corridor Capability Monitor (TCM)			√
16.	EMS Functions - Outage Scheduler			√
17.	Dynamic Security Assessment (DSA) Software (at RLDC only)		√	
18.	Dispatcher Training Simulator			√
19.	Identity Management Software	√		
20.	Network Access Control (NAC)	√		
21.	Patch Management Software	√		
22.	VAPT Tool		√	
23.	Host based intrusion prevention system (HIPS) with centrailised management		√	
24.	End Point Security Solution with centralised management		√	
25.	Centralised Management and Log Analyser of all FWs		√	

26.	Report Development & Generation Software	√		
27.	OPC Server Licenses for data transfer between OT and IT System	√		
28.	OPC Client Licenses for data transfer between OT and IT System	√		
29.	Load Shed Support (LSS) / ADMS	√		
30.	OPC server/client licenses (SCADA & Historian 5 each)	√		
31.	Test bench PDS for FEP, SCADA and ICCP Integration	√		
32.	Load Forecasting	√		
33.	Network Management System	√		
34.	Database development system (PDS)	√		
35.	Document Management System	√		
36.	Operating System for all the servers envisaged and required under the project		√	
37.	SIEM (Security Information and Event management)	√		
38. *	Virtualisation Software for all the virtual servers envisaged and required under the project along-with centralised management software			

*Virtualization Software is Commercial off the Shelf Software, presently developed on Open-source and global providers are available. There is lack of Commercial viability for domestic development.

7.2. For Hardware Components:

S. No.	Item Description	2026-27	2027-28	2028-29
1	Servers for various applications supplied under SCADA Project	√		
2	WAN Router cum Firewall for External Connectivity	√		
3	Data Concentrator PC (DCPC) at designated Location as per Volume-II TS - Industrial grade Computer	√		
4	Time & Frequency System NavIC (with failback to GPS) Based	√		
5	Digital Display for Date / Day / Time/ Frequency etc	√		
6	48 Port L3- LAN switch for SCADA/EMS LAN	√		
7	12 Port L3- LAN switch for External DMZ LAN	√		
8	Server Management Console	√		
9	Backup Solution	√		
10	Storage System - SAN System	√		

11	**Storage System - NAS System**	√		
12	**Smart Server Rack**		√	
13	**Cyber Security Appliances - Firewall with NIPS and centralised management**			√
14	**Cyber Security Appliances - Anti-APT**			√
15	**Cyber Security Appliances - Remote Diagnostic Tool**			√
16	**24 port FC switch for SAN Storage**		√	
17	**Workstation Consoles**	√		
18	**Video Projection System (RGB Laser) (with each modules of 70" (6*4))**	√		
19	**55-inch Video Wall with CPU (Wall/Floor mount with Stand)**	√		
20	**Color Laser Printer / Black & White Printer**	√		
21	**Link Load Balancer**	√		
22	**IP based KVM System**	√		
23	**Centralized Keyboard & Mouse Control Solution (CKMC)**	√		
24	**External Solid State Drive (SSD) - 4 TB**	√		
25	**Laptop for maintenance**	√		

These equipment are mostly Telecom and IT networking equipment and Power sector is a small user of these equipment. Thus, the Make in India trajectory as defined by Meity/ Department of Telecommunication (DoT) would prevail for these equipment.

7.3. Way Forward:

To achieve the above timeline, following follow up actions are recommended:

i. **Formal Institutional framework to drive the indigenization**: An institutional framework to drive the indigenization of SCADA system may be formalized. A National SCADA Mission or a specialized Working Group can be constituted, under the guidance of the Ministry of Power (MoP/CEA).

ii. **Development Model:** For the development and the comprehensive integration of all SCADA system components one of the following development models may be adopted:
   a. **Nomination Basis:** Government PSU/(s) having experience in SCADA development and Application such as C-DAC may be nominated.

   b. **Collaboration Basis/ Consortium Basis:** Powergrid/GRID

INDIA may initiate inviting expression of interest process, within one year.

iii. Testing of SCADA system:

a. **Establishment of platform of testing**: A platform for testing of indigenous SCADA modules by simulation of possible operation needs and for testing of cybersecurity aspects, is to be established, within next two years, with the Government Funding.

b. **Pilot projects** to be taken up under SLDC/RLDC/NLDC for demonstration and real-time field testing and validation of indigenous SCADA/EMS software and hardware (including RTUs, workstations and servers) in parallel to existing systems. SLDC Odisha volunteered to provide such testing environment.

8. Additional Recommendations:

8.1. Chairperson, CEA:

Dedicated Team: To develop the indigenous SCADA system, support of Module Developers may be taken initially, and a dedicated team in Grid India may be formed and future project management/upgradation may be done by the dedicated Team.

8.2. Grid-India:

Funding Mechanism: A suitable funding mechanism needs to be established for these indigenous SCADA/EMS development projects, either through government grants or through an alternative sustainable financing mechanism, to ensure adequate resources for research, development, testing.

8.3. Testing and Funding Imperative: It is emphasized that although the formulation of the trajectory was the original Terms of Reference (TOR) of the Committee, various stakeholders including developers emphasized that providing dedicated funding and comprehensive testing infrastructure are crucial for adherence to the proposed timelines.

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