SECTION -2, CHAPTER -1

SCADA FUNCTIONS

1.0 General requirements

This section describes the functions to be performed by the SCADA applications for distribution system for the project area. Bidders are encouraged to supply standard, proven & tested products that meet or exceed the Specification requirements. This chapter describes the requirements of ISR functions also. Unless specified as optional functions/ features all functions/ features mandatory for the project area.

1.1Design requirements

The software shall be modular in nature. The software shall be able to work platform based on minimum 64 bit architecture. All the variable parameters of SCADA/DMS applications, which require adjustment from time-to-time, shall be defined in the database and shall be adjustable by system personnel. All periodicities and time intervals contained in the Specification that define these parameters shall be considered as initial values to be used for performance purposes. The adjustments made to parameters by the user or programmer shall become effective without having to reassemble or recompile programs or regenerate all or portions of the database.

The specific requirements for output results are described along with the other requirements of each function. However, all results that the user deems to be important shall be stored in a form accessible for display and printing, whether or not explicitly specified in the particular subsection.

1.1.1 SCADA/DMS Function Access

Various application functions shall be designated as single user/ multi-user. For a single-user function, the user with access to the function must relinquish access to it before access can be granted to another user. For a multi-user function any number of users, up to the maximum designated for the function, may have access to the function simultaneously. All such actions shall be recorded as events in the event log

1.1.2 Critical & non critical functions

The functions defined in this specification shall be classified as Critical or as Non-critical. Every critical function must be supported by sufficient hardware& software redundancy to ensure that no single hardware & software failure will interrupt the availability of the functions for a period exceeding the automatic transfer time defined in the specification.

Non-critical function may not be supported by hardware & software redundancy and can be suspended in case of non-availability of corresponding hardware.

Generally the following are to be classified as Critical functions

a) All SCADA applications
b) Information Storage and Retrieval (ISR)
c) All DMS applications
d) Data exchange among the contractor supplied SCADA/DMS system, IT system established under R-APDRP
e) Web server applications , Security applications
f) Network Management system (NMS)
g) Data recovery function (DR)

The following are Non-Critical functions

a) Disptacher Training Simulator (DTS)
b) Database modification and generation
c) Display modification and generation
d) Report modification and creation
e) Data exchange with Remote VDUs ,if any

1.2 SCADA Functions

The following SCADA functions are envisaged under this specification.

- Data Acquisition from RTUs at S/S , FRTUs at RMUs /sectionalizer & FPIs
- Time synchronization of RTUs,, FRTUs & FPIs(if time synch is supported in FPI)
- Data Exchange among the contractor supplied SCADA/DMS system, IT system established under R-APDRP (in specified format (OPC / CIM-XML / ICCP / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS), State load dispatch centre.
- Data Processing
- Continuous real-time data storage and playback
- Sequence of event processing
- Supervisory Control
- Failsoft capability
- Remote database downloading ,diagnostics & configuration
- CIM compliance IEC61968
- GIS adaptor (GIS Landbase data, network model using GIS engines/adaptors supporting Native Adapters , CIM/XML Model for Distribution / Power System, using Model Exchange & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)
- Information Storage & Retrieval (ISR)
- Data recovery (DR)

The System Design Parameters of SCADA/DMS functions ,The power system sizing, Performance requirements for complete SCADA/DMS system are specified are specified in DESIGN PARAMETERS AND PERFORMANCE given section 8 The SCADA system shall have capability to accept data from the following sources:

(a) Telemetered data received from RTUs, FRTUs & FPIs
(b) Data received from IT system established under R-APDRP.
(c) Data exchange
(d) Calculated data
(e) Pseudo-data (Manually entered data)
(f) GIS land base data, network model using GIS engines/adaptors

All input data and parameters, whether collected automatically or entered by an user, shall be checked for reasonability and rejected if they are unreasonable. All intermediate and final results shall be checked to prevent unreasonable data from being propagated or displayed to the user. When unreasonable input data or results are detected, diagnostic messages, clearly describing the problem, shall be generated. All programs and all computer systems shall continue to operate in the presence of unreasonable data.
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Each of the SCADA functions is described below.

1.1.3 Communication protocol.

SCADA system shall use the following protocols to communicate

a) for RTU - IEC 870-5-104 protocol also 101 to communicate when acting as data concentrator with slave devices
b) for FRTU- IEC 870-5-101 /104 protocol
c) for FPIs - IEC 870-5-101 /104 protocol
d) for MFTs – MODBUS
e) for DR & Other any other SCADA system - ICCP/TASE.2 in specified format (OPC / CIM-XML / ICCP / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)
f) for IT Systems - (in specified format (OPC / CIM-XML / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)
g) In case existing system uses DNP3.0 protocol, the same shall be used for integration of existing RTUs.

The protocol considerations shall be made in accordance to the system/ device to be interfaced. However, system shall have capability to interface using all necessary protocols as specified above for the devices that may be interfaced in future

1.2.2 Data Acquisition

SCADA system shall acquire data from Remote Terminal Units (RTUs) ,FRTUs &FPIs

a) . RTU & FRTU

The type of data to be acquired through RTUs, FRTUs shall include analog values, digital status data (Double point and single point indications) and SOE data from the substation, RMUs etc.

Analog values like P, Q, F, each phase V, each phase I, each phase pf, and energy values (Export/Import KWh and KVARh) shall be collected by the RTU, FRTUs from the MFTs .

Analog values such as station battery voltage, oil temperature, winding temperature , tap changer, weather transducer data etc. shall also be acquired through RTU using analog input modules & suitable transducer, if defined in the RTU BOQ.

b) FPIs

Digital status in the form Fault protection indication viz O/C & E//F & in case also analog data such as Fault settings are remotely .

The actual point counts & type of data acquired are given in the RTU, FRTU specification.

1.2.2.1 Polling method

Digital status data from RTU shall be reported by exception and shall be updated and displayed within 4 seconds. Digital status data from FRTU & FPI shall be also be reported by exception and shall be updated and displayed within 6 seconds. Digital status data shall have higher priority than the Analog data. The system shall have dead band for data by exception.

All analog values except energy values shall be reported by exception from the RTU, FRTU & FPI . The analog value, when reported by exception, shall be updated & displayed within 5sec from S/S & 10sec from RMU/sectionlizer locations at the control centre. An integrity scan of all status & Analog values shall also be made every 10 minutes (configurable).

The provision shall also be made to report analog values & status data periodically at every 10sec (user configurable), if required by the user.

The time skew at SCADA/DMS control centre ,S/S , RMU,FPI shall not be more than 0.1sec at each location & latency shall not be more than 0.5sec for status. For analog data the time skew shall not be more than 1sec & latency shall not be more than 1sec for analog as per IEEE C37.1.

Energy values of 15 minute blocks shall be collected periodically from the RTU, FRTU at scan rate of 15 minute/1 hour (configurable upto 24 hours). Alternatively, the energy values shall be calculated for each 15 minute/1 hour blocks at SCADA level from the acquired energy values of MFTs through RTU & FRTU.

The contractor must asses & take the network delay into consideration while designing the system so that the update time in normal & peak level of activities are met.

The SCADA/DMS computer system shall also be able to collect any and all analog & digital data from its RTUs/FRTU/FPI on demand. Apart from the periodic integrity scan, the integrity scan shall also be initiated automatically for an RTU/ FRTU/ FPI whenever the following situations arise:

i. Upon start up of the system
ii. RTU/ FRTU/ FPI status change is detected such as RTU/ FRTU/ FPI restart, Communication Link restoration
iii. On demand by SCADA/DMS functions
iv. On request by the user

The TCP/IP Communication for RTU,FRTU,FPI on public network shall be encrypted over SSL Security / VPN & the equipment should take control command from designated Master IP address only and no other IP. The RTU, FRTU, FPI & all TCP/IP devices that are on Public Network shall form a private VPN network with the SCADA Front End, through which encrypted data gets exchanged.

1.2.2.2 Telemetry Failure

If data is not received from an RTU/FRTU/ FPI after a user-adjustable number of retries, each affected point in the SCADA system shall be marked with a **'telemetry failure quality code'** and an alarm shall be generated. Telemetry failure of data can be due to failure of communication link, failure of complete RTU/ ,FRTU/FPI or RTU/ FRTU module or MFT etc. Only a single alarm shall be generated if an entire RTU/ FRTU or its communication channel fails.

In the event of telemetry failure, the last good value/status shall be retained in the database for each affected point. When telemetry returns to normal, the associated SCADA system shall automatically resume updating the database with the scanned data.

The user shall be able to substitute a value in the database for any point that is experiencing telemetry failure which shall be marked with **'manual replaced' quality code** in addition to the **'telemetry failure' quality code.** The user shall also be able to delete any point (or entire RTU/FRTU/FPI) from scan processing. All deleted points shall be marked with a **'delete-from-scan' quality code.**

Acquisition Modes

The following modes of data acquisition shall be supported:

a) Enable
When RTU/FRTU/FPI is enabled, the data is scanned in normal fashion and control command execution is allowed.

b) Disable
When RTU/FRTU/FPI is disabled, the data scanning & control execution is disabled. This is equivalent to" delete from scan "of complete RTU.

c) Test /Maintenance

.—Placing an RTU/ FRTU in test mode shall generate an appropriate event message. When an RTU/FRTU is in the test mode, the real-time database shall retain the last value from all points collected via the RTU/FRTU before it was placed in the test mode. The points shall be marked in the database with a quality code indicating that their source RTU/FRTU is in the test mode. All system displays, programs, data links, and other devices shall use this value. Supervisory control of points that are in the test mode shall not be permitted.

When an RTU/FRTU is removed from the test mode, a message shall be generated, the test mode quality code shall be removed from all points assigned to the RTU/FRTU, the database values shall resume updating on each scan, and any controls for the RTU/FRTU shall be enabled.

1.2.3 Time synchronisation of RTUs

The SCADA/DMS system will be synchronised from the GPS based Time and frequency system. The SCADA system shall synchronise the time of all connected RTUs/FRTUs/FPI every 15 minutes (user configurable from 5 minutes to 24 hrs) using time synchronisation message in the IEC 870-5-104/101 protocol /NTP/SNTP. The servers /Workstations at SCADA/DMS control centre shall be synchronised using NTP/SNTP . The time of DR centre shall also be synchronised from the GPS based system installed in one of the SCADA/DMS control centre in the state.

1.2.4 Data Exchange

1.2.4.1 SCADA/DMS system with IT system

The SCADA/DMS System shall exchange data with ISR System & ISR System shall be the nodal interface with all IT System. The Data Center, DR Center and Customer Care Center under IT System, shall exchange data with the ISR System, using Open Standards like CIM/XML & IEC 61968 Series Standards for Power System, OPC, ICCP/TASE.2., ODBC

The GIS System shall exchange data with SCADA System over IEC 61968-1 SOA based ESB/Bus using CIM/XML Models for Power System using GIS Engine / Adapters supporting the standard.

Direct SQL/ODBC interfaces should continue to be supported for report generation and ad-hoc queries.

If utility was having GIS/ billing/customer system prior to R-APDRP i.e. considered as legacy in IT –R-APDRP, then interfaces may be selected accordingly viz ODBC/DDE etc using ASCII files. However, they shall provide system in compliance of the data exchange requirement specified in this para.

Data to be exchanged with IT system is defined ISR section. For DR & SLDC , it is given below:

1.2.4.2 For data exchange between SCADA/DMS control centres & DR centre , SLDC :

SCADA/DMS control centre shall also exchange data using ICCP with State Load Despatch Centre (SLDC) of the state..Data exchange shall also allow other information to be transferred report by exception but also configurable periodically, or on demand. . It shall be possible to exchange at least the following data:

- real-time telemetered data of the interconnected network,
- non-telemetered data of the interconnected network,
- calculated data of the interconnected network
- SOE data of the interconnected network
- historical data of the interconnected network
- scheduling data
- operator messages.
- Event /alarm lists

It is envisaged that the utility shall get the load forecasting & drawl schedules from SLDC & versa in order to execute planning of load distribution.. In addition , status /measurement of interconnected network shall be able exchanged in both directions.

The data exchange with DR is required all the data to be transferred from control centre to DR which is required for system build in order to build a system from scratch. ICCP . TASE.2 protocol or equivalent non proprietary / De-Facto protocol shall be used transfer network model / database changes on incremental /global basis automatically once a day & on demand It shall transfer all data /information which is required for system build in order to build a system from scratch.

1.2.5 Data Processing

The SCADA/DMS system shall prepare all data that they acquire for use by the power system operations and other applications. The data processing requirements shall apply to data collected from all specified sources.
Data acquired from RTUs/FRTUs/FPI/IT system , as well as data received from the DMS and the existing control centers if any, shall be processed and placed in the Real-Time Database as soon as it is received.

Data processing involves a value which has been converted to internal form and analyzed for violations of limits. The data processing shall set various data attributes depending on the results of the checks and shall trigger any additional processing or calculation. The SCADA /DMS system shall prepare all the acquired data for use by the power system applications. The SCADA system shall have capability to accept data from the following sources:

(a) Real-time (also referred as telemetered) data received from control centres /IT system (data centre, customer care ,DR centre and RTUs/FRTU/FPI etc)
(b) Calculated data
(c) Manually entered data
(d) Sequence of events data
(e) Alternate data sources

1.2.5.1 Analog Data Processing

Analog data processing shall be performed according to the requirements listed below.

(i) Conversion to Engineering Units

Analog points that are transmitted to SCADA system in raw data format shall be converted to engineering units before being stored in the database. This conversion function shall include, as a minimum, the capability to perform the following conversion algorithm:

Value = (A * scanned valued) + B ,

where A and B are programmer-adjustable constants assignable as database attributes on a per point basis.

(ii) Zero dead band processing

The SCADA system at control centre shall process each analog input for dead band zone processing. The acquired value, if falls between the dead band range around zero then it shall be considered as clamped zero value else the actual value shall be considered.

(iii) Reasonability Limit Check

The reasonability limits shall represent the extremes of valid measurements for the point's value. All analog values shall be compared against defined high and low reasonability limits. The comparisons shall be performed at the scan rates of the analog values. An alarm shall be generated the first time a reasonability limit violation is detected. The last valid value of the variable shall be maintained in the database and marked with a quality code indicating the **'reasonability limit violation'**. When data returns to a reasonable value, the new value shall be accepted and a return-to-normal message shall be generated.

(iv) Limit Monitoring

For bi-directional quantities (positive or negative) there shall be a set of three limits for each direction. For unidirectional quantities there shall be a set of three limits in one direction. These limits will represent increasing levels of concern and shall be named as **"Operational", "Alarm" and "Emergency"** limits. These three limits shall be set within the boundaries of reasonability limit. Generally, any alarm can be assigned as audible alarm but emergency limit shall necessarily be assigned as audible alarm.

All telemetered and calculated analog point shall be compared against above sets of high and low limits each time the value is scanned or calculated. Whenever a monitored point crosses a limit in the undesirable direction a limit violation alarm message shall be generated. Whenever a monitored point crosses a limit in the desirable direction, an exit alarm message shall be generated. If multiple limits have been crossed since the last check, each limit crossed shall be reported.

All limit monitoring shall preclude annunciation of multiple alarms when a value oscillates about an alarm limit by utilizing a programmer-adjustable alarm dead-band for each point.

The user shall be able to temporarily override any of the above limits (which are in use) by entering a new value. When the user overrides a limit, it shall be marked with a **'limit override quality code'** on all displays. The override value shall be recognized, and any display, report, or log containing the value of the overridden limit shall include it as such. An override value shall be used instead of the permanent value until the user removes the override condition or system is re-initiailised . Any change in alarm states resulting from a change in limit value shall be reported. Contractor shall finalise & take approval from utility for limit values.

(v) Rate of change /Gradient

All telemetered and calculated analog points shall be also processed for rate of change of / Gradient processing , if defined that point for such processing in the database . An Alarm for over shoot & event message for return to normal shall be generated.

The rate of change shall be calculated periodically for each assigned point, by dividing the point's values at the beginning and the end of the period into the length of the period. Filtering shall be applied so that single scan excursions do not cause an alarm. The result shall be saved as a non-telemetered database point. All the requirements that apply to calculated points, such as limit checking, alarming and availability for display and processing shall apply to the ROC points. There shall be a positive limit and a negative limit to catch excessive rises in the analog value.

vi) Sign Conventions

The sign conventions for the display, data entry and reporting of active and reactive power flow shall be used universally by all SCADA/DMS functions. All imports to bus bars shall be represented with + sign and all exports from bus bars shall be with –ve sign.

Vii) Accumulator Processing

The system shall be able to store accumulator history. Storing accumulator history shall be provided with a method in which that stores data only once per hour and in other method that stores data each time new data enters the system.

It shall be possible to use the two methods concurrently for any pulse accumulator, making it possible to maintain two records for data that are read more than once an hour.

1.2.5.2 Digital Input Data processing

Each state of a digital input point shall be associated with the state of an actual device. The number of bits that will be used to define the state of a device is defined in the RTU/FRTU Specification. A status point shall be defined as being either legal or illegal, and normal or abnormal:

- Illegal state: The first check on a new input to a digital status point is the legality check. If the new state is illegal, then the old value shall be left in the database and marked old with relevant quality code such as telemetery failure etc .
- Abnormal state: If the new state is legal, it shall be checked to see if it is among the normal states defined for the point. If not, the status point shall be marked as abnormal. While abnormal, it shall appear in the summary display of abnormal conditions/ off-normal summary
- Alarm checking: Each new value shall be checked to see if transitions into that state are to be alarmed. If so, and if no control action is pending on the status point, then an alarm action shall be triggered.

The following digital input data types shall be accommodated as a minimum:

(a) Two-state points: The following pairs of state names shall be provided as minimum :

(1) Open/Closed
(2) Tripped/Closed
(3) Alarm/Normal
(4) On/Off
(5) Auto/Manual
(6) Remote/Local
(7) On Control/Off Control

Three-state points: Any of the state combinations listed in (a) above shall be supported with a third, typically, in-transit state which is the case for slow operating devices such as isolator. If a device remains in this state for a period more than a threshold value, the same shall be alarmed.

Momentary change Detection (MCD): The input to capture the states of fast acting devices such as auto recloser.

Commanded changes initiated by supervisory control shall not be alarmed but shall generate an event message. All other status changes in the state of telemetered, calculated digital input points & uncommanded changes shall be alarmed . Each CB, isolator switching device etc shall have normal & off normal positions states defined. In the event of off normal positions, the same shall be reflected in the off normal summary list

1.2.5.3 Calculated Data processing

SCADA system shall be capable of performing calculations and storing the result in the database as calculated data available for display. The database variables to be used for arguments and the mathematical/statistical/logical functions to be used as operations shall be definable interactively at a console as well as by the programmer using database creation and maintenance procedures.

Calculated analog values shall use database points as the arguments and mathematical and statistical functions as the operations. Functions such as addition, subtraction, multiplication, division, maximum value, minimum value and average value, count, integration, square root extraction, exponentiation, trigonometric functions, logarithms and logical & comparative operators etc shall be provided.

It shall be possible to calculate running maximum value, minimum value and average value over a time interval (time interval configurable from 5 minutes to 60 minutes). The value shall be reset after the elapse of defined time interval. These

values shall be stored with time of occurrence for maxima and minima and the time for averaging.

Calculated status values shall use database points as arguments and combinational logic functions that include the logical, comparative operators such as AND, inclusive OR, exclusive OR, NOT, Less Than, Greater Than, Less Than or Equal To, Greater Than or Equal To, and Equal To ,If , else if etc. Suitable rules or operators (such as multi-level parentheses) shall be provided to indicate the sequence of operations in the calculation.

1.2.5.4 Substation Topology Processing

The SCADA /DMS system shall be provided with a Substation topology processor function. This function shall be capable of analyzing the open/closed status of switching devices, such as breakers–and disconnectors, in order to define the configuration of the substation for display. The energization of lines, transformers, bus sections and generating units shall be determined so that the associated displays may correctly show the status of these power system elements. The configuration shall be re-evaluated and updated whenever a switching device status change & analog value change beyond deadband is detected. A common display philosophy shall be generated and used in the SCADA/DMS of all the towns.

1.2.5.5 Alternate source for data:

The system shall have capability to accept multiple data sources by defining as main & secondary . Normally, data from normal source will be considered . In the event of non availability of primary source , data from secondary source shall be considered & once primary source is healthy , it shall switch back to primary source. There shall be an indication for primary /secondary source in displays , reports etc. Suitable alarm shall be generated in the event to change from primary to secondary & vice versa. Alternate source of data can be defined for certain critical points in the database.

1.2.5.6 Quality Codes

Quality codes indicate the presence of one or more factors that affect the validity of a data value. All quality codes that apply to a data value shall be maintained in the database for that data value.

The quality of the calculated value shall be the quality of its "worst" component of its arguments. The presence of a quality code on any of the component data values shall not disrupt the calculation using that value . Results of calculations that are manually overridden by the user shall be denoted with a quality code that can be differentiated from the propagation of a manual replaced quality code from one of its component values.

At least the following data quality codes preferably as the following single letter code shall be provided. However, distinct symbols /shapes after approval from employer may also be used.

Quality code	Code	Reason
Telemetry Failure (RTU Link)	T	Telemetry has failed
Manual Replaced	M	Manual updation
Delete from Scan (RTU/point)	D	User disabled the scan of the of data/point
Questionable data	Q	Analog values of the de-energized elements
Calculated	C	Calculated data
Estimated	E	Estimated data from state estimator
Limit Override	L	Limits are overridden
Primary /secondary source	P/S	Primary or secondary source
Reasonability Limit Exceeded	R	Value beyond reasonability limit
Alarm Inhibit	A	Alarm processing is inhibted
Test or maintenance mode	X	Point is in test /maintenance mode

1.2.6 Continuous Real-time data storage and playback

All real-time data (Analog and status) shall be continuously stored in auxiliary memory for atleast two weeks as and when it is received in the SCADA database from the RTUs.

It shall be possible to playback above stored data on single line diagram and network diagram for a time window of at least 10 minutes (configurable in seconds /minutes) by defining Start and End date and time. It shall be possible to have tabular and graphical trends of the stored data. It shall be possible to set a different sampling rate for playback than the sampling rate for data storage.

The users shall be able to select the time window of interest for archival of data in the ISR system for future retrieval and playback in SCADA system. This archived data shall be transferable in RDBMS database tables of ISR system for generation of tabular displays and reports.

1.2.7 Sequence-of-Events data

Sequence-of-events (SOE) data shall be chronological listings of 'status change events with time stamp' acquired from RTUs /FRTUs/FPIs. The SOE data shall be collected from all RTUs/FRTU/FPI either in normal polling or periodically/on demand . SOE data collection shall have lower priority than supervisory control actions and normal data acquisition. The SOE data collected from different RTUs/FRTU/FPI shall be merged for chronological listings and stored for subsequent review. Atleast latest 1000 SOE data shall be available for display. The SOE resolution of RTU/FRTU is defined in respective sections for RTU/FRTU. SCADA/DMS system at control centre shall have 1ms SOE resolution. However, as SOE time stamping is done at RTU/FRTU/FPI level , the same shall be in line with resolution defined for RTU/FRTU/FPI.
All SOE data collected from all RTU/ FRTU/FPIs shall be stored in daily RDBMS database of ISR system**.**

1.2.8 SCADA language

The SCADA system shall have capability to write various programs using IEC 61131-3 SCADA language or C/C++ or any non proprietary language . It will facilitate user (programmer) to write various programs/ logics using points defined in the database .

1.2.9 Supervisory Control

The operator shall be able to request digital status control, set-point control and raise/lower control on selected points and analogs using Select check before operate (SCBO) Sequence.

Supervisory control shall allow the SCADA system to remotely control switching devices. A control action shall require a confirmation-of-selection-prior-to-execution response. Initiation of the control execute step shall occur after the dispatcher confirms that the correct point and control action have been selected.

After the dispatcher/DMS function initiates control execution, the RTU/FRTU shall be addressed for verification that the correct point has been selected at the RTU/FRTU and then the control action shall be executed. It shall also be possible to reset the flag in FPI through a command.

It shall be possible to issue control commands as a group control from SCADA where switching devices pertaining to different RTUs/FRTU or a RTU/FRTU may be controlled as a group. The SCADA system shall send the control commands sequentially (without dispatcher intervention), if the commands pertain to switching devices in the same RTU/FRTU, using the Selection Check before operate

(SCBO) of prior–to-execution. The control commands pertaining to different RTUs /FRTUs may be executed in parallel.

If, after selecting a point, the user does not execute the control action within a programmer-adjustable time-out period, or if the user performs any action other than completing the control action, the selection shall be cancelled and the user be informed. If the communication to the RTU /FRTU is not available, the control command shall be rejected and shall not remain in queue.

The user shall not be prevented from requesting other displays, performing a different supervisory control action, or performing any other user interface operation while the SCADA/DMS system waits for a report-back on previously executed control actions.

The system shall process supervisory control commands with a higher priority than requests for data from the RTU /FRTU /FPI data acquisition function.

Functional requirements for the various types of supervisory control are given below. A supervisory control request shall be sent from control centre only after the controlled point was checked for proper conditions. The request shall be rejected by the System if:

1. The requested control operation is inhibited by a tag placed on the device;
2. The device or S/S in local manual control mode
3. An Uninitialized, Telemetry failure, delete from scan, manual replaced , Test/maintenance , or Manually Entered data quality indicator is shown for the device;
4. The Operating Mode/ user permission of the workstation/console attempting control does not permit supervisory control
5. The device is already selected for control request or control execution is from another workstation / user/window /console or control request is progressing
6. Time out after selection
7. The device is not subject to supervisory control of the type being attempted

Rejection of a control request from control centre shall occur before any transmission is made for control purposes. A control rejection message shall be displayed for the Dispatcher

1.2.9.1 Digital Status Control

A digital control output results in the activation of an output relay in a RTU. Different commands shall be possible for these digital status controls.:

Successful completion of the control request shall be recorded as an event. Failures to complete shall be handled as specified in UI section. Control

requests shall be canceled and the selection of the point shall be terminated when the user cancels a request, does not perform the next step of the control procedure within the selection time-out period from the previous step of the procedure, or the request is rejected.

1.2.9.1.1 Breakers

The user shall be able to select and operate the two state controllable switching device i.e. Circuit breakers/ isolators (in case of RMUs)

1.2.9.1.2 Capacitor Banks

The user shall be able to control capacitor devices. The procedure for controlling these devices shall be the same as that of a switching device except that any supervisory control action must be inhibited for a programmer-adjustable time period after the capacitor/ reactor device has been operated. A message shall appear if an attempt is made to operate the device prior to expiration of that time period & dispatcher is required to give command after expiration of inhibited time period.

1.2.9.1.3 Tap Changing Transformers

SCADA system shall have the capability to raise and lower the on load tap position of the transformers from SCADA control centre through supervisory commands.

Depending on system conditions, the user may raise or lower the tap positions of On Load Tap Changing (OLTC) transformers. OLTC's tap position need to be monitored if supervisory control action is to be exercised. OLTC tap position input shall be acquired as an analog value. Tap excursions beyond user-specified high and low limits shall cause the master station to generate an alarm.

Supervisory control of OLTCs shall only be permitted when the transformer's control mode is Supervisory. All attempted invalid control actions shall be rejected.

For supervisory operations, the initial selection and control of the transformer for a raise/lower operation shall follow the (SCBO) Sequence. Upon receipt of the raise/lower command, the RTU will immediately execute the control action. It shall not be necessary for the user to re-select the transformer for additional raise/lower operations; the user shall only have to repeat the desired number of raise/lower commands, which shall be executed immediately. Normal scanning functions shall not be suspended between the times that repeated raise/lower commands are issued.

The user shall be able to cancel the operation or have it automatically cancelled by the master station after a programmer-adjustable time period elapses after the last raise/lower command. This multi-step procedure as described below

1. The RAISE and LOWER pushbuttons shall be displayed.
2. The command shall be launched as soon as RAISE or LOWER is selected. The Raise and Lower buttons shall not be replaced by a single Execute button. The RAISE/LOWER pushbuttons shall continue to be displayed, and it shall be possible to initiate these controls repeatedly without reselection of the controlled point, provided that the execution of the previous control command has successfully been completed.
3. The RAISE/LOWER pushbuttons shall remain available until either (a) the dispatcher clicks the CANCEL button or (b) the control times out due to inaction by the dispatcher.
4. A separate timeout period, adjustable in the range of upto 120 seconds, shall be provided for incremental control. The timer shall be reset and start counting again whenever a RAISE or LOWER command is issued.

Successful completion of incremental control shall be recorded as an event . However failure of incremental control, including failure to achieve the intended result, shall be alarmed.

1.2.9.2 Set point Control

The SCADA/DMS shall provide the capability to issue set point control using SCBO procedure to field equipment The SCADA/DMS shall transmit a numerical value to the device being controlled, to indicate the desired operational setting of the device.

1.2.9.3 Auto execution sequence /Group control

The Auto execution sequence function shall permit multiple supervisory control commands to be programmed for automatic execution in a predefined sequence. The dispatcher shall be able to execute this sequence. Commands to be supported shall include:

- Time delayed
- Pause & until a user commanded restart or step execution
- Jump to other sequence on certain conditional logic
- Manual Entry.

After executing a supervisory control action, the SCADA/DMS shall pause to obtain an indication of a successful control completion check . If the control completion check is not received, or does not have the expected value, the SCADA/DMS shall terminate the execution of the sequence and shall declare an alarm. Apart from waiting for control completion checks, and unless there is an explicit command for a delay, such as a “Pause” or “Stop” command, the SCADA/DMS shall not introduce any other delays in the execution of an sequence. No limit shall be placed on the number of Auto execution sequences, which may execute in parallel.

At any time during the execution of a list, the user shall be able to stop further execution via an cancel feature.

1.2.9.4 Control Inhibit Tag

A user shall be able to inhibit or enable supervisory control on any device. A tag symbol indicating the control inhibit conditions shall be displayed next to the device on all displays where the device is presented.

The programmer shall be able to define up to 4 tag types with the following attributes for each:

(a) Type of controls that shall be inhibited by the tag (e.g., open only (Green tag) close only (Yellow tag), open and close (Red tag), or information only - no control inhibit (White tag). Tags shall be preferably identified by colours. However, distinct symbols /shapes after approval from employer may also be used.
(b) Tag priority

Further the user shall be able to place atleast 4 tags per device. Only the highest priority tag shall be displayed. Any combination of tags shall be supported, including multiple tags of the same type. The combined effect of multiple tags shall be to inhibit a type of control if it is inhibited by any of the tags.

When a tag is placed on a device, the user shall be prompted to enter tag number and comment. An event message shall be generated each time a control inhibit tag is placed or removed with information on user ID, type of tag, time of placement or removal of tags.

1.2.9.5 Control Permissive interlocks

It shall be possible to define the interlocks at SCADA level as necessary for control actions. It shall also be possible for operator to bypass the interlock which shall be recorded as an event message with user ID information.

1.2.9.6 Control Action Monitor

The response to all control actions shall be verified by monitoring the appropriate feedback variable. A report-back timer (the duration dependent on the type of device) shall be initiated when the command is issued. At least ten timer periods of 1 to 60 seconds (adjustable in steps of one second) shall be supported, any of which may be assigned to any device.

The user shall be provided with an indication that a control action is in progress and, subsequently, a report of the result. If the control was unsuccessful, an alarm shall be generated that states:

(a) the control message exchange was not completed successfully,
(b) the device failed to operate, or

(c) the device operated but failed to achieve the desired result (e.g., following a close control action, a three-state device operates from the open state, but remains in the transition state).

If the control was successful, an event message shall be generated.

For commands issued as part of a group control, DMS applications etc., the successful completion of all device control actions shall be reported via a single message. If the operation is unsuccessful, the user shall be informed of those devices in the group that failed to operate.

1.2.10 Failsoft capability

The SCADA system shall be able to manage & prevent system from total shutdown / crash etc in the event of system crosses mark of peak loading requirements through graceful de-gradation of non –critical functions & also relaxing periodicity / update rate of display refresh & critical functions by 50%..

1.2.11 Remote database downloading ,diagnostics & configuration :

The SCADA/DMS system shall be able to download database run diagnostics & create/modify /delete configuration/ parameterisation from centralised control centre locations to RTU/FRTU/FPI etc using ASDU/ messages of respective protocols or file transfer.

1.2.12 CIM & IEC61850 , SMART GRID interface, requirements

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The system shall utilize an IEC 61968 and IEC 61970 compliant interface. The system shall enable export of all data via a CIM-XML interface and shall utilize modeling from IEC 61968 as appropriate. The profiles supported should be CDPSM (Common Distribution Power System Model) and CPSM (Common Power System Model). Messaging interfaces shall be based on model neutral interfaces based on the IEC 61970-40X series for access to real-time and historical data and use the IEC 61968-3 and IEC 61968-9 standards for messaging interfaces that are model dependent for network operations and metering respectively.

Further the above Interfaces shall be used for Integrating with the R-APDRP IT Systems being deployed for real-time & historical data exchange to and from the SCADA/DMS & IT Systems. The IT Systems Interface & the SCADA/DMS Systems Interface shall be so provided using CIM/XML & IEC 61970/61968 standards such that, a 3rd Party application service provider can integrate the two systems, or add a 3rd IT or SCADA/DMS System easily, without having to know specific Database Tables / Information of the other system.

Any Change in the electrical network system which will be captured in GIS database (through IT system being procured under separate package under R-APDRP) of the utility shall be automatically added/modified to SCADA system. eg: A new asset addition, should be able to be exchanged through Model Information between the IT System, and SCADA/DMS System without programming or configuration effort automatically & adjust and accept the Model and re-configure its databases, and should provide updated results.

SCADA/DMS Vendors shall provide CIM/XML Adapters for ICCP, OPC or ODBC for their System and CIM/XML Model repository for data and model exchange with IT Systems.

Further, system shall be able to interface with IEC61850 (GOOSE & GSSE Models) & provide an Independent 3rd Party modeling tool that can support multiple vendor IEC 61850 IED's and create IEC 61850 SCD files.

To enable to Migrate to Smart Grid, the SCADA/DMS Systems shall support the following:

- ˜Security – The SCADA/RTU/FRTU Network has to be secure over SSL secure layer, and should be implemented as a VPN. Secure adapters between end nodes on public networks should be considered with IPSec or VPN.
- ˜ Interface to AMI/AMR System where-by DSM can be implemented over CIM/XML Interfaces
- ˜The SCADA CFE should be able to integrate with Smart Grid gateway that support ICCP / IEC 61850 / IEC 60870-5-101/104// DNP3, DLMS & ANSI C12.18/21 & IEEE C37.118 .

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1.3 Information Storage and Retrieval

Information Storage and Retrieval (ISR) function shall allow collection of data from real-time SCADA/DMS system and storing it periodically in a Relational database management system (RDBMS) database as historical information (HI) data. This includes storing of data such as SOE, status data, Analog values, calculated values, Energy values etc. Programmer shall also be able to set storage mode as by exception in place of periodic storage.

Subsequently, the data shall be retrieved for analysis, display, trending and report generation. All stored data shall be accessible from any time period regardless of changes made to the database after storage of that data (e.g., it shall be possible to retrieve stored data for a variable that no longer exists in the SCADA/DMS computer system through back ups on storage medias viz. tapes /MO disks etc and initialise study-mode DMS functions with stored data on the corresponding power system model).

The addition, deletion, or modification of data to be collected and processed shall not result in loss of any previously stored data during the transition of data collection and processing to the revised database.

It should be able to compress data, and should have 100% retrieval accuracy. However, the retrieval of compressed historical streams should be of the same performance levels as normal SCADA retrieval. The ISR should be able to interface over ICCP, OPC, ODBC and CIM/XML to external systems for analytics over SOA / ESB for Integration with IT Systems, over the Enterprise Services Bus & SOA Architecture provided as part of IT SRS. The ISR system shall act as the real interface between SCADA and IT System, where-by the real-time operational system is not affected with a transaction processing system like IT, and the IT Integration efforts will not in any way effect the real-time operationally of SCADA/DMS System.

In ISR should also support ad-hoc queries, and define display and report formats for selected data via interactive procedures from operator workstations. Formatted reports and responses to user queries shall be presented in alphanumeric or graphical format on either operator workstations or printers at the option of the user. Procedure definition facilities shall be provided for activities that will be frequently performed. SQL-based language shall be used for selecting, retrieving, editing, sorting, analysing, and reporting ISR data stored. The selection and sorting criteria shall include time tags and ranges, station names, point names, equipment types, status values, text string matches on selected data fields etc and combinations of these criteria.

It shall be possible to reload any IS&R archival media that has been removed from IS&R and access the archived data without disturbing the collection, storage, and retrieval of IS&R data in real-time ..

The ISR system shall also be used for mass storage of data/files such as DMS application save-cases, Output results of DMS applications, Continuous real-time data of selected time window etc.

The System Design Parameters of ISR system is given in the **section 8**

1.3.1 Circuit breaker status Table

The ISR function shall maintain a table in RDBMS database where real-time status of all Circuit breakers , in case of RMU isolators also along with the associated quality codes shall be stored. The change of status of any breaker shall be updated in this table as soon as the change is detected by the SCADA system. This table shall contain additional information such as date & time of tripping, cause of tripping, Expected duration of outage etc. Some of the causes of tripping could be Supervisory control by user, Protection tripping, Tripping / closing by DMS applications. Information on expected duration of outage shall be taken from schedules for DMS application such as Load shed application etc. For expected duration of outages due to protection tripping, the same shall be user enterable field.. Such daily tables for two months duration shall be stored on

auxiliary memory. Tables for the previous day shall be backed up to Magnetic tape by the user at 10AM daily.

The ISR function shall transfer the information available in the "Circuit breaker status table" as defined above, to the Customer Care centre under R-APDRP IT implementation / legacy system using SOA/Enterprise Service Bus supplied by ITIA, over CIM/XML Models, or CIM/XML OPC/ICCP Adapters / Interfaces. The complete Circuit Breaker Information shall be transferred to Customer care centre on demand & by exception along with the associated quality codes and additional information associated with the CB .

1.3.2 Real-time Database Snapshot Tables

At the end of each 5 minutes, the following real time snapshot data shall be stored in RDBMS **in Real-time Database Snapshot tables:**

a) All telemetered analog values and Calculated values for all tele-metered analog points (atleast maxima & minima with associated time and average values). Energy values are not envisaged for storage in Data snapshot tables.

b) All status values with time stamp

All the above values as specified above in (a) & (b) shall be stored alongwith their associated quality code. The periodicity of the snapshot shall be user adjustable to include 5, 15, 30, and 60 minutes. **Data Snapshot tables** shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Tables for the previous day shall be backed up to Magnetic tape/ MO disk by the user at 10AM of every day. The ISR function shall prompt the user through a pop-up window to inform the user for taking the backup. The pop-up window shall persist till user acknowledges the same. In addition to that data can be stored on offline storage device .

The user shall also be able to initialize the study-mode power system analysis functions from stored snapshot data.

1.3.3 Hourly Data tables

At the end of each hour information as defined below shall be included in the hourly data tables, in RDBMS database form:

(a) Selected analog values alongwith their associated quality codes
(b) Selected status values alongwith their associated quality codes
(c) Results of hourly calculations for selected analog points (atleast maxima & minima with associated time and average) alongwith their associated quality codes.
(d) In addition to above a separate hourly energy data table exclusively for energy values (Export and Import Active and reactive Energy values for

each feeder) shall be created in ISR alongwith their associated quality codes.

Hourly data tables shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Hourly data table for the previous month shall be backed up to Magnetic tape /MO disk by the user on the 10^{th} of every month. The ISR function shall prompt the user through a pop-up window to remind the user for taking the backup. The pop-up window shall persist till user acknowledges the same.

1.3.3.1 Missed Hourly Data Storage

The programmer shall be able to independently assign any one of the following processing for each hourly value to be executed when the value is missed and cannot be acquired prior to the storage of hourly values.

a) Store zero and a telemetry failure quality code for each missed hour.
b) Store the last good data value, with a questionable data quality code, for each missed hour.
c) Temporarily store zero with a telemetry failure code for each missed hour. When the next good hourly value is obtained, divide that value by the number of hours since the last good value was obtained and insert this value, with a questionable data quality code, for all hours with missed data and the first hour that good data was obtained as is the case for energy values.

1.3.3.2 Hourly Data Calculations

The programmer shall be able to define calculated values using stored hourly data and constants as operands. The calculations shall allow the carry-forward of data from one day, week, or month to the next. The results of all calculations shall include quality codes derived from the quality codes of the operands. The following calculations shall be provided:

(a) Addition, subtraction, multiplication, and division
(b) Summation of an hourly value by day, week, and month: The running total of the summation for the current day, week, and month shall be updated each hour and made available for display.

(c) Maximum and minimum of a value over a programmer-definable time period, and the time the maximum or minimum occurred
(d) Average of a value over a programmer-definable time period

1.3.4 Daily Energy Data table

The daily energy data table shall be generated for storage of daily energy values for 15 minute blocks / one hour blocks of a day & shall be stored for each feeder on daily basis alongwith quality codes. This daily energy data shall be exchanged

with the Billing system in Data centre & DR Under R-APDRP IT implementation/ legacy master billing centre on daily basis and on demand. This table shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Daily Energy data table for the previous month shall be backed up to Magnetic tape by the user on the 10th of every month.

1.3.5 Load priority table

ISR system shall maintain a Load priority table containing information such as breaker name, number of consumers connected to each Breaker and Load priority of each Breaker. This table shall be updated by the Billing system in Data centre. Under R-APDRP IT implementation/ legacy master billing centre . SCADA /DMS control centre operator can also assign priorities in load priority table & the priorities assigned by the Billing system in Data centre & DR Under R-APDRP IT implementation/ legacy billing system may be accepted/ rejected by him. There shall be suitable alarm/event message including user ID for such activity. The table information shall be used by various DMS applications**.**

1.3.6 SOE data table

ISR system shall maintain SOE data table which shall store the SOE data for complete distribution system . It shall be possible to sort the table by Time, Date, Substation name feeder/line name,device name etc. using SQL commands. This table shall be made on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. For the purpose of sizing of table, daily 4 changes per SOE point may be considered. All CBs, protection and alarm contacts shall be considered as SOE. Tables for the previous day shall be backed up to Magnetic tape/ MO disks by the user at 10AM of every day.

1.3.7 Data exchange with Billing system (Data centre & DR centre) Under R-APDRP IT implementation

The ISR function shall provide daily energy values along with associated quality codes to Billing system Under R-APDRP IT implementation or any legacy master billing centre once in a day and on demand. SCADA/DMS System shall have the provision to import/export energy values with Billing system at data centre/DR Under R-APDRP IT implementation. This information of Load priority in ISR system shall be updated by Billing system at data centre /DR Under R-APDRP IT implementation shall be used by DMS applications. Further data from snapshot table shall be transferred to IT system in R-APDRP

This data exchange shall be done using SOA / Enterprise Services Bus already provided by ITIA, over Open XML Models like CIM/XML, or over ICCP / OPC/ODBC.

1.3.8 Data Exchange with Customer Care System Under R-APDRP IT implementation

The ISR function shall transfer the information available in the "Circuit breaker status table" as defined in this chapter, to the Customer Care centre under R-APDRP IT implementation / legacy system using SOA/Enterprise Service Bus supplied by ITIA, over CIM/XML Models, or CIM/XML OPC/ICCP /ODBC Adapters / Interfaces. The complete Circuit Breaker Information shall be transferred to Customer care centre on demand or Changed Information shall be send along with the quality codes and additional information associated with the CB.

1.3.9 Data Exchange with GIS system:

SCADA Systems over CIM/XML Models using GID to IEC 61968-1 will be used by SCADA/DMS & other IT Systems for getting network information, customer and interconnection information.

The GIS will interface using CIM/XML adapters to other applications. SCADA will have model aware adapters to read from GIS network model repository, and update its own models. The system shall utilize an IEC 61970 and IEC 61968 compliant interface. The system shall enable export of all data via a CIM-XML interface per IEC 61970-452 and IEC 61970-552-4 and shall utilize modeling from IEC 61968-11 as appropriate.

Data exchange shall be over model neutral messaging services and CIM/XML data exchange for real-time or RDBMS will be used. The following standards as applicable will be used to achieve the above requirements:
Messaging interfaces shall be based on model neutral interfaces based on the IEC 61970-40X series for access to real-time and historical data and use the IEC 61968-3 and IEC 61968-9 standards for messaging interfaces that are model dependent for network operations and metering respectively

The Graphic data import from a GIS systems shall support native formats of GIS systems which shall be potentially used for data import. All Technological addresses (TAs) shall be automatically assigned within the system to the tags linking the graphic data to the attribute data in the GIS, the attribute data shall be loaded into the SCADA data base and the display diagrams shall be generated. The Graphics exchange between GIS and SCADA should happen over IEC-61970-453 Scalar Vector Graphic based XML representation

The complete network model including data of electrical network e.g. line (i.e. length, type of conductor, technical particular of conductor & transformer etc, land-base data . Suitable GIS interface adaptor to enable the compatibility with GIS software/ data format /model shall be provided . The Graphic data import from a GIS systems shall support native formats of GIS systems which shall be potentially used for data import. The data shall be transferred on global & incremental basis on manual request & automatically, once in a day The DMS shall automatically move elements that overlap one another in congested areas so that the operator can clearly see each segment of the network in the geographic view. In addition, the system shall automatically move and scale annotation text that come from GIS so that it is visible the user's current display SCADA/DMS in the geographic view. The system shall include tools to edit annotations /text & symbology placements in geo –referenced displays , substation and distribution network. It shall be possible to import related reference layers such as streets , buildings, poles etc and other background information.

All Technological addresses (TAs) shall be automatically assigned within the system to the tags linking the graphic data to the attribute data in the GIS, the attribute data shall be loaded into the SCADA /DMS data base and the data /text shall be displayed on SCADA/DMS diagrams if viewed in GIS mode shall display GIS in background with zoom ,pan , scaling & UI navigation techniques in synch with SCADA/DMS system displays. The GIS Network Model shall be exposed to the IT and SCADA Systems over CIM/XML Models using GID to IEC 61968-1 Enterprise Bus. This model repository will be the single model authority for the entire Utility network to be used by both IT & SCADA/DMS Systems under R-APDRP. This repository is maintained by the GIS System, and will be used by SCADA/DMS & other IT Systems for getting network information, customer and interconnection information.

1.3.10 Historical Information (HI) Data Retrieval

The data stored in the ISR system shall support the following retrieval capabilities:

(a) The user shall be able to view and edit HI data on displays/Forms and reports. The user shall be able to edit HI data, request recalculation of all derived values, and regenerate and print any daily, weekly or monthly HI report for the current and previous month.

(b) The user shall be able to view tabular trend and graphical trend of multiple data points simultaneously by specifying the start date and time, the end date and time, and the time period between displayed samples. The duration of viewable tabular trend and graphical trend could be upto 24 hours. The features of Tabular/graphic trend is mentioned in the specification for User interface.

(C) The HI retrieval shall expose the ISR Data over SOA / Enterprise Services BUS Supplied by ITIA, over CIM/XML, ICCP or OPC ODBC Interfaces / Adapters.

(D) The retrieval shall provide 100% accuracy and fidelity of data

1.3.11 System Message Log Storage and Retrieval

System message log, which shall consist of the chronological listing of the SCADA/DMS computer system alarm messages, event messages and user messages shall be stored for archival and analysis. Each entry shall consist of time tag and a text containing user and device identification as displayed on the Alarm Summary or Event Summary displays. The System message log data storage shall be sized for up to 20,000 entries per month.

System message log data shall be stored in daily tables & shall be available for minimum two months on auxiliary memory. System message log data for previous months shall be Backed up on Magnetic tapes/ MO disks by the user for which ISR function shall prompt the user every hour with suitable message to remind user for taking the backup on the 10th of every month. This message shall be disabled once the backup is taken.

Facilities to sort and selectively display and print the contents of the system message log shall be provided. The user shall be able to select the display of system message log entries based upon Alarm type, Events, User generated messages, Device, and Time period.

1.3.12 Mass storage of data/files

The ISR system shall be sized for mass storage of data/files for atleast the following :

a) 10 save-cases for each DMS application
b) 10 Output results of each DMS applications

1.4 Data recovery function (DR)

The DR function is a repository of system build up software of all towns where SCADA/DMS is going to be installed. One year online backup shall be available at this location with data pertaining to each town i.e. system build ups shall be available of each town separately so that the same can be utilised upon setting up newer system after disaster. The data related to network model of SCADA/DMS control centre of each town shall be sent to DR centre periodically once a day & upon user request. The data shall be configured to be sent globally & incremental.. All logs, data model etc & necessary interfaces that are essential for complete system build up shall be stored at DR centre . All requisite data which is build the system from scratch shall be transferred to DR. An alarm shall be generated & send to SCADA/DMS control centre upon attaining user defined threshold e.g. 80% for storage at DR centre

End of Section 2, Chapter 1