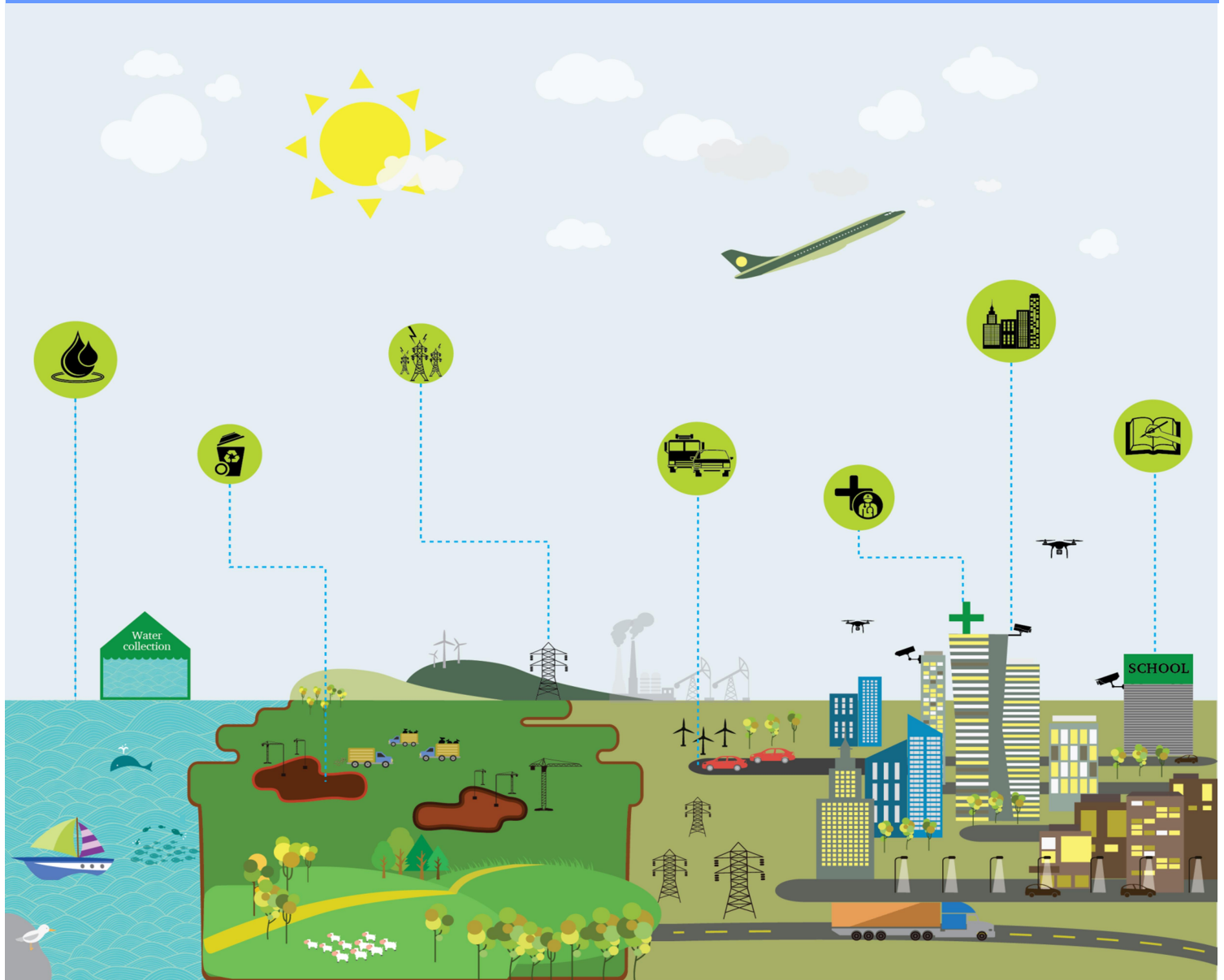


Request for Proposal *for* Selection of Master System Integrator for Naya Raipur Smart City System



Modified RFP

Volume II – Scope of Work, Technical and
Functional Specifications

RFP No-112/SMARTCITY/CE(E)/NRDA/2016-17, Naya Raipur Dated: 06-10-2016



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Disclaimer

1. This Request for Proposal ("RFP") is issued by Naya Raipur Development Authority (NRDA).
2. Only modified RFP shall be filled in and submitted by the prospective bidder. Anyone submitting the previous/initial version of RFP shall not be considered for evaluation and their bid shall stand disqualified.
3. The information contained in this RFP or subsequently provided to Bidders, whether verbally or in documentary or any other form by or on behalf of NRDA or any of its employees or advisers, is provided to Bidders on the terms and conditions set out in this RFP and all other terms and conditions subject to which such information is provided.
4. This RFP is not a contract and is neither an offer nor invitation by NRDA to the prospective Bidders or any other person. The information contained in this RFP has been provided to the best of knowledge of NRDA and in good faith. However, the information may not be complete and accurate in all respects and may not be exhaustive.
5. While reasonable care has been taken in providing information in this RFP, bidders are advised to not rely only on this information but also carry out their independent due diligence and risk assessments before submitting their response to this RFP. Further, the Bidders are advised to conduct their own analysis of the information contained in this RFP, carry out their own investigations about the project, the regulatory regime which applies thereto and all matters pertaining to project and to seek their own professional advice on the legal, financial and regulatory consequences of entering into an agreement or arrangement relating to the project.
6. The information contained in this RFP is subject to update, expansion, revision and amendment prior to the last day of submission of bids at the sole discretion of NRDA.

Glossary of Terms

- **‘Smart City System’**- Comprehensive Naya Raipur Smart City system comprising of Smart Governance, City Surveillance, Intelligent Transport Management System, Utility Management System for Electricity and Water, Command and Control Centre, Smart Network, Building Management System and Data Centre.
- **‘Master System Integrator (MSI)’**- Organization (Lead bidder in case of consortium) to be appointed by NRDA for implementation and maintenance of Smart City System.
- **‘Consortium Partner’**- Organization that will work with MSI in consortium for implementation and maintenance of Smart City System.
- **‘Bidder’**- The MSI and consortium partner (if any).

Abbreviations

Sr. No.	Abbreviation	Description
1.	ACD	Automatic Call Distributor
2.	AHU	Air Handling Unit
3.	BAS	Building Automation System
4.	BOM	Bills of Material
5.	BoQ	Bills of Quantity
6.	CCC	Command and Control Centre
7.	CCTV	Close Circuit Television
8.	CERTIN	Indian Computer Emergency Response Team
9.	CSEB	Chhattisgarh Electricity Board
10.	CWR	Clear Water Reserve
11.	DFMD	Door Frame Metal Detector
12.	DHCP	Dynamic Host Configuration Protocol
13.	DMS	Distribution Management System
14.	DNS	Domain Name Server
15.	EMS	Employee Monitoring System
16.	ERP	Enterprise Resource Planning
17.	ESS	Employee Self Service
18.	FMS	Facility Management Service
19.	FRS	Functional Requirement Specification
20.	FRTU	Feeder Remote Terminal Unit
21.	G2B	Government to Business
22.	G2C	Government to Citizen
23.	G2G	Government to Government
24.	GIS	Geographical Information System
25.	GOI	Government of India
26.	HDPE	High-density Polyethylene
27.	HLD	High Level Design
28.	HMI	Human Machine Interface
29.	HRMS	Human Resource Management System
30.	HVAC	Heating, ventilation and air conditioning
31.	IBMS	Integrated Building Management System
32.	ICT	Information and Communication Technology
33.	IED	Intelligent Electronic Device
34.	IEEE	Institute of Electrical and Electronics Engineers
35.	ISR	Information Storage & Retrieval
36.	IT	Information Technology
37.	ITMS	Intelligent Transport Management System
38.	KPI	Key Performance indicators
39.	LDAP	Lightweight Directory Access Protocol
40.	LLD	Low Level Design
41.	LTO	Linear Tape-Open

Sr. No.	Abbreviation	Description
42.	LUN	Logical Unit Number
43.	MPLS	Multiprotocol Label Switching
44.	MSA	Master Service Agreement
45.	MSI	Master System Integrator
46.	MSI	Master Service Integrator
47.	MTBF	Mean Time Between Failures
48.	MW	Mega Watt
49.	NOC	Network Operation Centre
50.	NRDA	Naya Raipur Development Authority
51.	OEM	Original Equipment Manufacturer
52.	OFC	Optical Fibre Cable
53.	OMS	Outage Management System
54.	OMS	Outage Management System
55.	OWASP	Open Web Application Security Project
56.	PABX	private automatic branch exchange
57.	RAID	Redundant Array of Inexpensive Disks
58.	RMU	Ring Main Unit
59.	RTDB	Real Time Data Base
60.	RTU	Remote Terminal Unit
61.	SAN	Storage Area Network
62.	SCADA	Supervisory Control and Data Acquisition
63.	SDC	State Data Centre
64.	SITC	Supply Installation Testing and Commissioning
65.	SLA	Service Level Agreement
66.	SNMP	Simple Network Management Protocol
67.	SRS	Software Require Specification
68.	SSL	Secure Sockets Layer
69.	STQC	Standard, Testing and Quality Certification
70.	UAT	User Acceptance Testing
71.	UGR	Under Ground Reservoir
72.	VLAN	Virtual Local Area Network
73.	VMS	Video Management System
74.	WTP	Water Treatment Plant

1. Introduction

Government of Chhattisgarh is having its capital currently in a Raipur which is constrained on various parameters which a modern city should have. Following are the major challenges that are being faced by current capital city:

- a. Rapid urbanization
- b. Severe pressure on city resources
- c. Unequal distribution of city resources
- d. Lack of social inclusion
- e. Livability challenges for citizens
- f. Environmental sustainability
- g. In efficiency in city operations

Migration towards cities is putting lot of pressure on cities infrastructure resulting in unplanned urbanization. City resources are not managed efficiently resulting in wastage of resources and further putting pressure on the city administration in terms of optimum utilization of resources. Livability of city is also a challenge since the residents do not get required city resources. Safety and security of city residents has become a major issue. Unplanned growth is also resulting in environmental sustainability of the city. An inefficient city is also not preferred as investment destination which in turn results in less employment opportunity for residents. These are putting severe pressure on city administrators in terms of improvising the living conditions of the citizens in the cities.

Considering the above issues, Government of Chhattisgarh has decided to build Naya Raipur as a new world class city which is modern but is built on green norms. Naya Raipur is being envisioned as a service hub across multiple sectors including Information Technology, Bio Technology, Finance, Trade, Hospitality, Medical and Education. To realize this vision, NRDA started with preparation of *development plan* with the help of a number of competent city planners, professional consulting organizations, special interest groups and elected representatives of people. NRDA has been successful in meeting the key schedule of its *development plan* and has so far developed major section of its physical and social infrastructure. Moving ahead with its *development plan*, NRDA intends to implement a **Smart City System** by developing ICT infrastructure for efficient city operations, optimization of available resources and delivering better services to its citizens, communities, business and various stakeholders. The Smart City System would help NRDA in:

- a. Adoption of innovative technologies to improve the city operations
- b. Provide real-time data on operations and maintenance of city infrastructure and services
- c. Realize efficiencies of service delivery system
- d. Enhancing the security of residents of the city
- e. Enhancing the quality of life for citizens
- f. Create environment to attract business investments in the city

1.1. Objective of this RFP

NRDA intends to select a Master System Integrator (MSI) by following competitive bidding process to design, develop, implement and maintain the Smart City System for a period of five years after Go Live date on turnkey basis.

This document contains the following details:

- a) Scope of work that will be assigned to the MSI as part of this project
- b) Other terms and conditions of the envisaged Smart City System

MSI will develop an Integrated Smart City System for Naya Raipur comprising of 6 Track/Components:

Track 1– Smart Governance (Applications) including common Portal and Mobile application.

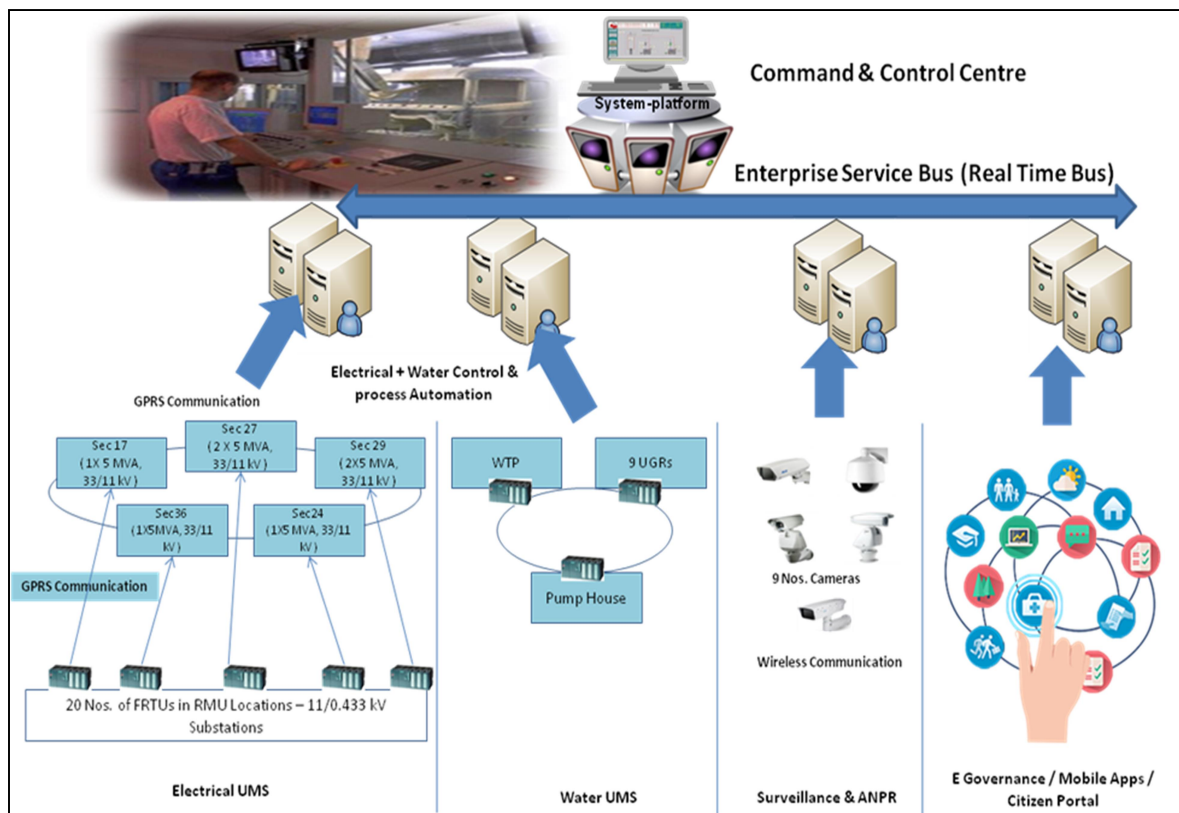
Track 2– City Surveillance System.

Track 3– Utility Management System

Track 4– Intelligent Transport Management System.

Track 5– Command & Control Centre, Data Centre and Integrated Building management System

Track 6– Smart Network



Illustrative Naya Raipur Smart City System

Smart Governance will automate the back end functions of city administration. Web Portal and Mobile Application will be interface for all citizens services with the city administration. Online systems in compliance with various standard operating procedures will bring transparency in city administration

City Surveillance is planned to be implemented for the city by deploying cameras across the city to get live feeds and monitor the safety and security of the city.

Electrical and Water Utility Management System will be implemented for management and monitoring of city utilities. This will result in equitable distribution of city resources by reducing transmission losses and

also by achieving operational and service excellence in this area. Smart Grid system will result in reduction of transmission losses of electricity. Smart water will reduce distribution losses and will provide better water management solutions to city administrators.

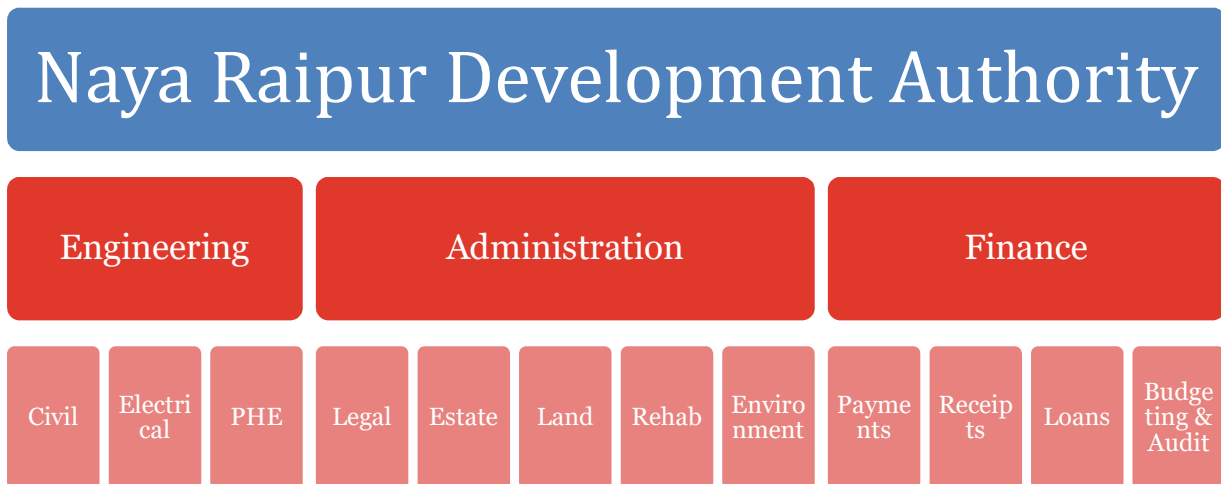
Intelligent Transport Management System will monitor and manage the transport and roads in the city and will provide efficient mobility solutions to the residents. This will also check traffic violation on city roads by helping the city to take enforcement measures.

It is also planned to set up a centralized Command and Control center which will be central hub for city management. The CCC will be helpful in managing the City Operations and emergency response. The hosting of all applications and database will be done at State data centre. MSI can suggest of using hybrid model for hosting the application by using cloud solution. Integrated Building management system will be implemented in the existing NRDA Office for managing and monitoring building utilities, access, security etc.

The city wide fiber based network is being setup by NRDA to provide backbone for high speed connectivity. This fiber backbone will be used to connect all Edge devices like camera, RTUs etc to be deployed under this project.

1.2. About NRDA and Existing System

A special area development authority ‘Naya Raipur Development Authority’ (NRDA) has been constituted in order to undertake the development, operation and maintenance of Infrastructures of the new city in a methodological way. The NRDA is divided in 3 Departments i.e. Engineering, Administration and Finance:



Engineering: The Engineering department is primarily responsible for construction, installation and maintenance of:

- Government & public buildings
- Roads & Bridges
- Public spaces
- Water bodies

-
- Street Lights
 - Solar Power Plant
 - Traffic Management System
 - BRTS
 - Drainage System
 - Solid Waste Management
 - Water Supply System
 - Electrical system (in co-ordination with CSEB)

Administration: The administrative department manages the municipal functions of NRDA including Asset management of the NRDA:

Land department:

- Acquisition of land
- Title investigation
- Land records management
- Land inspection

Estate department:

- Development of Land
- Allotment of Housing, Shops & Offices
- Management of Pay and Use (Parking, etc.)
- Advertisement Rights
- Collection of charges:
 - Land lease
 - Annuity
 - Water meter
 - Shops and establishments certificate renewal
 - Property tax
 - Professional tax
- Development Control
- Approval of Plan
- Control of Hoardings
- Encroachment Removal
- Hawking Zone
- Birth & Death Certificates

Legal department:

- Apply Land laws
- Apply Rehabilitation laws
- Present NRDA's legal cases

Rehabilitation department:

- Record of People Affected by Project (PAP)
- Policy for rehabilitation
- Programs for rehabilitation

Environment department:

- Environmental Impact Assessment Surveys
- Implement Environment programs
- Inspect for environmental impact

Finance: The Finance department manages all financial accounting activities of NRDA including arrangement of funds and release of payments:

Payments towards:

- Salaries of employees
- Contractors
- Vendors
- Land acquisitions

Receipts

- Land lease
- Annuity

Loans & re-payment

Budgeting:

- Expense projections
- Revenue projections
- Municipal Accounting

Currently, most of the NRDA operations are manually managed. Following IT applications are used by NRDA:

- e-Procurement solution (provided by CHiPS) is used for Tender Management.
- Digital Secretariat (provided by CHiPS), solution of digital movement of files Tally for accounting
- 96 core cable OFC network (for network connectivity).

- Geographic Information System (GIS) developed by NSRC

NRSC is developing GIS based Environment and Infrastructure Management System for Naya Raipur. The scope of NRSC includes:

- Existing NRSC and NRDA database to be hosted on Bhuvan Portal.
- Updation of the database with respect to latest satellite imagery.
- Creating an independent portal for NRDA where the above data will be uploaded in GIS format with hierarchy based access for Officials and restricted access for Public.
- Customization of the Portal as per the requirement of NRDA including user interface and dashboard.
- Development of Modules and tools for geo-Spatial planning and Eco system monitoring
 - Monitoring of Eco system of Naya Raipur such as Plantations, Water Bodies, etc.
 - Monitoring the development of village settlement,
 - Monitoring the unauthorized construction.
 - Monitoring the Infrastructural construction.
 - Mobile based Application support for these modules is envisaged
- Feasibility of integration of existing MIS developed by NRDA for Land management system, marketing, estate management, infrastructure design, construction management and municipal governance to the portal. Geospatial modules will only be in the scope of the project
- Capacity Building & Training on Geospatial Database organization, management, analysis to the identified staff of NRDA to build, develop and maintain the GIS system
- Periodical updating of the satellite imagery
- Support for Data Storage and Handling

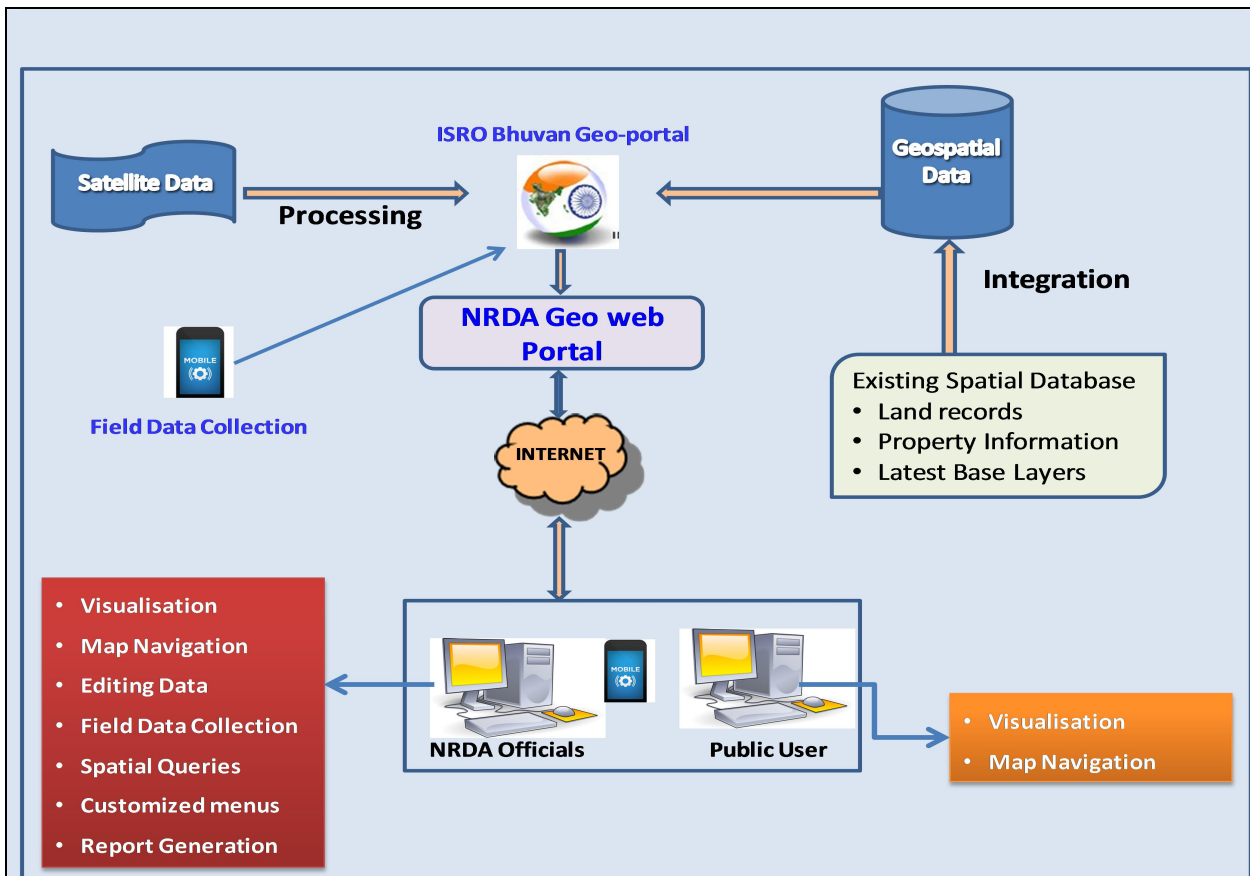
The engagement between NRDA and NRSC will provide carried out in phased manner as mentioned below:

Phase-I:

- Development of Portal for Visualization of data
- Hosting of Satellite data and Existing Geospatial databases on the Portal
- Geospatial database creation, Updating, Editing and Uploading on to the Portal
- Training and Capacity Building of NRDA officials

Phase-II:

- Development of GIS functionalities for Querying and Analysis
- Development of Modules and tools for Planning, Monitoring, Municipal and Civic services
- Integration of portal with the existing MIS of Land Management System
- Development of Mobile application for collection of field data and live uploading & Visualization on the web portal.



The Key Deliverables that will be provided by NRSC to NRDA are:

- Bhuvan-NRDA geospatial Web Portal which will host latest and existing satellite imagery & geospatial databases, including all functionalities like Visualization, Editing tools, Query and Analysis.
- Development of Modules and tools for Planning, Monitoring, Municipal and Civic services.
- Capacity Building of NRDA officials on Geospatial Database Preparation, Integration and Management.
- Development of Mobile application for collection of field data and live uploading & Visualization on the web portal.
- Integration of portal with the existing MIS of Land Management System.

2. Scope of the Project

2.1. Geographical Scope of the Project

Naya Raipur is a green field city where the population is gradually increasing, NRDA plans to develop the city in a phased manner. The smart city elements would be implemented in a phased manner and scaled up along with the city growth.

Based on Naya Raipur's expected growth in next 5 years, NRDA intends to cover following locations through the Smart City System:

Track	Geographical Scope		
Smart Governance	Pan city level		
City Surveillance and ITMS	9 City Entry and Exit Points. Locations details are available at Annexure IV of this volume.		
Electrical Utility Management System	5 Substations in sectors 27, 29, 24, 17 and 18 and 20 DTs spread across Sectors 17, 18, 19, 26, 27, 29, 30		
Water Utility Management System	Intake Well at Tila Village, Raw Water pumping main, WTP at Pacheda Village, Clear Water gravity main line.		
	UGR	Sector- UGR/Pump House Location	Distribution Sectors
	1.	5	5
	2.	16	16
	3.	17	17
	4.	19	19
	5.	21	21 & 20
	6.	22	22 and 23
	7.	24	24
	8.	26	26 & 27
9.	30	30 & 29	
Command and Control Centre	Sector 19 Naya Raipur (221 sq mt approx 2400 sq ft comprising of Operation room (CCTV/Video Wall monitoring), Office Staff room, meeting room, conference room)		
Data Centre	State data Centre at Civil Line, Raipur		
IBMS	NRDA Office Sector 19		
Smart Network	Pan city level (Last mile connectivity between edge devices etc and existing Core ring of Fibre Optic)		

The Smart City System will be scaled up in other sectors in next phases which will be decided by NRDA on need basis.

2.2. Users, storage and bandwidth requirement

The estimated number of users for Smart City system for next 5 years is

<i>Sr #</i>	<i>Users</i>	<i>Number</i>
1	Citizen/Residents	3,00,000
2	Households	75,000
3	Total users	120
3a	Engineering department	30
3b	Finance Department	30
3c	Administration Department	40
3d	Other departmental users	20
4	Concurrent Users	<ul style="list-style-type: none"> • 20 Internal users • 2000 External users

The data of various tracks are required to be available for access as per the mentioned below:

<i>Sr #</i>	<i>Track</i>	<i>Data Availability</i>
1	Smart Governance	Permanent
2	City Surveillance	30 days (7 Days on Primary and 23 Days on Secondary storage)
3	Utility Management System	30 days (7 Days on Primary and 23 Days on Secondary storage)
4	Intelligent Traffic Management System	90 days(7 Days on Primary and 83 days on secondary storage)
5	IBMS	30 days (7 Days on Primary and 23 Days on Secondary storage)

Camera Bandwidth and storage to be determined based on following parameters

Parameter		PTZ Camera	Fix Box Camera
Resolution		1920 X 1080	1920 X 1080
FPS (for Viewing & Storage)	Normal Time	25 FPS	25 FPS
	No Movement Period / Night Period	12 FPS	8 FPS

The actual bandwidth requirement and storage parameters required to meet SLAs should be calculated by the Bidder and the same shall be clearly proposed in the Technical Bid with detailed calculations. NRDA Department also requires the Bidder to meet the parameters of video feed quality; security & performance and bidders should factor the same while designing the solution.

Bidders are also required to estimate the bandwidth requirement for other connectivity (between Data Centers, Command Centers etc.) and propose in the Technical Bid.

For bandwidth estimation bidders can refer to below table:

#	Description	Number of locations	Bandwidth calculation considerations
1	Command and Control Centre	1	CCC should be designed for simultaneous viewing & event Management capability for about 10 cameras (of 63 camera including PTZ,ANPR, speed detection) and, Video Analytics on 30 camera (25% of 119 fixed outdoor camera at city entry and exit and BRTS shelter). Apart from these view of Utility management, GIS etc should also be available based on discussion with NRDA.
2	Data centre (at State data centre in Raipur)	1	Feed from all camera (approx 182).

Note:

1. The distance between the Data Centre and Command & Control centre is approximately 20 kms

2.3. Scope of Services

MSI (along with its consortium partner) will be responsible to implement and maintain the Smart City System. The scope of work for the MSI (selected bidder) will comprise development of Smart city system under following 6 Track/Components:

- Track 1– Smart Governance (Applications) including common Portal
- Track 2– City Surveillance System.
- Track 3– Utility Management System
- Track 4– Intelligent Transport Management System.
- Track5– Command & Control Centre, Data centre and Integrated Building management System
- Track 6– Smart Network

The scope of work for the MSI is to implement the Smart City System. The scope includes software/solution development and implementation, Information Technology (IT) and required Non IT infrastructure procurement, deployment, implementation and maintenance of the Smart City system including the common portal and Mobile Application. The maintenance phase will be for a period of 5 (five) years after Go-Live. Post completion of the 5 year period, the contract can be extended, at discretion of NRDA, for additional two years on yearly basis or part thereof.

MSI needs to design, implement and operate the Smart City System project on turnkey basis. MSI needs to do the appropriate solution design and sizing for the project as per the scope of work and other terms and conditions of the RFP. In case MSI has not considered any component/service which is necessary for the project requirement, the same needs to be brought by the MSI at no additional cost to NRDA.

Brief summary of the scope of work are as mentioned below:

2.3.1. Overview of Scope

The snapshot of scope is as below:

Track	Scope
Smart Governance (Application)including Common Portal	MSI will develop all modules and sub modules given below: <u>Functional Level</u> <ul style="list-style-type: none"> • Development Functions: <ul style="list-style-type: none"> ○ GIS based Land and Estate Management ○ Building Permission module ○ Rehabilitation module • Municipal Functions <ul style="list-style-type: none"> ○ Utilities module-Water and Sewage connection and billing ○ License department module ○ Property tax payment <u>Enterprise Level</u> <ul style="list-style-type: none"> • Human Resource Management System • Payroll • Asset Management system • Finance and Account Management

Track	Scope
	<p><u>Integration Service</u></p> <ul style="list-style-type: none"> • E-District services- Birth, Death and Marriage registration, Shop license, Trade license etc. • Town and country planning application. • Integration with existing mailing solution. • Integration with SMS Gateway • Integration with Banks for Online Payment • Integration with Social Media Applications <p><u>City Portal & Mobile Apps</u></p> <ul style="list-style-type: none"> • Single Citizen Portal providing access to all services • Citizen Collaboration and Engagement Platform • City Mobile App • Pollution level
City Surveillance	<p>MSI will supply, install and maintain following cameras and requisite infrastructure at 9 City Entry and Exit Points.</p> <ul style="list-style-type: none"> • 20 fixed box camera • 9 PTZ camera <p>MSI will also implement the following software to enable monitoring through the surveillance cameras:</p> <ul style="list-style-type: none"> • Video Management System • Video Analytics System for 20 fix box camera and 60 existing camera of BRTS bus shelters <p>MSI is also required to integrate the City Surveillance System with the City Command & Control Centre.</p>
Utility Management System	<p>MSI will supply, install and maintain SCADA system, Distribution Management System, Outage Management System, Leak detection (Water Management) for</p> <ul style="list-style-type: none"> • Electrical supply Management in 5 Substations and 20 DTs • Water supply management covering Intake and WTP and 9 UGR.
Intelligent Transport Management System	<p>MSI will supply, install and maintain following ITMS equipment:</p> <ul style="list-style-type: none"> • 10 Speed Violation Detection and Enforcement system • 42 ANPR
Command and Control Centers (CCC), Data Centers and Integrated Building Management System	<p>MSI will supply, install and maintain, Command and Control Centre comprising of:</p> <ul style="list-style-type: none"> ○ 6 (3x2) Video Wall & controller ○ Workstations for helpdesk, CCC, NoC, BMS, technical support etc operators ○ Command and Control Centre Application. ○ Integration with all Naya Raipur Smart City System ○ Integration with existing 4 STP's SCADA ○ Integration with existing Intelligent lighting System

Track	Scope
	<ul style="list-style-type: none"> ○ Integration with feed of BRTS shelter's existing CCTV cameras (60 camera of 15 Shelters). (Specification of existing camera is available in Annexure VIII) ○ MSI has to supply, install, commission and maintain following for 221 sq mt approx 2400 sq ft comprising of Operation room (CCTV/Video Wall monitoring), Office Staff room, meeting room, conference room. <ul style="list-style-type: none"> • UPS with Battery (2400 sqft + 10 KVA for corridor) • LAN Cabling • Water leak Detection System • Fire Detection & alarm System • Rodent Repellent System • Gas suppression system <p>• MSI will supply, install and maintain Data Centre Infrastructure and Application Software in existing State Data Centre</p> <p>MSI will supply, install and maintain following for NRDA Office:</p> <ul style="list-style-type: none"> • Access control system • Surveillance System (39 fix and 2 PTZ camera in Paryavaas Bhawan and CCC) • Physical security system • Building Management System for controlling and monitoring the building's mechanical and electrical equipment such as HVAC, Water supply, fire systems etc.
Smart Network and other networking	<ul style="list-style-type: none"> ○ MSI has to provide last mile physical connectivity between all field level equipments to be supplied and installed in this assignment like Camera including existing 60 camera at 15 bus shelters/stops, ANPRs, Utility management devices etc), Command centre and the existing 96 core OFC network using Copper/Fibre/ UTP considering RFP scope and SLA requirement. ○ MSI has to also provide required switches etc for last mile connectivity. ○ Command centre will be aggregation point and MSI has to provide required Network equipment at CCC. ○ Also NoC infrastructure including the Display, Desktop, Software, other hardware and Manpower, for monitoring the Network under this assignment has to be provided by MSI. ○ MSI has to provide sizing of bandwidth requirement as per RFP requirement and has to do coordination at time of implementation.

MSI will also provide following services as a part of this Assignment:

Sr #	Activity	Scope
1	Helpdesk/Contact Centre in CCC	<ul style="list-style-type: none"> • Provision of Helpdesk System for technical / operational support • Maintenance of the IT / Non-IT Infrastructure • Providing Technical & Operational Manpower for smooth running of the system
2	Data Recovery	There should be one data recovery system at CCC for recovering the data in case of crash of server at the Data Centre or any other main control centre.
2	Cloud Hosting (optional)	Provisioning of infrastructure over cloud and hosting applications on cloud subject to meeting of SLAs. (This is not mandatory requirement). Bidders may choose to propose cloud hosting subject to provisions of this RFP mentioned in Section 2.6.4

2.3.2. Key Activities & Deliverables

S. #	Key Activities	Deliverables	Track 1	Track 2	Track 3		Track 4	Track 5			Track 6
			Smart Governance	City Surveillance	Electrical-Utility Management System	Water-Utility Management System	ITMS	Command and Control Centre	Data Centre	Integrated Building management system	Smart Network
Project Inception Phase											
1.	Project Kick Off	1. Project Development Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.	Deployment of manpower	2. Risk Management and Mitigation Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓
Requirement Phase											
3.	Assess the requirement of IT Infrastructure and Non IT Infrastructure	1. Functional Requirement Specification Document	✓	✓	✓	✓	✓	✓	✓	✓	✓
4.	Assessment of Business processes	2. System Requirement Specification document (SyRS)	✓								
5.	Assessment of Legal rules	3. Requirements Traceability Matrix	✓								
6.	Assessment of requirement of Software requirements	4. Site Survey Report	✓	✓	✓	✓	✓	✓	✓	✓	✓

S. #	Key Activities	Deliverables	Track 1	Track 2	Track 3		Track 4	Track 5			Track 6
			Smart Governance	City Surveillance	Electrical-Utility Management System	Water-Utility Management System	ITMS	Command and Control Centre	Data Centre	Integrated Building management system	Smart Network
7.	Assess the Integration requirement		✓	✓	✓	✓	✓	✓		✓	
8.	Assess the connectivity requirement for field locations (including Building)			✓	✓	✓	✓	✓	✓	✓	
9.	Assessment the Network laying requirement			✓	✓	✓	✓	✓		✓	✓
10.	Assessment of training requirement		✓	✓	✓	✓	✓	✓		✓	
Design Phase											
11.	Formulation of Solution Architecture	1. Final Bill of Quantity 2. HLD documents	✓	✓	✓	✓	✓	✓	✓	✓	✓
12.	Creation of Detail Drawing	3. LLD documents 4. Application		✓	✓	✓	✓	✓		✓	✓

S. #	Key Activities	Deliverables	Track 1	Track 2	Track 3		Track 4	Track 5			Track 6
			Smart Governance	City Surveillance	Electrical-Utility Management System	Water-Utility Management System	ITMS	Command and Control Centre	Data Centre	Integrated Building management system	Smart Network
13.	Detailed Design of Smart City Solutions.	architecture documents.	✓	✓	✓	✓	✓	✓	✓	✓	✓
14.	Development of test cases (Unit, System Integration and User Acceptance)	5. Technical Architecture documents. 6. Network Architecture documents.	✓	✓	✓	✓	✓	✓	✓	✓	✓
15.	Preparation of final bill of quantity and material	7. ER diagrams and other data modeling documents. 8. Logical and physical database design.	✓	✓	✓	✓	✓	✓	✓	✓	✓
16.	SoP preparation	9. Data dictionary and data definitions. 10. GUI design (screen design, navigation, etc.). 11. All Test Plans 12. SoPs 13. Change						✓			

S. #	Key Activities	Deliverables	Track 1	Track 2	Track 3		Track 4	Track 5			Track 6
			Smart Governance	City Surveillance	Electrical-Utility Management System	Water-Utility Management System	ITMS	Command and Control Centre	Data Centre	Integrated Building management system	Smart Network
		management Plan									
Development Phase											
17.	Helpdesk setup	1. IT and Non IT Infrastructure Installation Report	✓	✓	✓	✓	✓	✓	✓	✓	✓
18.	Civil work/Physical Infrastructure setup	2. Completion of UAT and closure of observations report		✓	✓	✓	✓	✓		✓	✓
19.	Procurement of Equipment , edge devices, COTS software (if any), Licenses	3. Training Completion report	✓	✓	✓	✓	✓	✓	✓	✓	✓
20.	IT and Non IT Infrastructure Installation	4. Application deployment and configuration report		✓	✓	✓	✓	✓	✓	✓	✓
21.	Development, Testing and Production environment setup		✓	✓	✓	✓	✓	✓	✓	✓	

S. #	Key Activities	Deliverables	Track 1	Track 2	Track 3		Track 4	Track 5			Track 6
			Smart Governance	City Surveillance	Electrical-Utility Management System	Water-Utility Management System	ITMS	Command and Control Centre	Data Centre	Integrated Building management system	Smart Network
22.	Network connectivity			✓	✓	✓	✓	✓	✓	✓	✓
23.	Software Application customization		✓	✓	✓	✓	✓	✓	✓	✓	
24.	Development of Bespoke Solution (if any)		✓								
25.	Data Migration		✓								
26.	Integration with Third party services/application (if any)		✓								
27.	Unit and User Acceptance Testing		✓	✓	✓	✓	✓	✓	✓	✓	✓
28.	Implementation of Smart City Solutions		✓	✓	✓	✓	✓	✓	✓	✓	

S. #	Key Activities	Deliverables	Track 1	Track 2	Track 3		Track 4	Track 5			Track 6
			Smart Governance	City Surveillance	Electrical-Utility Management System	Water-Utility Management System	ITMS	Command and Control Centre	Data Centre	Integrated Building management system	Smart Network
29.	Preparation of User Manuals , training curriculum and training materials		✓	✓	✓	✓	✓	✓		✓	
30.	Role based training(s) on the Smart City Solutions		✓	✓	✓	✓	✓	✓		✓	
Integration Phase											
31.	SoP implementation	1. Integration Testing Report						✓			
32.	Integration with GIS		✓	✓	✓	✓	✓	✓		✓	
33.	Integration of solutions with Command and Control Centre		✓	✓	✓	✓	✓	✓		✓	
Go –Live											
34.	Go Live	1. Go-Live Report	✓	✓	✓	✓	✓	✓	✓	✓	✓
Operation and Maintenance											

S. #	Key Activities	Deliverables	Track 1	Track 2	Track 3		Track 4	Track 5			Track 6
			Smart Governance	City Surveillance	Electrical-Utility Management System	Water-Utility Management System	ITMS	Command and Control Centre	Data Centre	Integrated Building management system	Smart Network
35.	Operation and Maintenance of IT, Non IT infrastructure and Applications	1. Detailed plan for monitoring of SLAs and performance of the overall system	✓	✓	✓	✓	✓	✓	✓	✓	✓
36.	SLA and Performance Monitoring	2. Fortnightly Progress Report	✓	✓	✓	✓	✓	✓	✓	✓	✓
37.	Logging, tracking and resolution of issues.	3. Monthly SLA Monitoring Report and Exception Report	✓	✓	✓	✓	✓	✓	✓	✓	✓
38.	Application enhancement	4. Quarterly security Report	✓								
39.	Patch Updates	5. Issues logging and resolution report	✓	✓	✓	✓	✓	✓	✓	✓	✓
40.	Helpdesk services		✓	✓	✓	✓	✓	✓	✓	✓	✓

2.4. Timelines

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Months 7 - 66
Contract Signing	★						
Inception Phase							
Requirement Phase							
Design Phase							
Development Phase							
Integration & Testing Phase							
Go-Live						★	
Operations & Maintenance Phase							

MSI should complete all the activities within the defined timelines as indicated below. The timeline will be reviewed regularly during implementation phase and may be extended incase NRDA feels that extension in a particular vertical/component/track is imperative, for the reason beyond the control of the bidder. In all such cases NRDA's decision shall be final and binding. The MSI will be eligible for the payment based on the completion of activities and approval of the relevant deliverables.

2.5. Payment Milestones

Milestone	Track	Payment
Implementation Phase		
Implementation Services		
Inception Phase	All Tracks	5% of the Implementation Services Component of the Capital Cost

Milestone	Track	Payment
Requirement Phase Completion		15% of the Implementation Services Component of the Capital Cost
Design Phase Completion		15% of the Implementation Services Component of the Capital Cost
Development Phase Completion (Successful UAT of respective tracks)	Smart Governance Track	10% of the Implementation Services Component of the Capital Cost
	Utilities Management Track	4% of the Implementation Services Component of the Capital Cost
	City Surveillance Track	2% of the Implementation Services Component of the Capital Cost
	ITMS Track	2% of the Implementation Services Component of the Capital Cost
	Smart Network Track	5% of the Implementation Services Component of the Capital Cost
	IBMS Track	2% of the Implementation Services Component of the Capital Cost
	Data Center Track	5% of the Implementation Services Component of the Capital Cost
Go-Live	All Tracks	35% of the Implementation Services Component of the Capital Cost
Infrastructure Costs including Hardware, COTS Software licenses and other system software etc.		
Delivery and Receipt at site and after Verification of such items by NRDA/NRDA authorized agency	All Tracks	40% payment of cost of item(s) supplied
Power-up (for hardware), Installation, configuration and ready for Application deployment		30% payment of cost of item(s) supplied
Go-Live		30% payment for cost of item(s) supplied

Milestone	Track	Payment
Operations and Maintenance Phase		
Milestone	Deliverables	Payment
Completion of respective quarter's operation & maintenance as per requirements of the RFP (Q1 – Q20) of the Operations & Maintenance Phase	<ul style="list-style-type: none"> • SLA Compliance report • Project Status Report • Issue/Incident reports • Process audit reports 	5% of the Operational Cost per quarter

Note:

- i. Order for Infrastructure items including Hardware, COTS Software licenses and other system software etc. shall be placed by MSI only after receipt of written confirmation from NRDA in this regard.
- ii. All the milestone payments that are due to MSI after requisite approvals/acceptance as prescribed shall be made to MSI within 30 working days after receipt of valid invoice in this regard from the MSI, subject to correctness and validation of the invoice and no objections / observations by NRDA.
- iii. Unless otherwise mentioned in this RFP for any component, payment terms for additional work assigned through change management shall be defined in the change management order which will be, to the extent applicable, in line with payment terms defined in the above table.
- iv. Post UAT if the go-live trackwise is taking some time while a particular vertical/Track is functioning properly as per TOR and to the satisfaction of NRDA, in such cases NRDA may release additional 15% of implementation services component of the Capital Cost. However balance 15% shall be released only on complete Project's Go-Live.

2.6. Detailed Scope of Work

2.5.1 Stages of Implementation of Smart City System

2.6.1.1. Inception Phase

The MSI will be responsible for preparation of detailed project plan. The plan shall address at the minimum the following:

- i. Define an organized set of activities for the project and identify the interdependence between them.
- ii. Resource planning and loading for each phase/activity. This must also indicate where each resource would be based during that phase, i.e. onsite at the NRDA office or off site at MSI premises.

- iii. Establish and measure resource assignments and responsibilities
- iv. Highlight the milestones and associated risks
- v. Communicate the project plan to stakeholders with meaningful reports.
- vi. Measure project deadlines and performance objectives.
- vii. Project Progress Reporting. During the implementation of the project, the MSI should present weekly reports. This report will be presented in the Project Working Group (PWG) meeting to NRDA. The report should contain at the minimum the under mentioned:
 - a. Results accomplished during the period (weekly)
 - b. Cumulative deviations from the schedule date as specified in the finalized Project Plan
 - c. Corrective actions to be taken to return to planned schedule of progress
 - d. Plan for the next week
 - e. Proposed revision to planned schedule provided such revision is necessitated by reasons beyond the control of MSI
 - f. Support needed
 - g. Highlights/lowlights
 - h. Issues/Concerns
 - i. Risks/Show stoppers along with mitigation
- viii. Identify the activities that require the participation of client personnel (including NRDA, the Program Management Unit etc.) and communicate their time requirements and schedule early enough to ensure their full participation at the required time.

2.6.1.2. Requirement Phase

The MSI must perform the detailed assessment of the business requirements and IT Solution requirements for the Smart City System as mentioned in this RFP. Based on the understanding and its own individual assessment, MSI shall develop & finalize the System Requirement Specifications (SRS) in consultation with NRDA and its representatives. While doing so, MSI at least is expected to do following:

- a. MSI shall study and revalidate the requirements given in the RFP with NRDA and submit as an exhaustive FRS document.
- b. MSI shall translate all the requirements as captured in the FRS document into SRS.
- c. MSI shall develop and follow standardized template for requirements capturing and system documentation.
- d. MSI must maintain traceability matrix from SRS stage for the entire implementation.
- e. MSI must get the sign off from user groups formed by NRDA.
- f. For all the discussion with NRDA team, MSI shall be required to be present at NRDA office with the requisite team members.

2.6.1.3. Design Phase

The MSI shall build the solution for Smart City System as per the Smart City System Design Considerations detailed in **Annexure – VII**. The solution proposed by MSI should comply with the design considerations requirements as mentioned therein.

2.6.1.4. Development Phase

The MSI shall carefully consider the scope of work and provide a solution that best meets the Smart City System's requirements. Considering the scope set in this RFP, the MSI shall carefully consider the solutions it proposes and explicitly mention the same in the technical proposal. The implementation of the application software will follow the procedure mentioned below:

- a. Software Products (Configuration and Customization): In case MSI proposes software products the following need to be adhered:
 - i. MSI will be responsible for supplying the application and licenses of related software products and installing the same so as to meet Smart City System requirements. Following minimum licenses are required for operators of Command and Control centre, NoC, Helpdesk, Building Management System.
 - 3 Operator license for Utility management
 - 2 Surveillance operator
 - 2 ITMS Operator
 - 5 NMS/EMS license
 - 5 Helpdesk operator
 - 3 Building Management System operator
 - ii. MSI shall have provision for procurement of licenses in a staggered manner as per the actual requirement of the project.
 - iii. The MSI shall perform periodic audits to measure license compliance against the number of valid End User software licenses consistent with the terms and conditions of license agreements, volume purchase agreements, and other mutually agreed upon licensed software terms and conditions. The MSI shall report any exceptions to license terms and conditions at the right time to NRDA. However, the responsibility of license compliance solely lies with the MSI. Any financial penalty imposed on NRDA during the contract period due to license non-compliance shall be borne by MSI.
 - iv. MSI shall also supply any other tools & accessories required to make the integrated solution complete as per requirements. For the integrated solution, the MSI shall supply:
 - a) Software & licenses.
 - b) Supply tools, accessories, documentation and provide a list of the same. Tools and accessories shall be part of the solution.
 - c) System Documentation: System Documentation both in hard copy and soft copy to be supplied along with licenses and shall include but not limited to following. Documentation to be maintained, updated and submitted to NRDA regularly :
 - Functional Requirement Specification (FRS)
 - High level design of whole system
 - Low Level design for whole system / Module design level
 - System Requirements Specifications (SyRS)

- Any other explanatory notes about system
- Traceability matrix
- Technical and product related manuals
- Installation guides
- User manuals
- System administrator manuals
- Toolkit guides and troubleshooting guides
- Other documents as prescribed by NRDA
- Quality assurance procedures
- Change management histories
- Version control data
- SOPs, procedures, policies, processes, etc developed for NRDA
- Programs :
 - Entire source codes
 - All programs must have explanatory notes for understanding
 - Version control mechanism
 - All old versions to be maintained
- Test Environment :
 - Detailed Test methodology document
 - Module level testing
 - Overall System Testing
 - Acceptance test cases

(These documents need to be updated after each phase of project and to be maintained updated during entire project duration. The entire documentation will be the property of NRDA.)

b. Bespoke (Custom Developments)

- i. The successful MSI shall identify, design and develop components/functionalities that are required to address the requirements mentioned in this RFP.
- ii. The MSI shall supply the following documents along with the developed components:
 - Business process guides;
 - Program flow descriptions;
 - Data model descriptions;
 - Sample reports;
 - Screen formats;
 - Frequently asked question (FAQ) guides;
 - User manual
 - Technical manual

- Any other documentation required for usage of implemented solution

2.6.1.5. Integration & Testing Phase

The Command and control centre Application (CCA) at Command and control centre should be integrated with feeds of all tracks/component deployed under this Naya Raipur Smart City System.

The MSI shall provide the testing strategy including traceability matrix, test cases and shall conduct the testing of various components of the software developed/customized and the solution as a whole. The testing should be comprehensive and should be done at each stage of development and implementation.

The detailed testing requirements are mentioned in section 7.

2.6.1.6. Go-Live Preparedness and Go-Live

- a. MSI shall prepare and agree with NRDA, the detailed plan for Go-Live (in-line with NRDA's implementation plan as mentioned in RFP).
- b. The MSI shall define and agree with NRDA, the criteria for Go-Live.
- c. The MSI shall ensure that all the data migration is done from existing systems.
- d. MSI shall submit signed-off UAT report (issue closure report) ensuring all issues raised during UAT are being resolved prior to Go-Live.
- e. MSI shall ensure that Go –Live criteria as mentioned in User acceptance testing of Smart City System is met and MSI needs to take approval from NRDA team on the same.
- f. Go-live of the application shall be done as per the finalized and agreed upon Go-Live plan.

2.6.2. Data Digitisation / Migration

Following data has to be digitized and migrated:

- a. Consumer Details (Available in Excel)
- b. Asset Details (Not digitized)
- c. Land / Property Details (Available in Excel/Word))
- d. Account data from Tally
- e. Employee details (data available in software developed in PHP and Backend – MySQL)
- f. Vendor details (Not digitized)

The estimated data entry and scanning requirement is mentioned in Commercial bid format section of volume I.

2.6.3. IT Infrastructure procurement, supply, installation and info security

The MSI shall be responsible for procurement, supply and installation of entire ICT infrastructure, field equipment, sensors, cameras, edge level devices required for setting up and operations of the Smart City

System. The ICT infrastructure includes servers, storages, back up, networking, load balancers, security equipment, operating systems, database, enterprise management system, help desk system, edge level devices and other related IT infra required for running and operating the envisaged system. The ICT infra procurement will be planned considering the below factors:

- a. Ensure redundancy at critical points
- b. Support peak loads
- c. MSI will not procure Infrastructure including Hardware, COTS Software licenses and other system software etc. at the start of the project, but will procure as per the prescribed schedule and **after receipt of go ahead from NRDA.**
- d. MSI shall optimize procurement of ICT infrastructure i.e. the equipment shall not be procured earlier than its requirement.
- e. Virtualisation technologies to be used to reduce the physical space required for hosting
- f. ICT infra deployed for Smart City System should be dedicated for the project and MSI shall not use the same for any other purpose.
- g. The ownership of ICT infrastructure shall get transferred to NRDA after “Acceptance and Go Live” of such items by NRDA/NRDA appointed TPAs.
- h. MSI to ensure warranties/AMCs are procured for all the hardware components for entire duration of the project. For software components the support from OEM to be obtained for prescribed components. There would be a mechanism to verify these details on annual basis.
- i. Minimum specifications of the IT infra are detailed in Annexure-III, the bidder needs to size and provide IT infra to meet the project functional requirements and Service Level Agreements (SLAs).
- j. Other details relating to IT infra, info security, etc. are mentioned in Annexure-II & III and VII

2.6.4. Hosting Services

- a. The Smart City System shall be hosted in the State Data Centre (SDC) of Govt. of Chhattisgarh. NRDA shall be responsible for entering into a Memorandum of Understanding with Chhattisgarh infotech Promotion Society, the nodal agency responsible for managing the SDC in Chhattisgarh. The following services shall be provisioned by SDC
 - i. Internet Bandwidth
 - ii. Hosting Space
 - iii. Power & Cooling
 - iv. Secured Data Center Environment
- b. MSI need to do the sizing of rack space required at facilities based on its capacity planning and sizing for the entire duration of the contract with adequate space for future expansion.

- c. MSI also needs to provide fireproof media storage capability. All the requisite consumables like tapes, hard disks, etc. for backup shall be provided by the MSI as per the project requirements. All the tapes, hard disks, etc. once deployed for the project will become property of NRDA. . The corrupted/damaged devices will be returned to MSI after data removal/retrieval .
- d. The Data backup site shall be set up at Command Center Building, adjacent to NRDA's office in Naya Raipur.
- e. MSI shall be responsible for setting up entire Data backup site at Command Center Building including all security and infrastructure requirements.

Cloud Hosting

- a. MSI may propose to host Applications of following tracks etc on cloud:
 - Smart Governance (Applications) including common Portal.
 - Utility Management System
 - Command & Control Centre and Integrated Building management System
 - Smart Network Application
- b. MSI should select the Cloud Service Provider from the empanelled vendors of MeitY. List is empanelled Cloud service provider is provided in Annexure XIV of this volume
- c. Below are the key factors to be considered for cloud hosting-
 - i. The MSI is required to prepare and submit along with their technical proposal, the details of methodologies and computations for sizing and capacity of storage, compute, backup, network and security.
 - ii. Government Community Cloud should only be used by CSP
 - iii. There should be physical and logical separation (of space, servers, storage, network infrastructure and networks) to protect data, applications and servers.
 - iv. The system will be hosted in the site identified by the MSI and as agreed by the NRDA for DC and remote data backup.
 - v. There should be sufficient capacity (compute, network and storage capacity offered) available for near real time provisioning (as per the SLA requirement of the NRDA) during any unanticipated spikes in the user load.
 - vi. Ensure redundancy at each level
 - vii. MSI shall provide interoperability support with regards to available APIs, data portability etc. for the NRDA to utilize in case of Change of cloud service provider, migration back to in-house infrastructure, burst to a different cloud service provider for a short duration or availing backup or DR services from a different service provider.
 - viii. The MSI is fully responsible for tech refreshes, patch management and other operations of infrastructure that is in the scope of the MSI.
 - ix. NRDA retains ownership of all virtual machines, templates, clones, and scripts/applications created for the NRDA's application. NRDA retains the right to request (or should be able to retrieve) full copies of these virtual machines at any time
 - x. Provide a robust, fault tolerant infrastructure with enterprise grade SLAs with an assured uptime of 99.5%, SLA measured at the VM Level & SLA measured at the Storage Levels
 - xi. Cloud services should be accessible via internet and MPLS
 - xii. Provide private connectivity between a NRDA's network and Data Centre Facilities
 - xiii. Required Support to be provided to the NRDA in migration of the VMs, data, content and any other assets to the new environment created by the NRDA or any Agency (on behalf of

- the NRDA) on alternate cloud service provider's offerings to enable successful deployment and running of the NRDA's solution on the new infrastructure.
- xiv. The MSI should configure, schedule and manage backups of all the data including but not limited to files, folders, images, system state, databases and enterprise applications
 - a) Perform and store data and file backups consisting of an initial full back up with daily incremental backups for files;
 - b) For the files, perform weekly backups;
 - c) For the databases, perform a twice weekly full database backup, with a three times daily backup of database log files
 - d) Encryption of all backup files and data and management of encryption keys as a service that can be enabled for Government Departments that require such a service.
 - e) Retain database backups for thirty (30) days
 - xv. The MSI should offer dashboard to provide visibility into service via dashboard.
 - xvi. MSI shall not delete any data at the end of the agreement (for a maximum of 45 days beyond the expiry of the Agreement) without the express approval of the NRDA.

2.6.5. Network

- a. MSI has to provide last mile physical connectivity between field level equipments (Camera including existing 60 camera at 15 bus shelters/stops , Utility management devices etc), Command centre and the existing 96 core OFC network using Copper/Fibre/ UTP considering RFP scope and SLA requirement.
- b. MSI has to also provide required switches etc for last mile connectivity.
- c. Command centre will be aggregation point and MSI has to provide required Network equipment at CCC.
- d. Also NoC infrastructure including the Display, Desktop, Software, other hardware and Manpower, for monitoring the Network under this assignment has to be provided by MSI.
- e. MSI has to coordinate with NRDA, NRDA's OFC network Contractor for setting up last mile physical connectivity between edge/field devices and OFC network. The OFC DUCT network and distance of Assets (like camera locations, Substations, UGRs etc) from the existing DUCT is provided in Annexure VIII of this RFP.
- f. Provision of requisite bandwidth – This includes provisioning of Replication bandwidth between DC and Data backup site (at CCC), last mile connectivity between all field locations, CCC / Data backup site, NRDA office and DC.
- g. MSI has to provide sizing of bandwidth requirement as per RFP requirement and has to do coordination at time of implementation. MSI shall coordinate with telecom service provider for bandwidth/internet connection, however any bandwidth charges applicable will be payable by NRDA.
- h. Bandwidth estimation is to be done by MSI based on the data replication requirement, user projections for entire contract duration and to comply with the service levels.

- i. MSI shall provide the detailed Bandwidth calculation and should ensure that bandwidth utilization should not cross 70% at any point of time. The MSI through EMS/NMS should also provide network related reports including the below:
 - a. Link up/down (real-time as well as periodic)
 - b. Link utilization in % (real-time as well as periodic) (Link utilisation should not be more than 70% in each case, barring acceptable occasional surges)
 - c. Top and Bottom N graphs showing the best and worst links in terms of availability (periodic)
 - d. Reports on threshold violations. Provisions for setting thresholds and getting alerts on threshold violations should be there in the system. (real-time as well as periodic)
 - e. Bandwidth utilization report for each link and utilization trends. The report should have provisions for displaying the minimum, maximum and average for each link. (real-time as well as periodic)
 - f. The monitoring solution provides for application/port level traffic analysis with source and destination identifications
 - g. Report on jitters, latency due to network parameters, closely linked to reachability shall be available. (real-time as well as periodic)
 - h. Router Statistics: CPU utilization and free memory reports of all the routers in the network should be available. Memory and CPU utilization reports will show maximum and minimum against a predefined threshold.

2.6.6. Helpdesk Setup and Operations

1. This track includes running centralised helpdesk setup and operations for Smart City System project for a period of 5 years from the date of Go Live.
2. The help desk will handle user queries and issues relating to Smart City System.
3. Helpdesk is required to ensure that users / citizens can log calls and complaints for any technical issues they face while using the Smart City System. The following is included in the scope of work of MSI:
 - a. Help Desk to have Interactive Voice Response (IVR) system for first level of call segregation.
 - b. Accordingly Standard Operating Procedures (SOPs) shall be created by MSI and MSI shall be paid based on actual Customer Service Executives (CSE) deployed.
 - c. In addition to the telephone call, the MSI shall also provide other channels for call logging like email and web interface.
 - d. Following is also part of scope of work of MSI: (a) Development of training material for CSEs and supervisors (b) training to be imparted to CSEs and supervisors (c) provision of Call centre application (d) Development of standard operating procedures with call prioritisation guidelines, problem security codes and escalation procedures etc. in consultation with NRDA (e) Helpdesk related infrastructure.
 - e. Language Capabilities : Hindi and English

- f. The service window for Help Desk is 365X24X7 (Monday to Sunday).
- g. Estimated number of CSEs at the start of the project: 2 for peak shift. During non-peak hours reduced number of seats may be operated. The call statistics will be analysed every quarter after Go-Live and the number of CSEs may be ramped up or down accordingly on a week's notice.
- h. MSI shall deploy helpdesk application accessible to all users through the Smart City portal for logging issues.
- i. MSI to provision for inbound calls.

2.6.6.1. Training to Help Desk Manpower

- a. Considering the nature of the services, training is an important aspect of Smart City System Help Desk. MSI should make arrangements for imparting proper training in soft skills; call handling, exposure to related application so as to prepare the CSEs to answer different types of queries, and on other aspects of Help Desk.
- b. The MSI should ensure that all the CSEs are put on actual duty only after providing them proper training on at least the following areas:

S. No.	Training Area	Responsibility
1	Soft Skills	MSI
2	Application (s)	MSI
3	Call Handling procedures	MSI
4	Smart City System	MSI

- c. The MSI shall include the cost of training the resources for any new process, modules, etc., in the per seat cost quoted in the price bid.
- d. Before deployment of CSE, he/she need to undergo training for at least a week time covering above areas. Certificate of such training need to be submitted on quarterly basis to NRDA.

2.6.6.2. Set up IT Infrastructure for Helpdesk Operations

MSI shall arrange for IVR, dialer and related hardware and network components for running the IT Help Desk Operations.

- a. Automatic Call Distributor (ACD):

ACD distributes incoming calls to CSEs as they are received. It should have at least the following features:

- i. System should be able to intelligently route the callers to CSEs based on their availability to take calls on first come first serve basis.
- ii. Standard features like Call Transfer, Conference, Barge in, Dialed Number Identification Sequence (DNIS), Automatic Number Identification (ANI), and Caller Line Identification (CLI) etc.

- iii. System should announce the queue waiting time for the caller before getting attended by a CSEs
- iv. System shall support the ability to play customized announcements per queue as defined by the administration.
- b. Other Infrastructure, but not limited to, to be provided by MSI are:
 - i. Call barging and recording software
 - ii. CSEs computers, phone sets and head sets.

2.6.6.3. Helpdesk operations

Helpdesk would have following major activities and tasks:

- a. Issues logged by users through Helpdesk should be accessed and serviced by the helpdesk personnel.
- b. Track and route requests for service and to assist end users in answering questions and resolving problems. Assign severity level to each ticket as per the SOPs.
- c. Acknowledgement should be sent to user along with service ticket number through an email immediately on call logging.
- d. Routing the query received to the concerned team of the MSI for resolution of tickets (Issues that the helpdesk personnel are not able to resolve)
- e. Escalate the issues/complaints, to NRDA if necessary as per the escalation matrix.
- f. Notifying users the problem status and resolution through the tickets over email & SMS.
- g. All the issues on logging shall be assigned severity of issue. Basic guideline for assigning severity is as follows:

Severity	Definition
Severity 1	<p>Severity 1 problems are the ones which have a critical business impact. These problems will have any of the following characteristics:</p> <ul style="list-style-type: none"> • Entire or part of any service unavailable (including APIs) • Incorrect behavior of the system (wrong results, etc.) • Security Incidents • Data Theft/loss/corruption • Severe impact on customer satisfaction/NRDA reputation – bad media publicity • No work-around to mitigate the disruption in service • Repeat calls (same problem that has occurred earlier reported more than 2 times) • Financial impact on NRDA

Severity 2	Severity 2 problems are the ones which have a significant business impact. These problems will have any of the following characteristics: <ul style="list-style-type: none"> • The efficiency of users is being impacted • Has a viable workaround • Severely degraded performance (slow service)
Severity 3	Severity 3 problems are the ones which have a minimal business impact. These problems will have any of the following characteristics: <ul style="list-style-type: none"> • No impact on processing of normal business activities. • A low impact on the efficiency of users • Has a simple workaround • Enhancement requests

- h. Every call received/done from the Helpdesk would be recorded in the Helpdesk application against the respective id.
- i. Each call would have a unique identifier and in case there is any query/any other request, stakeholder shall be intimated about the call id for future tracking purpose.
- j. To ensure Customer Service Quality, NRDA shall conduct Regular audits, Random audits and call barging
 - i. NRDA will do a random sample survey of calls on call quality as well as be involved into calls without prior notification. For this purpose administration level permissions to access all sub-systems/servers to monitor and generate reports including those required for cross-verification of SLAs and related payments will be provided by the MSI.
 - ii. All calls should be recorded. The call data from the voice logger should be archived on to hard disk every 15 days. The data on the hard disk should be stored in using such naming conventions that supports easy retrieval. These records shall be retained on hard disk for another 30 days.
- k. If it is observed by NRDA that a CSE/team leader has misbehaved with a caller on telephone, or if complaint is received against any of the CSE/team leader or if his/her performance is found to be lacking in the opinion of NRDA, NRDA may instruct the MSI to remove such person from Smart City System Helpdesk immediately and provide replacement within 1 week.
- l. Helpdesk shall keep the user informed on various stages of resolution through email.
- m. Even if the call is forwarded to external entity, coordination between user and external entity would be maintained by helpdesk along with informing the user on call status.
- n. Incidents which are not meeting SLAs and which are exceptional in nature (highly critical, wider spread etc.) shall be escalated as per defined escalation matrix.
- o. Helpdesk should comply with SLAs applicable to them as mentioned in this RFP. Non-adherence to SLAs shall lead to imposition of liquidated damages.

p. Continuous Improvement:

- i. Prepare Knowledge base for frequently reported problems along with the resolution steps/solutions and publish on the portal.
 - ii. Publish and continuously update the knowledge basis on the website that can enable user to find resolution without calling the helpdesk.
 - iii. On a quarterly basis, MSI shall carry out the analysis of help desk tickets (open and closed) to identify the recurring incidents and conduct a root cause analysis on the same. MSI shall submit a report to NRDA with the analysis and provide inputs to NRDA on user training requirements, awareness messages to be posted on the portal, redesign recommendations and/or application enhancements (functional/design) based on help desk ticket analysis. The objective of the analysis should be to address the repeat incidents and enhance the delivery of services to the end users.
- q. MSI shall prepare and submit reports to NRDA team as per the mutually agreed reporting structure. These reports shall include but not limited to the following:
- i. Incident logs (category, severity and status of call etc.)
 - ii. Incidents escalated
 - iii. SLA compliance/non-compliance report with reasons for non-compliance
 - iv. Problem management
 - v. Detailed analysis of the calls containing opportunities of automation, trainings, FAQs, etc.
 - vi. Helpdesk & CSE utilization reports, benchmarked against industry standards for similar application/environment.

2.6.7. Training and Capacity Building

1. The purpose of this section is to define the scope of work for training and capacity building to be implemented at various levels namely:
 - a) NRDA employees
 - b) Stakeholder departments
2. The MSI's scope of work also includes preparing the necessary documentation and aids required for successful delivery of such trainings.
3. The details provided in this section are indicative and due to the complex nature of the project the number of training sessions may increase. Over and above the team considered for performing the training as detailed in subsequent sections,
4. Further the MSI has to provide cost for additional and optional training sessions in its commercial proposal in case more training's are required. MSI has to conduct such additional training sessions on NRDA's request.
5. MSI will develop a training and capacity building strategy that will also include a detailed plan of implementation.
6. MSI will get the Training and capacity building strategy including training material finalized with NRDA before starting the training programs.

7. MSI will prepare all the requisite audio/visual training aids that are required for successful completion of the training for all stakeholders. These include the following for all the stakeholders:
 - a. Training manuals for NRDA employees / stakeholder departments such as Police, Electricity Board etc.
 - b. Computer based training modules
 - c. Video (recorded sessions) for portal functionality, back end modules, business intelligence, dynamic reporting Smart City System
 - d. Presentations
 - e. User manuals
 - f. Operational and maintenance manuals for the modules provided along with the Smart City System
 - g. Regular updates to the training aids prepared under this project
8. MSI will maintain a copy of all the training material on the City Portal and access will be provided to relevant stakeholders depending on their need and role. The access to training on the portal would be finalized with NRDA. MSI has to ensure the following points:
 - a. For each training session, the MSI has to provide the relevant training material copies to all the attendees.
 - b. The contents developed shall be the property of NRDA with all rights.
9. There are estimated 120 users who need to be trained. MSI may accordingly plan the training budget.
10. MSI has to ensure that the training sessions held are effective and that the attendees would be able to carry on with their work efficiently. For this purpose, it is necessary that the effectiveness of training sessions is measured. The MSI will prepare a comprehensive feedback form that will capture necessary parameters on measuring effectiveness of the training sessions. This form will be discussed and finalized with NRDA.
11. After each training session, feedback will be sought from each of the attendees on either printed feedback forms or through a link available on the web portal. One member of the stakeholder group would be involved in the feedback process and he/she has to vet the feedback process. The feedback received would be reported to NRDA for each training session.
12. For each training session, the MSI will categorise the feedback on a scale of 1 to 10, where 10 will denote excellent and 1 will denote unsatisfactory.
13. The training session would be considered effective only after the cumulative score of the feedback [sum of all feedback divided by number of attendees] is more than 7.5.
14. The Training entire infrastructure including Air conditioned seating space, furniture, water, electrical and internet connectivity, seats will be provided by NRDA.

2.6.8. Operation and Maintenance (O&M)

MSI will operate and maintain all the components of the Smart City System for a period of five (5) years after Go-Live date. During O&M phase, MSI shall ensure that service levels are monitored on continuous basis; service levels are met and are reported to NRDA. After Go-Live, if any system/sub-system/appliance that is deployed during the O&M phase must be added in the Smart City System only after proper induction procedures are followed including hardening and security testing. MSI needs to implement suitable Performance Improvement Process (PIP) in the project. PIP program applies to all the processes of Smart City System project. MSI need to submit its detailed approach for PIP in its technical proposal. Every process and procedure implemented in Smart City System project must be reviewed and updated by MSI at least on annual basis from the Go-Live Date. All the manpower engaged for O&M support of the project should be citizens of India.

MSI will ensure that at no time shall any data of Smart City System be ported outside the geographical limits of the country.

Some broad details of O&M activities are mentioned below:

2.6.8.1. Applications Support and Maintenance

Application support includes, but not limited to, production monitoring, troubleshooting and addressing the functionality, availability and performance issues, implementing the system change requests etc. The MSI shall keep the application software in good working order; perform changes and upgrades to applications as requested by the NRDA team. All tickets related to any issue/complaint/observation about the system shall be maintained in an ITIL compliant comprehensive ticketing solution. Key activities to be performed by MSI in the application support phase are as follows:

a. Compliance to SLA

MSI shall ensure compliance to SLAs as indicated in this RFP and any upgrades/major changes to the software shall be accordingly planned by MSI ensuring the SLA requirements are met at no additional cost to the NRDA.

b. Annual Technology Support

The MSI shall be responsible for arranging for annual technology support for the OEM products to NRDA provided by respective OEMs during the entire O&M phase.

c. Application Software Maintenance

- i. MSI shall provide unlimited support through onsite team/telephone/Fax/E-mail/Video Conferencing/installation visit as required
- ii. MSI shall address all the errors/bugs/gaps in the functionality in the solution implemented by the MSI (vis-à-vis the FRS, BRS and SRS signed off) at no additional cost during the O&M phase
- iii. All patches and upgrades from OEMs shall be implemented by the MSI ensuring customization done in the solution as per the NRDA's requirements are applied. Technical upgrade of the installation to the new version, as and when required, shall be done by the MSI. Any version upgrade of the software / tool / appliance by MSI to be

done after taking prior approval of NRDA and after submitting impact assessment of such upgrade.

- iv. Any changes/upgrades to the software performed during the support phase shall subject to the comprehensive and integrated testing by the MSI to ensure that the changes implemented in the system meets the specified requirements and doesn't impact any other function of the system. Release management for application software will also require NRDA approval. A detailed process in this regard will be finalized by MSI in consultation with NRDA.
 - v. Issue log for the errors and bugs identified in the solution and any change done in the solution shall be maintained by the MSI and periodically submitted to the NRDA team.
 - vi. MSI, at least on a monthly basis, will inform NRDA about any new updates/upgrades available for all software components of the solution along with a detailed action report. In case of critical security patches/alerts, the MSI shall inform about the same immediately along with his recommendations. The report shall contain MSI's recommendations on update/upgrade, benefits, impact analysis etc. The MSI shall need to execute updates/upgrades through formal change management process and update all documentations and Knowledge databases etc. For updates and upgrades, MSI will carry it out free of cost by following defined process.
- d. Problem identification and Resolution
- i. Errors and bugs that persist for a long time, impact a wider range of users and is difficult to resolve becomes a problem. MSI shall identify and resolve all the application problems in the identified solution (e.g. system malfunctions, performance problems and data corruption etc.).
 - ii. Monthly report on problem identified and resolved would be submitted to NRDA team along with the recommended resolution.

e. Change and Version Control

All planned or emergency changes to any component of the system shall be through the approved Change Management process. The MSI needs to follow all such processes (based on industry ITSM framework). For any change, MSI shall ensure:

- i. Detailed impact analysis
- ii. Change plan with Roll back plans
- iii. Appropriate communication on change required has taken place
- iv. Proper approvals have been received
- v. Schedules have been adjusted to minimize impact on the production environment
- vi. All associated documentations are updated post stabilization of the change
- vii. Version control maintained for software changes

The MSI shall define the Software Change Management and Version control process. For any changes to the solution, MSI has to prepare detailed documentation including proposed changes, impact to the system in terms of functional outcomes/additional features added to the system etc. MSI shall ensure that software and hardware version control is done for entire duration of MSI's contract.

f. Maintain configuration information

MSI shall maintain version control and configuration information for application software and any system documentation.

g. Training

MSI shall provide training to NRDA personnel whenever there is any change in the functionality. Training plan has to be mutually decided with NRDA team.

h. Maintain System documentation

MSI shall maintain at least the following minimum documents with respect to the Smart City System:

- i. High level design of whole system
- ii. Low Level design for whole system / Module design level
- iii. System requirements Specifications (SRS)
- iv. Any other explanatory notes about system
- v. Traceability matrix
- vi. Compilation environment

MSI shall also ensure updation of documentation of software system ensuring that:

- i. Source code is documented
 - ii. Functional specifications are documented
 - iii. Application documentation is updated to reflect on-going maintenance and enhancements including FRS and SRS, in accordance with the defined standards
 - iv. User manuals and training manuals are updated to reflect on-going changes/enhancements
 - v. Standard practices are adopted and followed in respect of version control and management.
- i. All the project documents need to follow version control mechanism. MSI will be required to keep all project documentation updated and should ensure in case of any change, the project documents are updated and submitted to NRDA by the end of next quarter.
 - j. For application support MSI shall keep dedicated software support team to be based at MSI location that will single point of contact for resolution of all application related issues. This team will receive all the application related tickets/incidents and will resolve them. In its technical proposal MSI need to provide the proposed team structure of application support including number of team members proposed to be deployed along with roles and skills of each such member. Application support team shall be employees of MSI
 - k. Any software changes required due to problems/bugs in the developed software/application will not be considered under change control. The MSI will have to modify the software/application free of cost. This may lead to enhancements/customizations and the same needs to be implemented by the MSI at no extra cost.
 - l. Any additional changes required would follow the Change Control Procedure. NRDA may engage an independent agency to validate the estimates submitted by the MSI. The inputs of

such an agency would be taken as the final estimate for efforts required. MSI to propose the cost of such changes in terms of man month rate basis and in terms of Function point/Work Breakdown Structure (WBS) basis in the proposal.

2.6.8.2. ICT Infrastructure Support and Maintenance

ICT infrastructure includes servers, storages, back up, networking, load balancers, security equipment, operating systems, database, enterprise management system, help desk system and other related ICT infra required for running and operating the envisaged system. MSI shall define, develop, implement and adhere to IT Service Management (ITSM) processes aligned to ITIL framework for all the IT Services defined and managed as part of this project.

2.6.8.3. Warranty support

- a. MSI shall provide comprehensive and on-site warranty for 5 years from the date of Go-Live for the infrastructure deployed on the project. MSI need to have OEM support for these components and documentation in this regard need to be submitted to NRDA on annual basis.
- b. MSI shall provide the comprehensive & onsite manufacturer's warranty in respect of proper design, quality and workmanship of all hardware, equipment, accessories etc. covered by the RFP. MSI must warrant all hardware, equipment, accessories, spare parts, software etc. procured and implemented as per this RFP against any manufacturing defects during the warranty period.
- c. MSI shall provide the performance warranty in respect of performance of the installed hardware and software to meet the performance requirements and service levels in the RFP.
- d. MSI is responsible for sizing and procuring the necessary hardware and software licenses as per the performance requirements provided in the RFP. During the warranty period MSI shall replace or augment or procure higher-level new equipment or additional licenses/hardware at no additional cost to the NRDA in case the procured hardware or software is not enough or is undersized to meet the service levels and the project requirements.
- e. During the warranty period MSI shall maintain the systems and repair/replace at the installed site, at no charge to NRDA, all defective components that are brought to the MSI's notice.
- f. The MSI shall carry out Preventive Maintenance (PM) of all hardware and testing for virus, if any, and should maintain proper records at each site for such PM. The PM should be carried out at least once in six months as per checklist and for components agreed with NRDA.
- g. The MSI shall carry out Corrective Maintenance for maintenance/troubleshooting of supplied hardware/software and support infrastructure problem including network (active/passive) equipment, security and rectification of the same. The MSI shall also maintain complete documentation of problems, isolation, cause and rectification procedures for building knowledge base for the known problems in centralized repository, accessible to NRDA team as well.
- h. MSI shall monitor warranties to check adherence to preventive and repair maintenance terms and conditions.
- i. The MSI shall ensure that the warranty complies with the agreed technical standards, security requirements, operating procedures, and recovery procedures.

- i. MSI shall have to stock and provide adequate onsite and offsite spare parts and spare component to ensure that the uptime commitment as per SLA is met.
- ii. Any component that is reported to be down on a given date should be either fully repaired or replaced by temporary substitute (of equivalent configuration) within the time frame indicated in the Service Level Agreement (SLA).
- iii. The MSI shall introduce a comprehensive Assets Management process & appropriate tool to manage the entire lifecycle of every component of Smart City System.

2.6.8.4. Maintenance of ICT Infrastructure at the DC and Data Backup Sites:

a. Management of DC, CCC(Data Backup site)

MSI need to deploy requisite mix of L1, L2 and L3 resources (on 24X7 basis) for management of entire Smart City System including ICT infrastructure deployed at DC and Data backup(at CCC). All resources deployed in the project should be employees of MSI and be Indian citizens. All the L1 and L2 resources proposed for the project need to be dedicated for the Smart City project. Any change in the team once deployed will require approval from NRDA. It is expected that the majority of resources have worked with MSI for at least preceding 1 year and have proven track record and reliability. Considering the criticality of the project, NRDA may ask for security verification (Police verification) of every resource deployed on the project and MSI need to comply the same before deployment of the resource at the project. At all times, the MSI need to maintain the details of resources deployed for the project to NRDA and keep the same updated. A detailed process in this regard will be finalised between NRDA and MSI. The MSI shall maintain an attendance register for the resources deployed Attendance details of the resources deployed also need to be shared with NRDA on monthly basis. NRDA reserves the right to interview resources deployed for Operations and maintenance and assess the suitability of the resource for the role. In case a resource is not found suitable, MSI will change the resource on request of NRDA. MSI shall comply with this.

The scope of work for infrastructure and maintenance includes the following:

- i. DC operations to be in compliance with industry leading ITSM frameworks like ITIL, ISO 20000 & ISO 27001
- ii. Ensure compliance to relevant SLA's
- iii. 24x7 monitoring & management of availability & security of the infrastructure and assets
- iv. Perform regular hardening, patch management, testing and installation of software updates issued by OEM/vendors from time to time after following agreed process
- v. Ensure overall security – ensure installation and management of every security component at every layer including physical security
- vi. Prepare documentation/policies required for certifications included in the scope of work
- vii. Preventive maintenance plan for every quarter
- viii. Performance tuning of system as required
- ix. Design and maintain Policies and Standard Operating Procedures
- x. User access management
- xi. Other activities as defined/to meet the project objectives
- xii. Updation of all Documentation.

During operations phase the MSI needs to submit proof of renewal of support for all IT infrastructure products and other system software's for whom it is mandated to have OEM support. This needs to be submitted on an annual basis and needs to be verified before release of 2nd quarter payment of each year.

b. System Maintenance and Management

- i. MSI shall be responsible for tasks including but not limited to setting up servers, configuring and apportioning storage space, account management, performing periodic backup of data and automating reporting tasks, and executing hardware and software updates when necessary. It shall be noted that the activities performed by the MSI may also be reviewed by NRDA.
- ii. MSI shall provision skilled and experienced manpower resources to administer and manage the entire system at the Data Center.
- iii. On an ongoing basis, MSI shall be responsible for troubleshooting issues in the IT infrastructure solution to determine the areas where fixes are required and ensuring resolution of the same.
- iv. MSI shall be responsible for identification, diagnosis and resolution of problem areas pertaining to the IT Infrastructure and maintaining the defined SLA levels.
- v. MSI shall implement and maintain standard operating procedures for the maintenance of the IT infrastructure based on the policies formulated in discussion with NRDA and based on the industry best practices/frameworks. MSI shall also create and maintain adequate documentation/checklists for the same.
- vi. MSI shall be responsible for managing the user names, roles and passwords of all the relevant subsystems, including, but not limited to servers, other devices, etc. MSI shall be required to set up the directory server. Logs relating to access of system by administrators shall also be kept and shall be made available to NRDA on need basis.
- vii. MSI shall implement a password change mechanism in accordance with the security policy formulated in discussion with NRDA and based on the industry best practices/frameworks like ISO 27001, ISO 20000 etc.
- viii. The administrators shall also be required to have experience in latest technologies so as to provision the existing and applicable infrastructure on a requirement based scenario.

c. System Administration

- i. 24*7*365 monitoring and management of the servers in the DC.
- ii. MSI shall also ensure proper configuration of server parameters and performance tuning on regular basis. MSI shall be the single point of accountability for all hardware maintenance and support the ICT infrastructure. It should be noted that the activities performed by the MSI may be reviewed by NRDA.
- iii. MSI shall be responsible for operating system administration, including but not limited to management of users, processes, preventive maintenance and management of upgrades including updates, upgrades and patches to ensure that the system is properly updated.
- iv. MSI shall also be responsible for installation and re-installation of the hardware(s) as well as the software(s) in the event of system crash/failures.
- v. MSI shall also be responsible for proactive monitoring of the applications hosted
- vi. MSI shall appoint system administrators to regularly monitor and maintain a log of the monitoring of servers to ensure their availability to NRDA at all times.

- vii. NRDA shall undertake regular analysis of events and logs generated in all the sub systems including but not limited to servers, operating systems etc. The system administrators shall undertake actions in accordance with the results of the log analysis. The system administrators shall also ensure that the logs are backed up and truncated at regular intervals. MSI shall refer to CERT-In Guidelines so as to ensure their alignment with the practices followed.
- viii. The system administrators shall adopt a defined process for change and configuration management in the areas including, but not limited to, changes in servers, operating system, applying patches, etc.
- ix. The system administrators shall provide hardening of servers in line with the defined security policies. Validation of hardening configuration will be carried out quarterly and deviations must be tracked through SLA reporting
- x. The system administrators shall provide integration and user support on all supported servers, data storage systems etc.
- xi. The system administrators shall be required to trouble shoot problems with web services, application software, server relationship issues and overall aspects of a server environment like managing and monitoring server configuration, performance and activity of all servers.
- xii. The system administrators should be responsible for documentation regarding configuration of all servers, IT Infrastructure etc.
- xiii. The system administrators shall be responsible for managing the trouble tickets, diagnosis of the problems, reporting, managing escalation, and ensuring rectification of server problems as prescribed in Service Level Agreement.
- xiv. The administrators will also be required to have experience in latest technologies so as to provision the existing and applicable infrastructure on a requirement based scenario.

d. Storage Administration

- i. MSI shall be responsible for the management of the storage solution including, but not limited to, storage management policy, configuration and management of disk array, SAN fabric/switches, tape library, etc. It should be noted that the activities performed by the MSI may be reviewed by NRDA.
- ii. MSI shall be responsible for storage management, including but not limited to management of space, SAN/NAS volumes, RAID configuration, LUN, zone, security, business continuity volumes, performance, etc.
- iii. The storage administrator will be required to identify parameters including but not limited to key resources in the storage solution, interconnects between key resources in the storage solution, health of key resources, connectivity and access rights to storage volumes and the zones being enforced in the storage solution.
- iv. The storage administrator will be required to create/delete, enable/disable zones in the storage solution.
- v. The storage administrator will be required to create/delete/modify storage volumes in the storage solution.
- vi. The storage administrator will be required to create/delete, enable/disable connectivity and access rights to storage volumes in the storage solution.
- vii. To facilitate scalability of solution wherever required.
- viii. The administrators will also be required to have experience in latest technologies such as virtualisation and cloud computing so as to provision the existing and applicable infrastructure on a requirement based scenario.

e. Database Administration

- i. MSI shall be responsible for monitoring database activity and performance, changing the database logical structure to embody the requirements of new and changed programs.
- ii. MSI shall be responsible to perform physical administrative functions such as reorganizing the database to improve performance.
- iii. MSI shall be responsible for tuning of the database, ensuring the integrity of the data and configuring the data dictionary.
- iv. MSI will follow guidelines issued by NRDA in this regard from time to time including access of data base by system administrators and guidelines relating to security of data base.
- v. Database administration should follow the principle of segregation of duties to ensure no single DBA can update production tables/data singularly.
- vi. In addition to restrictions on any direct change in Data by any administrator, the Databases shall have Auditing features enabled to capture all activities of administrators.

f. Backup/Restore/Archival

- i. MSI shall be responsible for implementation of backup & archival policies as finalized with NRDA. The MSI is responsible for getting acquainted with the storage policies of NRDA before installation and configuration. It should be noted that the activities performed by the MSI may be reviewed by NRDA.
- ii. MSI shall be responsible for monitoring and enhancing the performance of scheduled backups, scheduled regular testing of backups and ensuring adherence to related retention policies.
- iii. MSI shall be responsible for prompt execution of on-demand backups of volumes and files whenever required by NRDA or in case of upgrades and configuration changes to the system.
- iv. MSI shall be responsible for real-time monitoring, log maintenance and reporting of backup status on a regular basis. MSI shall appoint administrators to ensure prompt problem resolution in case of failures in the backup processes.
- v. MSI shall undertake media management tasks, including, but not limited to, tagging, cross-referencing, storing, logging, testing, and vaulting in fire proof cabinets (onsite and offsite as per the detailed process finalised by during project implementation phase).
- vi. MSI shall also provide a 24 x 7 support for file and volume restoration requests at the Data Centre(s).

g. Network monitoring

- i. MSI shall provide services for management of network environment to maintain performance at optimum levels on a 24 x 7 basis. It should be noted that the activities performed by the MSI may be reviewed by NRDA.
- ii. MSI shall be responsible for creating and modifying VLAN, assignment of ports to appropriate applications and segmentation of traffic.
- iii. MSI shall also be responsible for break fix maintenance of the LAN cabling within DC/CCC etc.
- iv. MSI shall also provide network related support and will coordinate with connectivity service providers of NRDA/other agencies who are terminating their network at the DC/CCC for access of system.

h. Security Management

- i. Regular hardening and patch management of components of the Smart City System as agreed with NRDA
- ii. Performing security services on the components that are part of the NRDA environment as per security policy finalized with NRDA
- iii. IT Security Administration – Manage and monitor safety of information/data
- iv. Reporting security incidents and resolution of the same
- v. Proactively monitor, manage, maintain & administer all security devices and update engine, signatures, and patterns as applicable.
- vi. Managing and monitoring of anti-virus, anti-malware, phishing and malware for managed resources.
- vii. Ensuring 100 percent antivirus coverage with patterns not old more than period agreed on any given system
- viii. Reporting security incidents and co-ordinate resolution
- ix. Monitoring centralized pattern distribution (live update) and scan for deficiencies
- x. Maintaining secure domain policies
- xi. Secured IPsec/SSL/TLS based virtual private network (VPN) management
- xii. Performing firewall management and review of policies on atleast quarterly basis during first year of O&M and then after atleast on half-yearly basis
- xiii. Resolution of calls for security notifications, system alerts, vulnerabilities in hardware/software and alerting NRDA as appropriate
- xiv. Performing patch management using software distribution tool for all security applications including content management system, antivirus and VPN
- xv. Providing root cause analysis for all defined problems including hacking attempts
- xvi. Monthly reporting on security breaches and attempts plus the action taken to thwart the same and providing the same to NRDA
- xvii. Maintaining documentation of security component details including architecture diagram, policies and configurations
- xviii. Performing periodic review of security configurations for inconsistencies and redundancies against security policy
- xix. Performing periodic review of security policy and suggest improvements
- xx. Reviewing logs daily of significance such as abnormal traffic, unauthorized penetration attempts, any sign of potential vulnerability. Security alerts and responses. Proactive measures in the event a problem is detected
- xxi. Policy management (firewall users, rules, hosts, access controls, daily adaptations)
- xxii. Modifying security policy, routing table and protocols
- xxiii. Performing zone management (DMZ)
- xxiv. Sensitizing users to security issues through regular updates or alerts - periodic updates/Help NRDA issuance of mailers in this regard
- xxv. Performing capacity management of security resources to meet business needs
- xxvi. Rapidly resolving every incident/problem within mutually agreed timelines
- xxvii. Testing and implementation of patches and upgrades
- xxviii. Network/device hardening procedure as per security guidelines from NRDA
- xxix. Implementing and maintaining security rules
- xxx. Performing any other day-to-day administration and support activities

i. Other Activities

- i. MSI shall ensure that it prepares configuration manual for OS, appliances, middleware, all tool, servers/devices and all equipment's and the same need to be submitted to NRDA, any changes in the configuration manual need to be approved by NRDA. Configuration manual to be updated periodically.
- ii. MSI shall maintain data regarding entitlement for software upgrades, enhancements, refreshes, replacements and maintenance.
- iii. If the Operating System or additional copies of Operating System are required to be installed/reinstalled/un-installed, the same should be done as part of O&M.
- iv. MSI should carry out any requisite adjustments/changes in the configuration for implementing different versions of Application Software.
- v. Updates/Upgrades/New releases/new versions: The MSI shall provide from time to time the Updates/Upgrades/new releases/new versions of the software and operating systems as required. The MSI should provide free upgrades, updates & patches of the software and tools to NRDA as and when released by OEM.
- vi. MSI shall provide patches to the software as part of IT infrastructure, operating system, databases and other applications.
- vii. Software License Management: The MSI shall provide for software license management and control. MSI shall maintain data regarding entitlement for software updates, enhancements, refreshes, replacements, and maintenance.
- viii. Data backup/recovery management services
- ix. All other activities required to meet the project requirements and service levels.

It is responsibility of the MSI to scale up the Operations & Maintenance (O&M) team as and when required to ensure smooth project execution throughout the project duration.

2.6.8.5. Compliance to SLA

- i. MSI shall ensure compliance to uptime and performance requirements of project solution as indicated in the SLA table of RFP and any upgrades/major changes to the Smart City System shall be accordingly planned by MSI for ensuring the SLA requirements.
- ii. MSI shall be responsible for measurement of the SLAs at the Smart City System level as well as at the user level with the help of the enterprise monitoring tool on a periodic basis.
- iii. Reports for SLA measurement must be produced NRDA officials as per the project requirements.

2.7. Manpower deployment

MSI shall deploy Manpower during implementation and O&M phases. The deployed resource shall report to NRDA's Project In-charge for Smart City Project and work closely with Program Management Office of the project. Following are the minimum resources required to be deployed in the Project (Price should be quoted accordingly in commercial bid format), however MSI may deploy additional resources based on the need of the Project and to meet the defined SLAs in this RFP:

#	Type of Resource	Minimum Quantity	Minimum Deployment during Implementation phase	Minimum Deployment during Operation and Maintenance phase
1.	Program Manager	1	Atleast 80%	100%
2.	Citizen services/Municipal Domain expert	1	Atleast 60%	Onsite Support to Project team on need basis
3.	Solution Architect	1	Atleast 60%	Onsite Support to Project team on need basis
4.	Project Manager- Software	1	Atleast 80%	100%
5.	Project Manager – Infrastructure	1	Atleast 80%	100%
6.	Database Architect/DBA	1	Atleast 80%	100%
7.	Security Expert	1	Atleast 60%	Onsite Support to Project team on need basis
8.	Mobile App development Expert	1	Atleast 80%	100%
9.	Programmer	As required	As required	As required
10.	Business Analyst	2	100%	50%
11.	Quality Assurance/Testing	2	100%	50%
12.	Surveillance Expert	1	Atleast 40%	Onsite Support to Project team on need basis
13.	Water SCADA expert	1	Atleast 60%	Onsite Support to Project team on need basis
14.	Electrical SCADA expert	1	Atleast 60%	Onsite Support to Project team on need basis
15.	ITMS Expert	1	Atleast 40%	Onsite Support to Project team on need basis
16.	Command Centre Expert	1	Atleast 60%	100%
17.	IBMS expert	1	Atleast 50%	Onsite Support to Project team on need basis
18.	Help Desk team Member	3	NA	100%
19.	Technical Support Team Member	4	NA	100%
20.	CCC Operator	6	NA	100%
21.	NoC Operator	3	NA	100%
22.	BMS Operator	3	NA	100%
23.	GIS layer Updation team member	1	NA	100%

Note: MSI shall not replace any resource unless there are compelling circumstances like medical reason or discontinuation of service. Replacement shall be done after approval of NRDA.

2.8. Supporting Documents

The drawings and other information related to the scope of this assignment is provided in following annexures:

1. Annexure VIII-Approximate Distance of Naya Raipur Assets and Proposed camera from OFC Duct
2. Annexure IX: Water Supply and Distribution network and Existing & Proposed Instrumentation detail
3. Annexure X: Process & Instrument Diagram for WTP
4. Annexure XI: RMU Drawings
5. Annexure XII: HVAC Drawings for Paryavaas Bhawan
6. Annexure XIII: Command and Control Centre Layout
7. Annexure XIV: List of empanelled Service Providers

The CAD and PDF files of the above mentioned annexures is also provided to the Bidder with this RFP.

3. Exit Management

- a. This sets out the provisions, which will apply on expiry or termination of the Master Service Agreement, the Project Implementation, Operation and Management SLA.
- b. In the case of termination of the Project Implementation and/or Operation and Management, the Parties shall agree at that time whether, and if so during what period, the provisions of this Schedule shall apply.
- c. The Parties shall ensure that their respective associated entities carry out their respective obligations set out in this Exit Management Schedule.

3.1. Cooperation and Provision of Information

During the exit management period:

- a. The MSI will allow the *NRDA* or its nominated agency access to information reasonably required to define the then current mode of operation associated with the provision of the services to enable the *NRDA* to assess the existing services being delivered;
- b. Promptly on reasonable request by the *NRDA*, the MSI shall provide access to and copies of all information held or controlled by them which they have prepared or maintained in accordance with this agreement relating to any material aspect of the services (whether provided by the System integrator or sub-contractors appointed by the MSI). The *NRDA* shall be entitled to copy of all such information. Such information shall include details pertaining to the services rendered and other performance data. The MSI shall permit the *NRDA* or its nominated agencies to have reasonable access to its employees and facilities, to understand the methods of delivery of the services employed by the MSI and to assist appropriate knowledge transfer.

3.2. Confidential Information, Security and Data

- a. The MSI will promptly on the commencement of the exit management period supply to the *NRDA* or its nominated agency the following:
 - information relating to the current services rendered and customer and performance data relating to the performance of sub-contractors in relation to the services;
 - documentation relating to Intellectual Property Rights;
 - documentation relating to sub-contractors;
 - all current and updated data as is reasonably required for purposes of *NRDA* or its nominated agencies transitioning the services to its Replacement *MSI* in a readily available format nominated by the *NRDA*, its nominated agency;
 - all other information (including but not limited to documents, records and agreements) relating to the services reasonably necessary to enable *NRDA* or its nominated agencies, or its Replacement *MSI* to carry out due diligence in order to transition the provision of the Services to *NRDA* or its nominated agencies, or its Replacement *System integrator* (as the case may be).
- b. Before the expiry of the exit management period, the MSI shall deliver to the *NRDA* or its nominated agency all new or up-dated materials from the categories set out in Schedule above and shall not retain any copies thereof, except that the MSI shall be permitted to retain one copy of such materials for archival purposes only.

3.3. Employees

- a. Promptly on reasonable request at any time during the exit management period, the MSI shall, subject to applicable laws, restraints and regulations (including in particular those relating to privacy) provide to the NRDA or its nominated agency a list of all employees (with job titles) of the MSI dedicated to providing the services at the commencement of the exit management period.
- b. NRDA or Replacement MSI may make an offer of employment or contract for services to such employee of the MSI and the MSI shall not enforce or impose any contractual provision that would prevent any such employee from being hired by the NRDA or any Replacement MSI.

3.4. Transfer of Certain Agreements

On request by the *NRDA* or its nominated agency the *MSI* shall effect such assignments, transfers, licences and sub-licences *NRDA*, or its Replacement *MSI* in relation to any equipment lease, maintenance or service provision agreement between *MSI* and third party lessors, vendors, and which are related to the services and reasonably necessary for the carrying out of replacement services by the *NRDA* or its nominated agency or its Replacement *MSI*.

3.5. General Obligations of the MSI

- a. The MSI shall provide all such information as may reasonably be necessary to effect as seamless a handover as practicable in the circumstances to the NRDA or its nominated agency or its Replacement MSI and which the MSI has in its possession or control at any time during the exit management period.
- b. For the purposes of this Schedule, anything in the possession or control of any MSI, associated entity, or sub-contractor is deemed to be in the possession or control of the MSI.
- c. The MSI shall commit adequate resources to comply with its obligations under this Exit Management Schedule.

3.6. Exit Management Plan

- a. The *MSI* shall provide the *NRDA* or its nominated agency with a recommended exit management plan ("Exit Management Plan") which shall deal with at least the following aspects of exit management in relation to the MSA as a whole and in relation to the Project Implementation, and the Operation and Management SLA.
 - A detailed program of the transfer process that could be used in conjunction with a Replacement *MSI* including details of the means to be used to ensure continuing provision of the services throughout the transfer process or until the cessation of the services and of the management structure to be used during the transfer;
 - plans for the communication with such of the *MSI*'s sub-contractors, staff, suppliers, customers and any related third party as are necessary to avoid any material detrimental impact on the *NRDA*'s operations as a result of undertaking the transfer;
 - (if applicable) proposed arrangements for the segregation of the *MSI*'s networks from the networks employed by *NRDA* and identification of specific security tasks necessary at termination;
 - Plans for provision of contingent support to *NRDA*, and Replacement *MSI* for a reasonable period after transfer.

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- b. The MSI shall re-draft the Exit Management Plan annually thereafter to ensure that it is kept relevant and up to date.
 - c. Each Exit Management Plan shall be presented by the MSI to and approved by the NRDA or its nominated agencies.
 - d. The terms of payment as stated in the Terms of Payment Schedule include the costs of the MSI complying with its obligations under this Schedule.
 - e. In the event of termination or expiry of MSA, and Project Implementation, each Party shall comply with the Exit Management Plan.
 - f. During the exit management period, the MSI shall use its best efforts to deliver the services.
 - g. Payments during the Exit Management period shall be made in accordance with the Terms of Payment Schedule.
 - h. This Exit Management plan shall be furnished in writing to the NRDA or its nominated agencies within 90 days from the Effective Date of this Agreement.

4. Compliance to Standards & Certifications

- a. For a large and complex set up such as the Smart City System, it is imperative that the highest standards applicable are adhered to. In this context, the MSI will ensure that the entire Smart City System is developed in compliance with the applicable standards.
- b. During project duration, the MSI will ensure adherence to prescribed standards as provided below:

Sl. No.	Component/Application/System	Prescribed Standard
1.	Information Security	ISO 27001
2.	IT Infrastructure Management	ITIL specifications
3.	Service Management	ISO 20000 specifications
4.	Project Documentation	IEEE/ISO/CMMi (where applicable) specifications for documentation

- c. Apart from the above the MSI need to ensure compliance of the project with Government of India IT security guidelines including provisions of:
 - The Information Technology Act, 2000” and amendments thereof and
 - Guidelines and advisories for information security published by Cert-In/DeitY (Government of India) issued till the date of publishing of tender notice. Periodic changes in these guidelines during project duration need to be complied with.
- d. While writing the source code for application modules the MSI should ensure high-quality documentation standards to improve the readability of the software module. An illustrative list of comments that each module contained within the source file should be preceded by is outlined below:
 - The name of the module
 - The date when module was created
 - A description of what the module does
 - A list of the calling arguments, their types, and brief explanations of what they do
 - A list of required files and/or database tables needed by the module
 - Error codes/Exceptions
 - Operating System (OS) specific assumptions
 - A list of locally defined variables, their types, and how they are used
 - Modification history indicating who made modifications, when the modifications were made, and what was done.
- e. Apart from the above MSI needs to follow appropriate coding standards and guidelines inclusive of but not limited to the following while writing the source code -
 - Proper and consistent indentation
 - Inline comments
 - Structured programming

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- Meaningful variable names
 - Appropriate spacing
 - Declaration of variable names
 - Meaningful error messages
- f. Quality Audits
- NRDA, at its discretion, may also engage independent auditors to audit any/some/all standards/processes. The MSI shall support all such audits as per calendar agreed in advance. The result of the audit shall be shared with the MSI who has to provide an effective action plan for mitigations of observations/non-compliances, if any.

5. Project Management and Governance

5.1. Project Management Office (PMO)

A Project Management office will be set up during the start of the project. The PMO will, at the minimum, include a designated full time Project Manager from MSI. It will also include key persons from other relevant stakeholders including members of NRDA and other officials/representatives by invitation. The operational aspects of the PMO need to be handled by the MSI including maintaining weekly statuses, minutes of the meetings, weekly/monthly/project plans, etc.

PMO will meet formally on a weekly basis covering, at a minimum, the following agenda items:

- i. Project Progress
- ii. Delays, if any – Reasons thereof and ways to make-up lost time
- iii. Issues and concerns
- iv. Performance and SLA compliance reports;
- v. Unresolved and escalated issues;
- vi. Project risks and their proposed mitigation plan
- vii. Discussion on submitted deliverable
- viii. Timelines and anticipated delay in deliverable if any
- ix. Any other issues that either party wishes to add to the agenda.

During the development and implementation phase, there may be a need for more frequent meetings and the agenda would also include:

- i. Module development status
- ii. Testing results
- iii. IT infrastructure procurement and deployment status
- iv. Status of setting up/procuring of the Helpdesk, DC hosting
- v. Any other issues that either party wishes to add to the agenda.

Bidder shall recommend PMO structure for the project implementation phase and operations and maintenance phase.

5.2. Steering Committee

The Steering Committee will consist of senior stakeholders from NRDA, its nominated agencies and MSI. MSI will nominate its Smart City vertical head to be a part of the Project Steering Committee

The MSI shall participate in monthly Steering Committee meetings and update Steering Committee on Project progress, Risk parameters (if any), Resource deployment and plan, immediate tasks, and any obstacles in project. The Steering committee meeting will be a forum for seeking and getting approval for project decisions on major changes etc.

All relevant records of proceedings of Steering Committee should be maintained, updated, tracked and shared with the Steering Committee and Project Management Office by MSI.

During the development and implementation phase of the project, it is expected that there will be at least fortnightly Steering Committee meetings. During the O&M phase, the meetings will be held at least once a quarter.

Other than the planned meetings, in exceptional cases, NRDA may call for a Steering Committee meeting with prior notice to the MSI.

5.3. Project Monitoring and Reporting

The MSI shall circulate written progress reports at agreed intervals to NRDA and other stakeholders. Project status report shall include Progress against the Project Management Plan, status of all risks and issues, exceptions and issues along with recommended resolution etc.

Other than the planned meetings, in exceptional cases, project status meeting may be called with prior notice to the Bidder. NRDA reserves the right to ask the bidder for the project review reports other than the standard weekly review reports.

5.4. Risk and Issue management

The MSI shall develop a Risk Management Plan and shall identify, analyse and evaluate the project risks, and shall develop cost effective strategies and action plans to mitigate those risks.

The MSI shall carry out a Risk Assessment and document the Risk profile of NRDA based on the risk appetite and shall prepare and share the NRDA Enterprise Risk Register. The MSI shall develop an issues management procedure to identify, track, and resolve all issues confronting the project. The risk management plan and issue management procedure shall be done in consultation with NRDA.

The MSI shall monitor, report, and update the project risk profile. The risks should be discussed with NRDA and a mitigation plan be identified during the project review/status meetings. The Risk and Issue management should form an agenda for the Project Steering Committee meetings as and when required.

5.5. Staffing requirements

NRDA has identified certain key positions that should be part of MSI's team during execution. MSI shall provide resource deployment schedule including these key positions and other team members as mentioned in RFP Vol 2.

CVs of the key resources need to be submitted along with the proposal.

Please note that NRDA shall require that all project related discussion should happen in NRDA office. While the identified key personnel will operate out of NRDA's office, other key members of the development/Data Centre team may need to travel to NRDA office for critical Project/Steering Committee meetings at their own expenses.

5.6. Governance procedures

MSI shall document the agreed structures in a procedures manual.

5.7. Planning and Scheduling

The MSI will prepare a detailed schedule and plan for the entire project covering all tasks and sub tasks required for successful execution of the project. The MSI has to get the plan approved from NRDA at the start of the project and it should be updated every week to ensure tracking of the progress of the project.

The project plan should include the following:

1. The project break up into logical phases and sub-phases;
2. Activities making up the sub-phases and phases;
3. Components in each phase with milestones;
4. The milestone dates are decided by NRDA in this RFP. MSI cannot change any of the milestone completion dates. MSI can only propose the internal task deadlines while keeping the overall end dates the same. MSI may suggest improvement in project dates without changing the end dates of each activity.
5. Key milestones and deliverables along with their dates including those related to delivery and installation of hardware and software;
6. Start date and end date for each activity;
7. The dependencies among activities;
8. Resources to be assigned to each activity;
9. Dependency on NRDA

6. Change Management & Control

6.1. Change Orders / Alterations / Variations

- a. The MSI agrees that the requirements given in the Bidding Documents are minimum requirements and are only indicative. The vendor would need to etch out the details at the time of preparing the design document prior to actual implementation. It shall be the responsibility of the MSI to meet all the requirements of technical specifications contained in the RFP and any upward revisions and/or additions of quantities, specifications sizes given in the Bidding Documents required to be made during execution of the works, shall not constitute a change order and shall be carried out without a change order and shall be carried out without any time and cost effect to Purchaser.
- b. Further upward revisions and or additions required to make MSI's selected equipment and installation procedures to meet Bidding Documents requirements expressed and to make entire facilities safe, operable and as per specified codes and standards shall not constitute a change order and shall be carried out without any time and cost effect to Purchaser.
- c. Any upward revision and/or additions consequent to errors, omissions, ambiguities, discrepancies in the Bidding Documents which the MSI had not brought out to the Purchaser's notice in his bid shall not constitute a change order and such upward revisions and/or addition shall be carried out by MSI without any time and cost effect to Purchaser.

6.2. Change Order

- a. The Change Order will be initiated only in case (i) the Purchaser directs in writing the MSI to include any addition to the scope of work covered under this Contract or delete any part of the scope of the work under the Contract, (ii) MSI requests to delete any part of the work which will not adversely affect the operational capabilities of the facilities and if the deletions proposed are agreed to by the Purchaser and for which cost and time benefits shall be passed on to the Purchaser, (iii) the Purchaser directs in writing the MSI to incorporate changes or additions to the technical specifications already covered in the Contract.
- b. Any changes required by the Purchaser over and above the minimum requirements given in the specifications and drawings etc. included in the Bidding Documents before giving its approval to detailed design or Engineering requirements for complying with technical specifications and changes required to ensure systems compatibility and reliability for safe operation (As per codes, standards and recommended practices referred in the Bidding Documents) and trouble free operation shall not be construed to be change in the Scope of work under the Contract.
- c. Any change order as stated in Clause 2 a. comprising an alteration which involves change in the cost of the works (which sort of alteration is hereinafter called a "Variation") shall be the Subject of an amendment to the Contract by way of an increase or decrease in the schedule of Contract Prices and adjustment of the implementation schedule if any.
- d. If parties agree that the Contract does not contain applicable rates or that the said rates are inappropriate or the said rates are not precisely applicable to the variation in question, then the parties shall negotiate a revision of the Contract Price which shall represent the change in cost of the works caused by the Variations. Any change order shall be duly approved by the Purchaser in writing.

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- e. Within ten (10) working days of receiving the comments from the Purchaser or the drawings, specification, purchase requisitions and other documents submitted by the MSI for approval, the MSI shall respond in writing, which item(s) of the Comments is/are potential changes(s) in the Scope of work of the RFP document covered in the Contract and shall advise a date by which change order (if applicable) will be submitted to the Purchaser.

7. Testing and Acceptance Criteria

- a. MSI shall demonstrate the following mentioned acceptance criteria prior to acceptance of the solution as well as during project operations phase, in respect of scalability and performance etc. The MSI may propose further detailed Acceptance criteria which the NRDA will review. Once NRDA provides its approval, the Acceptance criteria can be finalized. In case required, parameters might be revised by NRDA in mutual agreement with bidder and the revised parameters shall be considered for acceptance criteria. A comprehensive system should be set up that would have the capability to log & track the testing results, upload & maintain the test cases and log & track issues/bugs identified.
- b. The following table depicts the details for the various kinds of testing envisaged for the project:

Type of Testing	Responsibility	Scope of Work
System Testing	MSI	<ol style="list-style-type: none"> MSI to perform System testing MSI to prepare test plan and test cases and maintain it. NRDA may request the MSI to share the test cases and results Should be performed through manual as well as automated methods Automation testing tools to be provided by MSI. NRDA doesn't intend to own these tools
Integration Testing	MSI	<ol style="list-style-type: none"> MSI to perform Integration testing MSI to prepare and share with NRDA the Integration test plans and test cases MSI to perform Integration testing as per the approved plan Integration testing to be performed through manual as well as automated methods Automation testing tools to be provided by MSI. NRDA doesn't intend to own these tools
Performance and load Testing	<ul style="list-style-type: none"> MSI NRDA / Third Party Auditor (to monitor the performance testing) 	<ol style="list-style-type: none"> MSI to do performance and load testing. Various performance parameters such as transaction response time, throughput, page loading time should be taken into account. Load and stress testing of the Smart City System to be performed on business transaction volume Test cases and test results to be shared with NRDA. Performance testing to be carried out in the exact same

		<p>architecture that would be set up for production.</p> <p>6. MSI need to use performance and load testing tool for testing. NRDA doesn't intend to own these tools.</p> <ul style="list-style-type: none"> NRDA if required, could involve third party auditors to monitor/validate the performance testing. Cost for such audits to be paid by NRDA.
<p>Security Testing (including Penetration and Vulnerability testing)</p>	<ul style="list-style-type: none"> MSI NRDA / Third Party Auditor (to monitor the security testing) 	<ol style="list-style-type: none"> The solution should demonstrate the compliance with security requirements as mentioned in the RFP including but not limited to security controls in the application, at the network layer, network, data centre(s), security monitoring system deployed by the MSI The solution shall pass vulnerability and penetration testing for rollout of each phase. The solution should pass web application security testing for the portal, mobile app and other systems and security configuration review of the infrastructure. MSI should carry out security and vulnerability testing on the developed solution. Security testing to be carried out in the exact same environment/architecture that would be set up for production. Security test report and test cases should be shared with NRDA Testing tools if required, to be provided by MSI. NRDA doesn't intend to own these tools During O&M phase, penetration testing to be conducted on yearly basis and vulnerability assessment to be conducted on half-yearly basis. <p>NRDA will also involve third party auditors to perform the audit/review/monitor the security testing carried out by MSI. Cost for such auditors to be paid by NRDA.</p>
<p>User Acceptance Testing of Smart City System</p>	<ul style="list-style-type: none"> NRDA or NRDA appointed third party auditor 	<ol style="list-style-type: none"> NRDA / NRDA appointed third party auditor to perform User Acceptance Testing MSI to prepare User Acceptance Testing test cases UAT to be carried out in the exact same environment/architecture that would be set up for production MSI should fix bugs and issues raised during UAT and get approval on the fixes from NRDA / third party auditor before production deployment

		5. Changes in the application as an outcome of UAT shall not be considered as Change Request. MSI has to rectify the observations.
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Note:

- a. Bidder needs to provide the details of the testing strategy and approach including details of intended tools/environment to be used by MSI for testing in its technical proposal. NRDA does not intend to own the tools.
- b. The MSI shall work in a manner to satisfy all the testing requirements and adhere to the testing strategy outlined. The MSI must ensure deployment of necessary resources and tools during the testing phases. The MSI shall perform the testing of the solution based on the approved test plan, document the results and shall fix the bugs found during the testing. It is the responsibility of MSI to ensure that the end product delivered by the MSI meets all the requirements specified in the RFP. The MSI shall take remedial action based on outcome of the tests.
- c. The MSI shall arrange for environments and tools for testing and for training as envisaged. Post Go-Live; the production environment should not be used for testing and training purpose. If any production data is used for testing, it should be masked and it should be protected. Detailed process in this regard including security requirement should be provided by the MSI in its technical proposal. The process will be finalized with the selected bidder.
- d. All the Third Party Auditors (TPA) as mentioned above will be appointed and paid by NRDA directly. All environments required for testing shall be provided by the MSI.
- e. STQC/Other agencies appointed by NRDA shall perform the role of TPA. MSI needs to engage with the TPA at the requirement formulation stage itself. This is important so that unnecessary re-work is avoided and the audit is completed in time. The audit needs to be completed before Go-Live of different phases. MSI needs to prepare and provide all requisite information/documents to third party auditor and ensure that there is no delay in overall schedule.
- f. The cost of rectification of non-compliances shall be borne by the MSI.

8. Annexure I - Service Level Agreement

8.1. Definitions

- a. Non-Working Days: All Sundays, 2nd & 3rd Saturdays and all Public Holidays declared by Government of Chhattisgarh.
- b. Business hours are defined from 10am to 6pm on all days except non-working days
- c. Days: All Working and Non-working days (365 days in a calendar year)
- d. 24*7 means three shifts of 8 hours every day. This is applicable for all seven days of the week without any non-working days
- e. “Scheduled Maintenance Time” shall mean the time that the System is not in service due to a scheduled activity as defined in this SLA. The scheduled maintenance time would not be during 16X7 (7:00 am to 11:00 pm) timeframe. Further, scheduled maintenance time is planned downtime taken after permission of NRDA.
- f. “Scheduled operation time” means the scheduled operating hours of the System for the month. All scheduled maintenance time on the system would be deducted from the total operation time for the month to give the scheduled operation time. The total operation time for the systems and applications will be 24X7X365 (per year).
- g. “System or Application downtime” means accumulated time during which the System is totally inoperable within the Scheduled Operation Time but outside the scheduled maintenance time and measured from the time a call is logged with the MSI of the failure or the failure is known to the MSI from the availability measurement tools to the time when the System is returned to proper operation.
- h. “Availability” means the time for which the services and facilities are available for conducting operations on the system including application and associated infrastructure. Availability is defined as: $\{(Scheduled\ Operation\ Time - System\ Downtime) / (Scheduled\ Operation\ Time)\} * 100\%$
- i. “Helpdesk Support” shall mean the support centre which shall handle Fault reporting, Trouble Ticketing and related enquiries during this contract. Helpdesk support is to be provided as per service window defined in this RFP.
- j. “Incident” refers to any event/abnormalities in the functioning of the any of IT Equipment/Services that may lead to disruption in normal operations of the Data Centre, System or Application services.
- k. Each penalty point is equivalent to 0.1% of the Equated Monthly Fee payable to the MSI by NRDA
- l. Equated Monthly Fee is defined as Total Fee Payable to the MSI by NRDA for O&M phase divided by 60 (months).

8.2. Interpretation & General Instructions

- a. During the initiation phase, the SLA parameters and metrics thereof would be established by NRDA in consultation with MSI and Third Party Agencies (appointed by NRDA), if any, which would be reviewed on an annual basis along with the Corrective Action & Preventive Action (CAPA) plan.
- b. During O&M phase, the SLA parameters shall be monitored on a monthly basis as per the individual SLA parameter requirements. In case the service levels cannot be achieved at service

levels defined in the tables below, it shall result in a breach of contract and shall invoke liquidated damages.

- c. Root cause analysis (RCA) should be prepared for all cases of breach in SLAs and shared with NRDA. For any exceptions or SLA breach beyond the control of the MSI, the MSI may submit the RCA along with a justification, which may be considered by NRDA. In case the RCA establishes that the breach on SLA was on account of services provided by the MSI under this Agreement, the MSI would be liable for the applicable penalty.
- d. For certain incidents, RCA may be carried out by NRDA (or NRDA appointed agency).
- e. Liquidated damages are mentioned as a percentage of certain components of cost:
 - For the Implementation Phase related Performance Levels (Section 8), the liquidated damages are capped at 5% of Total Cost of Bid as defined in the Commercial Bid Format of Vol 1 of the RFP.
 - During O&M phase, liquidated damages per quarter are capped at 0.5% of the total amount payable for O&M phase.
- f. If SLA penalty calculations exceed 15% of the quarterly payment for two consecutive quarters or 25% in any quarter, then NRDA may take appropriate action including termination of the contract and invoking the Performance Bank Guarantee.
- g. The MSI shall bring the necessary tools required to measure the SLA parameters mentioned in this Agreement. The MSI shall be generating monthly SLA reports to NRDA. NRDA may appoint a Third Party Agency to audit the performance, accuracy and integrity of the tools generating SLA data and also review the monthly SLA reports for SLA penalty computation.
- h. If the MSI is getting penalized on two or more parameters because of one incident, then the MSI may seek exemption from getting penalized on the parameters resulting in the least amount of penalty. NRDA may exercise its discretion in granting such exemptions.

The Service Level agreements have been logically segregated in the following categories:

1. Implementation Phase SLAs
2. Operations & Maintenance Phase SLAs
 - a. Applications
 - b. Field Equipment
 - c. Command Center and Data Center
 - d. Smart Network
 - e. Security
 - f. Helpdesk
 - g. Miscellaneous

8.3. Implementation Phase SLAs

The SLAs applicable during Implementation Stage are as given below:

The Penalty to be deducted for Sr no 3 (on Project Milestone) will be waived off/refunded in case Project Go live within defined timeline as per the final agreement.

#	SLA Parameter	Definition & Target	Service Level	Liquidated Damages
1.	Team mobilization and commencement of work	The MSI is expected to mobilize the team for commencement of work for this project within 15 days of issuance of Letter of Intent (LoI) Target: Complete Team Mobilization within 15 days	<=15 Days	Nil
			INR 1 Lakh per proposed resource not deployed for each week's delay or part thereof.	
2.	Replacement of proposed named resource (resources evaluated during technical bid evaluation)	The MSI is expected to deploy all the proposed named resources, the profiles of which have been evaluated as per technical evaluation criteria. No replacement of evaluated profiles is expected	0 replacement	Nil
			INR 2 Lakhs per replaced profile	
3.	Delay in any of the project milestones (M1 to M4) except Go-Live as agreed in the Project Plan	Measured as the difference between the planned date for the milestone and the actual date of its completion. Target: <=7 Days	<=7 Days	Nil
			0.25% of the respective milestone payment for each week's delay (beyond 7 days) or part thereof. <i>Note: The penalty amount, if any, on this account shall be withheld by NRDA and will either be:</i> <ul style="list-style-type: none"> • released to the MSI, if the MSI achieves the Go-Live milestone (M5) as per planned date. • adjusted against the total penalty leviable for breach of SLA # 4 in this table. 	
4.	Delay in overall project Go-Live date (M5)	Measured as the difference between the planned date for the milestone and the actual date of its completion. Target: <=15 Days	<=15 days	Nil
			0.5% of the Total Contract Value for each week delay (beyond 15 days) or part thereof	

Note:

In the event of circumstances beyond the control of the MSI, NRDA, at its sole discretion, may revise the target dates.

8.4. Operations and Maintenance Phase SLAs

Following SLAs are applicable at each quarter of Operation and Maintenance Phase of the Project tenure.

#	SLA Parameter	Definition & Target	Service Level	Penalty
High Critical Applications Availability				
1.	Availability of following High critical Applications and their related portals <ul style="list-style-type: none"> • Web Portal • Mobile Application • Land and Estate Management • Layout and Building Permission • Water and sewerage (Utility) Connection and Billing module • Property tax module • Licensing Module • Electrical SCADA • Water SCADA • Command and Control Centre (CCC) Application • Video management System • EMS 	Availability is defined as: $\{(Scheduled\ Operation\ Time - System\ Downtime) / (Scheduled\ Operation\ Time)\} * 100\%$ Target >= 99.5% measured 24x7 on monthly basis	Minimum 99.5% measured on a monthly basis For each application, 1 point per 1% drop in monthly availability (beyond 99.5%) or part thereof. Total points would be calculated by adding each application's points	Nil

	<ul style="list-style-type: none"> • NMS • BMS • Helpdesk Application 		
Less Critical Applications Availability			
2.	<p>Availability of other Applications and their related portals</p> <ul style="list-style-type: none"> • Asset Management • HRMS and ESS • Finance management • Dashboard, MIS 	<p>Availability is defined as: $\frac{\{(Scheduled\ Operation\ Time - System\ Downtime)\}}{(Scheduled\ Operation\ Time)} * 100\%$</p> <p>Target >= 99% measured 16x6 on monthly basis</p>	<p>>= 99% availability measured on a monthly basis</p> <p>Nil</p> <p>For each application, 0.5 point per 1% drop in monthly availability (beyond 99%) or part thereof.</p> <p>Total points would be calculated by adding each application's points</p>
Application Performance			
3.	<p>Percentage of transactions meeting the prescribed Response Time for Business Transactions for following applications:</p> <ul style="list-style-type: none"> • Web Portal • Mobile Application • Land and Estate Management • Layout and Building Permission • Water and sewerage (Utility) Connection and Billing 	<p>Response Time would be calculated as time elapsed between sending a request from client to server and receiving the response</p> <p>Response time of services to be measured at an interval of 30 minutes and averaged monthly on 24x7 basis</p> <p>Target >= 95% business transactions over internet to be completed within 4 seconds</p>	<p>For each application, 1 point per 1% drop in transactions not meeting the prescribed Response Time (beyond 95%) or part thereof.</p> <p>Total points would be calculated by adding each application's points</p>

	<ul style="list-style-type: none"> • module • Property tax module • Licensing Module • Helpdesk Application • Asset Management • HRMS and ESS • Finance management • Dashboard, MIS 		
4.	<p>Percentage of transactions meeting the prescribed Loading time for all pages for following web applications:</p> <ul style="list-style-type: none"> • Web Portal • Mobile Application • Land and Estate Management • Layout and Building Permission • Water and sewerage (Utility) Connection and Billing module • Property tax module • Licensing Module • Helpdesk Application • Asset 	<p>Average Loading Time for a web application would be calculated as average of times taken by all pages of an application to load over internet.</p> <p>Average loading time to be measured at an interval of 30 minutes and averaged monthly on 24x7 basis</p> <p>Target \geq 95% readings of Average Loading time per application to be within 3 seconds</p>	<p>For each application, 1 point per 1% drop in percentage of transactions not meeting prescribed Loading Time (beyond 95%) or part thereof.</p> <p>Total points would be calculated by adding each application's points</p>

	<p>Management</p> <ul style="list-style-type: none"> • HRMS and ESS • Finance management • Dashboard, MIS 			
Field Equipment				
5.	Uptime per camera (live feed available irrespective of network/power/etc issues)	<p>Measured as the percentage of time for which feed of each Camera is received at Data Center or Command Center. Uptime will be measured on 24X7 basis.</p> <p>Average Uptime = $\frac{((\text{Total Uptime}-\text{Planned downtime})-\text{Downtime}) * 100}{(\text{Total Uptime}-\text{Planned downtime})}$</p> <p>Target $\geq 99\%$</p>	<p>Uptime for each camera $\geq 99\%$</p>	<p>Nil</p>
			<p>For each camera, 0.5 point per 1% slippage in uptime (beyond 99%) or part thereof.</p> <p>Total points would be calculated by adding each camera's points</p>	
6.	Quality of Video feeds (Bad feeds due to Video Jitter)	<p>Measured as the percentage of video feed received in good quality Quality of video feed measured at an interval of 1 hour on 24x7 basis.</p> <p>Average Quality = $\frac{((\text{Camera Uptime}-\text{Camera Planned downtime})-\text{Bad feed Duration}) * 100}{(\text{Camera Uptime}-\text{Camera Planned downtime})}$</p> <p>Target $\geq 99\%$</p>	<p>Percentage of Quality Video Feed for each camera $\geq 99\%$</p>	<p>Nil</p>
			<p>For each camera, 0.5 point per 1% slippage in percentage of quality video feed (beyond 99%) or part thereof.</p> <p>Total points would be calculated by adding each camera's points</p>	
7.	Uptime per Speed detection device (available irrespective of network/power/etc issues)	<p>Measured as the percentage of time each of the speed detection device is up and running. Uptime of the equipment will be measured on 24X7 basis.</p> <p>Average Uptime = $\frac{((\text{Total Uptime}-\text{Planned downtime})-\text{Downtime}) * 100}{(\text{Total Uptime}-\text{Planned downtime})}$</p> <p>Target $\geq 99\%$</p>	<p>Uptime for each device $\geq 99\%$</p>	<p>Nil</p>
			<p>For each device, 0.5 point per 1% slippage in uptime (beyond 99%) or part thereof.</p> <p>Total points would be calculated by adding each device's points</p>	

8.	Video stream Latency	Latency refers to the average time required for transmission of video feed from Camera location to the Command Centre / Data Center Target <=40ms	<=40ms per camera	Nil
			For each camera, 0.5 point per 10ms slippage in Video Stream Latency (beyond 40ms) or part thereof. Total points would be calculated by adding each camera's points	
9.	Availability of RTUs/FRTUs/PLCs	Measured as the percentage of time each of the PLC/RTU/FRTU is up and running. Uptime of the equipment will be measured on 24X7 basis. Average Uptime = (((Total Uptime-Planned downtime)-Downtime)*100)/ (Total Uptime-Planned downtime) Target >= 99%	>= 99% for each device	Nil
			For each device (FTU/RTU/PLC), 0.5 point per 1 % drop in availability (beyond 99%) or part thereof. Total points would be calculated by adding each device's points	
10.	Availability of sensors <ul style="list-style-type: none"> • DFMD • HHMD • Access control device • Air Differential Pressure switch for fans & AHU Filter • Temperature sensor • Duct Static Pressure sensor • Air Velocity sensor • Water Hardness Analyzer • TDS Meter etc 	Measured as the percentage of time each of the sensors is up and running. Uptime of the equipment will be measured on 24X7 basis. Average Uptime = (((Total Uptime-Planned downtime)-Downtime)*100)/ (Total Uptime-Planned downtime) Target = 100%	100%	Nil
			For each device (HHMD/DFMD/Access Control Device), 0.25 point per 1 % drop in availability or part thereof. Total points would be calculated by adding each device's points	
Command Center and Data Center				

11.	Uptime of Monitoring workstations /video wall/servers / storage / network devices /other Data Center Equipment Note: For calculation of this SLA, in case of equipment implemented in cluster/HA, the cluster/HA will be counted as one unit.	Measured as the percentage of time each device is up and running on monthly basis. Uptime of the equipment will be measured on 24X7 basis. Uptime = (((Total Uptime-Planned downtime)-Downtime)*100)/ (Total Uptime-Planned downtime) Target ≥ 99.9	$\geq 99.9\%$ for each workstation	Nil
			For each device, 1 point per 1 % drop in uptime or part thereof. Total points would be calculated by adding each device's points	
12.	Peak CPU Utilization for servers installed at the Data Center	Peak CPU utilization of server crossing 60% for a sustained period of more than 1 hour is the criteria for default Penalty percentage for this measurement shall be a multiple of number of occurrences of above event in the quarter. Target = 0 occurrence	0 occurrence	Nil
			1 point for each occurrence of default	
Smart Network				
13.	Availability of network links	Measured as the percentage of time each link is up on a monthly basis. Availability of the network link will be measured on 24X7 basis. Availability = (((Total Uptime-Planned downtime)-Downtime)*100)/ (Total Uptime-Planned downtime) Target $\geq 99.9\%$	$\geq 99.9\%$ for each link	Nil
			For each link (except for Data Center and Command Center links), 0.25 point per 1 % drop in availability or part thereof. For Command Center and Data Center Links, 5 points per 1% drop in availability or part thereof Total points would be calculated by adding each link's points	

14.	Network Device Uptime	Measured as the percentage of time each of the Active Network device (switch and router) is up and running on a monthly basis. Uptime of the equipment will be measured on 24X7 basis. Average Uptime = $\frac{((\text{Total Uptime}-\text{Planned downtime})-\text{Downtime}) * 100}{(\text{Total Uptime}-\text{Planned downtime})}$ Target $\geq 99.9\%$	$\geq 99.9\%$ for each device	Nil
			For each device, 0.5 point per 1 % drop in availability or part thereof. Total points would be calculated by adding each device's points	
15.	Network Link Latency	Measured as average time required to transmit data packets to the Data Center from a network node. Latency of each link to be measured on 24x7 basis Target $\leq 10\text{ms}$ for each link	$\leq 10\text{ms}$ for each link	Nil
			For each link, 0.25 point per 10ms addition of link latency or part thereof. Total points would be calculated by adding each link's points	
16.	Average Packet Drops	Measured as dropped packets as a percentage of total packets transmitted on a monthly basis. Target $\leq 1\%$ for each link	$\leq 1\%$ for each link	1%
			For each link, 0.25 point per 0.5% increase of packet drops or part thereof. Total points would be calculated by adding each link's points	
Security				
17.	Security reporting	Quarterly Security report to be submitted on quarterly basis within pre-defined timelines 100% reporting of the security KPI's (defined during project start) Target: 100% on time reporting	On time	Nil
			1 point per 5 days of delay in submission of Quarterly Security Report	
18.	Patch updates	Availability of latest patches	$\geq 98\%$	Nil

		<p>on the system components.</p> <p>Target: All patches released, to be installed on at least 98% of all applicable components within 7 days of patch release</p>	10 points per 1% slippage in the criteria	
19.	Anti-virus (AV) signature update	<p>Availability of latest AV signature on the system components.</p> <p>Target: Latest AV signature to be installed on at least 98% of all applicable within 24 hours.</p>	>=98%	Nil
			10 points per 1% slippage in the criteria	
20.	Vulnerability assessment and closure	<p>Vulnerability Assessment for all systems / sub systems / network devices shall be performed once every six months and all detected vulnerabilities closed within the cycle.</p> <p>Target: No delay</p> <p>Note: NRDA may appoint a Third Party Agency to conduct Vulnerability Assessment</p>	<=10 days	Nil
			For each vulnerability, 1 point per 5 days of delay in closure of vulnerability	
21.	Penetration testing	<p>Penetration Testing (external) will be conducted once every year. All detected vulnerabilities to be closed within the year.</p> <p>Note: NRDA may appoint a Third Party Agency to conduct Penetration Testing</p>	<=10 days	Nil
			For each vulnerability, 1 point per 5 days of delay in closure of vulnerability	

Helpdesk

Under this SLA, incidents related to all Smart City Components contained in the RFP shall be covered.

#	SLA Parameter	Definition & Target	Service Level	Severity Level
1.	Availability of Toll - Free Lines at Help Desk Location	<p>Uptime = $\{1 - [(Toll\ Free\ Line\ downtime) / (Total\ Time)]\}$</p> <p>Total Time shall be measured on 24*7 basis</p> <p>Downtime shall be measured from the time the Toll Free Line at a help desk becomes unavailable to the respective users to the time it becomes available</p> <p>Target: Minimum 95 % up time measured on a Monthly basis per toll-free line</p>	100% of the toll-free lines should meet the Target	Nil
			<p>For each toll-free line, 1 point per drop of 1% in performance below 95%</p> <p>Total points would be calculated by adding points of each line.</p>	
2.	Helpdesk ticket/ Incident Response time	<p>Average Time taken to acknowledge and respond once a ticket/incident is logged through one of the agreed channels. This is calculated for all tickets/incidents reported within the reporting month (24x7x365).</p> <p>Target: 95% of the tickets must be responded to within 30 Minutes of receipt</p>	100% within the defined target	Nil
			<p>For each additional drop of 1% in performance below 95%, liquidated damages of 1% will be levied as additional liquidated damages.</p>	
3.	Time to Resolve – Severity 1	<p>Time taken to resolve the reported problem.</p> <p>Target: 100% of the incidents should be resolved within 2 hours of problem reporting</p>	100% within the defined target	Nil
			<p>For each incident not resolved within 2 hours , 1 point for each 30 minutes delay beyond 2 hours</p> <p>The points for all incidents would be added to calculate total penalty points under this criteria</p>	
4.	Time to Resolve – Severity 2	<p>Time taken to resolve the reported problem.</p> <p>Target: 100% of the incidents should be resolved within 8 hours of problem reporting</p>	100% within the defined target	Nil
			<p>For each incident not resolved within 8 hours , 0.5 point for each 2 hours delay beyond 8 hours</p>	

#	SLA Parameter	Definition & Target	Service Level	Severity Level
			The points for all incidents would be added to calculate total penalty points under this criteria	
5.	Time to Resolve – Severity 3	Time taken to resolve the reported problem. Target: 100% of the incidents should be resolved within 24 hours of problem reporting	100% within the defined target	Nil
			For each incident not resolved within 24 hours , 0.25 point for each 8 hours delay beyond 24 hours The points for all incidents would be added to calculate total penalty points under this criteria	
6.	Percentage of reopened incidents	For all incidents which are designated resolved by the SI, but are re-opened by the client. This is calculated for all incidents reported within the quarter. Target: <= 2%	<=2% incidents	Nil
			1 point for each additional 1% of reopened incidents beyond 2%	
7.	Submission of Root Cause Analysis (RCA) reports	For all Level 1 Severity incidents resolved during the quarter, SI to submit RCA reports. Target: Average within 5 Working days	<=5 Working days	Nil
			For each RCA not submitted within 5 days, 1 point per 5 day delay beyond initial 5 days	

Miscellaneous

#	SLA Parameter	Definition & Target	Service Level	Severity Level
1.	Resource availability: For all Resources mentioned in Section 2.7 of the volume II of RFP.	No. of shift hours for which resource present at the all designated locations / Total no. of shift hours	99% averaged over all resources designated for SI services and calculated on a monthly basis	Nil
			10 points for every 1% drop in resource availability beyond 99%	
2.	Submission of monthly, quarterly reports	Refer Sections 2.3.2 and 2.6 Target: 100% adherence to	=100% adherence	Nil
			<100% adherence	2 points per

#	SLA Parameter	Definition & Target	Service Level	Severity Level
		timelines		report not submitted within timelines

Note: There will be SLA holiday of 3 months from the date of Go Live.

9. Annexure II-Functional, Non-Functional and Technical Requirements

I. Smart Governance (Application) including Common Portal and Mobile Application

The Smart Governance Application is the one of the most critical component for current scope of the project. The details on final reference architecture for the Application have been provided in the functional requirement section of this volume in addition to generic requirements. The modules to be developed for the Smart Governance Application are:

Sr No	Modules
Development Functions:	
1.	GIS based Land and Estate Management
2.	Rehabilitation Module
3.	Building Permission module
Municipal Functions	
4.	Property tax module
5.	Utilities module-Water and Sewage connection and billing
6.	License department module
Core ERP	
7.	HRMS
8.	Payroll
9.	Asset Management system
10.	Finance and Accounting
Integration	
11.	Integration with eDistrict, Town and country planning application
12.	Integration with existing mailing solution (for email notifications).
13.	Integration with SMS Gateway
14.	Integration with Banks for Online Payment
15.	Integration with Social Media Applications (Facebook and Twitter)

The modules will be accessible to the users through the City Web portal and City Mobile application. The portal and smart governance Application will be hosted in State Data centre (or on cloud (optional)). The list of modules required to be accessible on Portal and Mobile application is mentioned in below:

Module/ Services	Access Mode/channel for			
	Service Request	Service Processing	Service Delivery	Status tracking
Land and Estate Management	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	<ul style="list-style-type: none"> • Web Portal 	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	<ul style="list-style-type: none"> • Web Portal • Mobile Application
Building Permission module	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	<ul style="list-style-type: none"> • Web Portal 	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	<ul style="list-style-type: none"> • Web Portal • Mobile Application
Utilities module-Property tax, Water and Sewage connection and billing	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	<ul style="list-style-type: none"> • Web Portal 	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	<ul style="list-style-type: none"> • Web Portal • Mobile Application
License department module	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	<ul style="list-style-type: none"> • Web Portal • Mobile Application
HR and ESS	Web Portal	Web Portal	Web Portal	Web Portal
Payroll	Web Portal	Web Portal	Web Portal	Web Portal
Asset Management system	Web Portal	Web Portal	Web Portal	Web Portal
Finance and Account Management	Web Portal	Web Portal	Web Portal	Web Portal
Utility bill payment service	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	On Line department system	On Line department system	<ul style="list-style-type: none"> • Web Portal • Mobile Application
E-District services-Birth, Death and Marriage registration, Shop license, Trade license etc.	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	On Line department system	On Line department system	<ul style="list-style-type: none"> • Web Portal • Mobile Application
Town and country planning application	<ul style="list-style-type: none"> • Web Portal • Mobile Application 	On Line department system	On Line department system	<ul style="list-style-type: none"> • Web Portal • Mobile Application

MSI may propose any COTS product for these modules or can develop it bespoke. The Web Portal and Mobile Applications shall comply with all industry standards and manage access and identity management, Single sign-on etc.

A sandbox environment shall be created with access to public data that will allow entrepreneurs/individuals/other agencies to develop Mobile applications for public use.

Module wise functional requirement are mentioned below:

Sr #	Requirements
General Requirement	
1.	<p>The system should have minimum of the following:</p> <ul style="list-style-type: none"> • The Modules specified above, will be developed afresh based on approved requirement. • Apart from this some services are already developed/under development phase by the specific department, such services will be integrated with the Smart City System. These service will be processed through department specific Application in backend. • The user of citizen services should be given a choice to interact with the system in Hindi in addition to English. The application should provision for uniform user experience across the multi lingual functionality covering following aspects: <ul style="list-style-type: none"> ○ Front end web portal in English and local language ○ E-forms (Labels & Data entry in local languages). Data entry should be provided preferably using the Enhanced Inscript standard (based on Unicode version 6.0 or later) keyboard layout with option for floating keyboard. ○ Storage of entered data in local language using UNICODE (version 6.0 or later) encoding standard. ○ Retrieval & display in local language across all user interfaces, forms and reports with all browsers compliant with Unicode version 6.0 and above. ○ Facility for bilingual printing (English and the local language) ○ Sakal Bharti font (compliant to UNICODE version 6.0) to be used for local language data and content. Latest version of the font is available on www.ildc.in • Application should have a generic workflow engine for citizen centric services. This generic workflow engine will allow easy creation of workflow for new services. At the minimum, the workflow engine should have the following features : <ul style="list-style-type: none"> ○ Feature to use the master data for the auto-populating the forms and dropdowns ○ Creation of application form, by “drag & drop” feature using meta data standards <ul style="list-style-type: none"> i. Defining the workflow for the approval of the form ii. First in First out iii. Defining a citizen charter/delivery of service in a time bound manner ○ Creation of the “output” of the service, i.e. Certificate, Order etc. ○ Reports • MSI shall ensure using Digital signatures/eAuthentication(Aadhar Based) to authenticate approvals of service requests etc. • The Smart City Application should have roadmap to integrate with key initiatives of NRDA. • Complete mobile enablement of the Smart City System • Citizen services should be available from Web Portal/Mobile application/ Lok sewa Kendra and other kiosks appointed by NRDA. • Creating self-logins for Citizens and availing services online from Web Portal. • Creating log-ins of various organizations associated with NRDA (Hospitals, Engineers, Architects, Advocates). • SMS and Email notifications at every major stage of the Service.

Sr #	Requirements
	<ul style="list-style-type: none"> • Facility to pay online via payment gateway, or offline at Bank or Kiosk counter. • Facility to upload scanned documents, images, maps as relevant for the application. • Verification of uploaded documents by authorities and informing the confirmation/ discrepancy in documents if any. • Approval/ Rejection of the application. • Facility to digitally sign and authorize the final approval letters where relevant. • Citizen Dashboard giving details of services applied with the status of the same. • Department dashboard giving details of Applications/ work pending for a User.
Web Portal Requirement	
1.	The web will be main channel to access NRDA services and it should be possible to offer citizens these services through any device incorporating Internet access. Web portal will be the single window for the outside world to interact with the NRDA online.
2.	<p>NRDA will utilize portal to:</p> <p>Deliver public services to citizens, businesses, and other governments Engage with citizens through the use of social media, online communities elsewhere on the Web. Enable users/partners to retrieve and manipulate government provided data.</p>
3.	Various services will be accessed and delivered through the secure web portal. Web portal will have departmental links for detailed information. Using the web portal citizen can pay the taxes, apply for certificates, licenses and launch a complaint and many more other activity.
4.	<p>The Web portal of NRDA shall have minimum of following sections in the portal:</p> <ul style="list-style-type: none"> • Message from Mayor, CEO • Vision, Mission, Objectives of NRDA • Link to various sub-sections <ul style="list-style-type: none"> ○ City Information ○ Online Services ○ About NRDA ○ Projects • Opinion Poll • Citizen Charter • Photo Gallery • Tenders • FAQ's • Emergency Information • Feedback • Contact Us
5.	User Interface (UI) and access functionalities for the Citizen/Business and the government authorities should be different in the Portal
6.	<p>External Users: Non NRDA users like citizen and business community will have to register themselves in the Portal while providing their personal, demographic and local address proof and other details. System will register these applicants as authorized Non NRDA users after necessary approval(if required) by concerned authority. The registered Non NRDA user can use all 'Online Services'. Such users will be able to able to avail following services through the Portal:</p> <ul style="list-style-type: none"> • Apply for services like certificates, licenses, new connections etc using Online/Pseudo Online

Sr #	Requirements
	<p>forms</p> <ul style="list-style-type: none"> • Create digital locker to store the soft copy of documents online. • All generated certificate, license etc will get store in digital locker in chronological order. • Pay taxes, bill online, get copy of receipts, dues etc. • Participate in government online engagement programs/initiatives like providing suggestions on policy, Web chat etc.
7.	Internal Users: NRDA users from various sections
Mobile Application	
1.	Mobile enablement framework will be deployed for NRDA Smart city, which deals with both rendering the web pages in mobile devices through necessary UI components as well as making mobile apps for leading mobile platforms such as Android, iOS, Windows.
2.	The mobile apps will be capable of offline data capture and can be installed and used by all the citizens as well as government officials. All Citizen/Business and the Government specific services will be accessible to users based on authorization.
3.	<p>Should have capability of capturing various documents/images while performing the site inspection and survey.</p> <ul style="list-style-type: none"> a. Image compression, B/w conversion from color images b. Multiple page document capture d. Auto cropping, Auto orientation, perspective correction, geo capture e. Image capture setting (camera resolution, image type)
Document Management system	
1.	All departments of NRDA and employee should have an access of this module. The system should be linked with all Smart Governance applications where there is a functionality to upload while processing and submission of application. It should also aid users to refer any document while sanctioning the layout plan etc.
2.	<p>The DMS will facilitate the system to maintain the details/report about, Document creation date, creator name, access rights, subject, description, department details etc. DMS should have capability of:</p> <ul style="list-style-type: none"> • Categorization of documents in folders-subfolders • Document Version Management • Extensive document and folder level operation such as move / copy, email, download, delete • Repository should be format agnostic which can archive documents of any format • Indexing of the documents on user defined parameters • - Association of the key words with the documents

Sr #	Requirements
3.	<p>The system should have minimum of the following:</p> <ul style="list-style-type: none"> • Assign unique id to every document uploaded • Have the facility to create, store, view and update the document. • Have the facility to assign the view and edit rights for existing document by the creator • Have the facility to scan upload the documents • Have the facility to index the submitted documents for referencing the file no and transactions • Store the index such that data can be easily converted into logical file/ set • Have the facility to store different pages of the document as a single set. It should assign the image no to the pages of the single document. However system should be able to retrieve the complete document as a single set. • Assign note and annotation to the uploaded document for further reference of any other documents if required • Allow the documents to be referenced to the concerned file number • Have the facility of archiving the document with time and date stamp • Have the facility to import and export email, print and encrypt the document • Have the facility to group the documents in a docket and unique id should be assigned to the docket • Have the facility to manage the version of the documents and dockets by means of time, user and date stamps • Allow the user to search information (within document) by keying keywords, and page no#. • Have the search facility to locate documents or Folders • Have the combined search facility on Profile, Indexed and Full Text • Have the facility to search document or folder profile information such as name, created, modified or accessed times, keywords, owner etc. • Support the view of thumbnails for the pages in the documents • Maintain extensive Audit-trails at user and folder levels. • Maintain Audit trails on separate actions, and between specific date/times • Document Repository for managing information • Organizing documents into hierarchical storage like Folders and Subfolders for management and classification of information • Provide easy filing and indexing for quick retrieval
Geographical Information System (GIS) Platform	
1.	<p>Geographical Information System (GIS) is for management, analysing and displaying data of all areas within Naya Raipur which are spatially referenced to earth for efficient and effective decision making, spatial planning, management of crisis/disasters and for monitoring of normal circumstances, thus providing an important tool to respond faster to incidents or even avert certain incidents</p> <p>Currently NRDA has agreement with National Remote Sensing Centre (NRSC) for following:</p> <ul style="list-style-type: none"> • Development of Portal for Visualization of data • Hosting of Satellite data and Existing Geospatial databases on the Portal • Geospatial database creation, Updating, Editing and Uploading on to the Portal • Development of GIS functionalities for Querying and Analysis • Development of Modules and tools for Planning, Monitoring, Municipal and Civic services

Sr #	Requirements						
	<ul style="list-style-type: none"> Integration of portal with the existing MIS of Land Management System Development of Mobile application for collection of field data and live uploading & Visualization on the web portal. Training and Capacity Building of NRDA officials <p>This existing portal and existing GIS layer has to be utilised for Smart City GIS platform.</p>						
2.	GIS platform is intended to provide common GIS capability to all other systems being deployed as part of Naya Raipur Smart City initiative. The objective of architecting a common GIS layer is to keep a single repository of all GIS data for easy maintenance, avoid duplication and easy dissemination of information to all the dependent systems.						
3.	The dependent systems include Surveillance, Intelligent Transport Management and Utility Management Systems. More systems may be added in the future and therefore the GIS application should be able to integrate with such applications through standards based interfaces						
4.	The GIS platform would be importing a lot of existing data from various sources into most industry standard formats.						
5.	The GIS platform would also need to exchange data with a number of external applications and therefore should be capable of exporting data in most industry standard formats						
6.	<p>Functionality of GIS base application for various services:</p> <table border="1"> <thead> <tr> <th>Service</th> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>Property details (Management of detailed information regarding properties)</td> <td> <ul style="list-style-type: none"> Details of each property <ul style="list-style-type: none"> Use Type (residential, commercial, industrial, ancillary user, MIX, state government, Central Government, etc), Plot, plinth and built areas, Building type (Single/Multiple) Number of floor/units, no of car parks Type of structure –RCC, Load bearing Owner / Occupier Details Property Tax details – Integration with property tax module Service availability and details such as water connections (metered / un- metered), Size of connection, Sewerage facility, Telephones etc. Plot and building boundaries measurement Building height approximated to the nearest meter with number of floors. Building age, name, locality and street no. Inspection report. </td> <td> <ul style="list-style-type: none"> Properties paying tax Dangerous properties (depending on inspection report and building age) Area having particular(Residential/ Non residential) type of property Properties with particular type of construction Properties with number of stories and above Properties with age *** and above Properties involved in court cases Display properties as and when they are assessed for tax </td> </tr> </tbody> </table>	Service	Input	Output	Property details (Management of detailed information regarding properties)	<ul style="list-style-type: none"> Details of each property <ul style="list-style-type: none"> Use Type (residential, commercial, industrial, ancillary user, MIX, state government, Central Government, etc), Plot, plinth and built areas, Building type (Single/Multiple) Number of floor/units, no of car parks Type of structure –RCC, Load bearing Owner / Occupier Details Property Tax details – Integration with property tax module Service availability and details such as water connections (metered / un- metered), Size of connection, Sewerage facility, Telephones etc. Plot and building boundaries measurement Building height approximated to the nearest meter with number of floors. Building age, name, locality and street no. Inspection report. 	<ul style="list-style-type: none"> Properties paying tax Dangerous properties (depending on inspection report and building age) Area having particular(Residential/ Non residential) type of property Properties with particular type of construction Properties with number of stories and above Properties with age *** and above Properties involved in court cases Display properties as and when they are assessed for tax
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Sr #	Requirements		
		<ul style="list-style-type: none"> • Survey Number etc • Assessment code and Account number. • Ratable value of each property. • Date of assessment for each property. • Carpet area for each property. • Year wise rate of property taxes. • Arrears with action. • Gates/Entrance. • Tree/Bushes. • Cellular transmission antenna/ cabins/Solar Equipment / Rain Water harvesting. • Parameters pertaining to Building Proposal. 	
	Estate Management (Management of estates' information for NRDA)	<ul style="list-style-type: none"> • Municipal plot details • City survey number/ village details • Built up area, plinth area, floor wise details, use category, plot dimensions with margin, date of possession • Landmarks of plots with nature of land • Details of encroachment • Legal information of plots • Ready reckoner rates • Details of heritage structure and buffer • Slum details • Land and village zoning • Ward boundaries • Election wards 	<ul style="list-style-type: none"> • Urban/ rural/industrial etc slum. • Location of various type of land area • Information on vacant lands.
	Water supply including Water Bodies Water supply mains of all the dimensions up to water meter for every property Management	<ul style="list-style-type: none"> • Leakage rectification data • Data relating to existing public taps • Data relating to requests registered for additional taps. • Data relating to complaints received regarding unpotable water • Database for • Location of pumping station • Raw water mains Treatment plant built • Location and structural details of reservoir tanks including balancing tanks 	<ul style="list-style-type: none"> • Detection of spots where leakage in the pipes have occurred • Pipe line which exceeds *** number of leakage spots • Distribution of public taps in the suitable location to overcome the water problem. • Identifying the zones of intermixing of pipeline

Sr #	Requirements		
	<p>and future planning of Water works / supply</p> <p>Developing On line Complaint Redressal System</p>	<ul style="list-style-type: none"> • Location details of water sources • Location details of pump station and water bodies. 	<p>with sewage water</p> <ul style="list-style-type: none"> • Treatment for water during epidemics • Segregation of certain type of complaint area • Identifying nearest water line to tap the water • Distribution network • Shortest route from source to the pump station • Selection of the diameter of pipeline based on the population statistics of the area
	<p>Sewerage system: Collection, treatment and disposal of sewerage</p>	<ul style="list-style-type: none"> • Database for • Type of sewer, year laid • Details of pipe <ul style="list-style-type: none"> ○ Shape ○ Dimension ○ Material ○ Lining coating • Invert level • Details of manhole <ul style="list-style-type: none"> ○ Number ○ Location ○ Cover shape ○ Cover design ○ Lock provision ○ Hinge provision ○ Cover type ○ No of steps in manhole • Type of pumping station, and installed capacity • Sub main sewers • Centre to centre distance from upstream manhole and from downstream manholes • House service connection • The diameter, age, material and condition of pipe, length of pipeline, slope of pipeline • Maintenance record (location, no of people involved in the process, nature of job etc) 	<ul style="list-style-type: none"> • Position of manholes including depth and size • Pipelines with select material of construction • Slippages in maintenance schedule • Position details of ventilation columns • Flow, capacity and current status of pumping mains • Affected area due to plugging of line • Sewer line trace

Sr #	Requirements	
		<ul style="list-style-type: none"> • Details of ventilation columns • Details of pumping arrangement • Details of sewerage treatment plant (layout, capacity)
	<p>Road and Traffic including Transportation (Bus stands, Taxi stands, Petrol Pumps) Maintenance of Roads of all the widths and all the types, bus stands, taxi stands and petrol pumps</p>	<ul style="list-style-type: none"> • Database for • Length and width of road • Year of construction and resurface of road • Resurfacing cycle • Central verge details of roads • Position of catch pit, water entrants and manholes • Road levels • Details of footpath, footpath surface details • Traffic island and signal details • Bridge details • Tree plantation details on road side • Partition details for heavy and light vehicle • Complaint record • Details of speed breaker • Details of Bus Stands • Location details • Bus route details • Intermediate bus stop locations for all the routes. • Alternate route details for every possible jams or emergency • Maintenance record Details of Petrol Pumps/Gas filling stations • Location details • Storage capacity of each petrol pump
Land and Estate Management		
1.	<p>Scope: The main role of this section/department is:</p> <ul style="list-style-type: none"> • Making proposals for acquiring land as per NRDA needs according to Land Acquisition Act. • Ensures transfers of land according • Surveys and maintains properties of NRDA • Allotment of property built on NRDA land. • Automation of the Land Acquisition process and its integration with GIS would allow the 	

Sr #	Requirements
	<p>department to monitor the process efficiently. Various departments involved will get the required data through workflow management system.</p>
2.	<p>Interfacing and Integration requirement:</p> <ul style="list-style-type: none"> • The Land and Estate management System be used in integration with GIS and Document Management Platform • The Module shall be required to be integrated with Property Tax, Building permission, Account and HRMS Modules
3.	<p>Functionality:</p> <ul style="list-style-type: none"> • The System shall allow user to create Proposal for Land Acquisition, enter/update Scrutiny of Land Details, enter/update Valuation of Land. • The System shall allow user of Planning Section to mark the land on Map and share the acquisition requirement to Land Section for procurement of land. • The System shall allow authorised citizen users to fills the application for land acquisition and submits the form in Smart City System • The system once submitted should be automatically marked to RI (Land) • System shall allow RI (Land) to draft the report of field visit. • RI put up comments in Smart City System and initiates approval process based on the work flow defined in application • System should allow Asst. Manager, Manager, GM to reviews application in Smart City System • Respective actor, logs into application with their • Goes to their work flow to see pending request login credentials • Reviews application and approves or seek additional information as next action along with their comments • Based on the user response, File is automatically marked to respective stakeholder for necessary further action • NRDA CEO reviews the file • After registry the system should direct the request to CEO to provide approval for check creation • System shall allow Finance to reviews the file for creation of Checks • System regularly calculates the annual annuity (of Rs 15000 per acre and Rs 750 incremental year on year per acre) to citizen whose land is procured. The System shall initiates request for electronic fund to citizen • System generate certificate to land owner on stamp duty waiver for 3 years of amount equivalent to the land purchase value • System shall allow Land Section to updates Smart City System with records of new registry and prints the certificate for citizens/applicants. • The System shall allow user of Estate Section performs the allotment of land in NRDA via auction, tender, Direct Negotiation and Invitation.

Sr #	Requirements
	<ul style="list-style-type: none"> • System shall allow user to maintain details of Possession of Land on GIS system with coordinates, both spatial and non-spatial data like boundary, ownership, Survey no. • System shall allow NRDA to identify land/plots/area to be sold. • System shall allow user to create advertisement in defined template for publishing in newspapers • System shall allow user to create NIT and tender document and integrate with States' EProcurement solution • System shall allow to user to create land allotment application form is created • Allow user (applicant) to apply for land allotment and ay fees online • Allow NRDA to conducts lottery through System. Results approval process to be initiated though automated workflow • RI shall be able to put up comments in Smart City System and initiates approval process based on the work flow defined in application • System shall allow Estate Naiab tehsildar/Estate manger/GM/CEO to reviews, Approve, send back/reject approval application in Smart City • User shall be able to updates records in Smart City System; reinitiate approval process • System shall allow CEO to initiates NRDA Chairman and BOD's approval process • Smart City System calculate shall be able to calculate premium amount to be deposited by allottee • System shall calculate rent Collection and allow user to pay the same • System shall generate defaulter list on payment or lease rent, issues notice • System shall update records is updated in Smart City System including GIS after every allotment • System shall allow creation and maintenance of database of the public infrastructure • System shall allow to create and update land use maps on GIS system • System shall allow transfer of Details to Concerned Department as a part of work flow for approvals. • System shall have facility for registered and unregistered user to check land ownership and other details. • System shall allow user to create and maintain record in the Estate Register like <ul style="list-style-type: none"> ○ Handover detail ○ Tenure detail ○ Rent detail ○ Payment status ○ Renewal of lease/ agreement ○ Maintenance record
4.	<p>MIS and dashboard requirement:</p> <p>The Module will generate following reports:</p>

Sr #	Requirements
	<ul style="list-style-type: none"> • NRDA Land Register details • Land Acquisition related reports • Revenue Reports for Estate on Rent/Lease • Outstanding Register for Estate on Rent/Lease • Top Defaulters List
Building Plan Approval Module	
1.	<p>Scope: Planning department is responsible for approving the development plan of Government and Private entities and providing construction approval. Currently the approval process is manual requiring several applications and several layers of approvals for clearances required at different stages.</p> <ul style="list-style-type: none"> • The Web Based application is expected to be an integrated application which can manage all aspects of approvals online and at the same time introduce transparency into the process.
2.	<p>Interfacing and Integration requirement:</p> <p>The module will be used in integration with GIS and Document Management Platform.</p> <ul style="list-style-type: none"> • The Module shall be required to be integrated with Property Tax, Land and Estate management system, Account Modules. • Integration with Airport Authority Online system for approval.
3.	<p>Functionality:</p> <ul style="list-style-type: none"> • General requirement • Registration of Technical persons like Architect and Engineer. Approval for such registrations. • Application for Development Plan (Layout Permission) <ul style="list-style-type: none"> ○ Capture details of multiple owners where relevant. ○ Usage type wise area ○ Other necessary information like area for parking, area kept for road widening. ○ Facility to upload maps in .dxf / .dwg format • Application for Building Permission (in case of permission for erection, re-erection or making material alteration) <ul style="list-style-type: none"> ○ Apply based on the reference id assigned at the time of approving development plan – establish link between development plan and building permission. ○ Capture relevant details like Usage type, plot width and length, plot area, location of the plot. ○ Integration with GIS to select the road on which permission is applied for. ○ Validate basic parameters like height of the building based on road width • Occupancy Certificate <ul style="list-style-type: none"> ○ Apply based on the reference id assigned at the time of approving development plan – establish link between development plan, building permission and occupancy certificate. • Revalidation of Building Permission • Revised Building Permission • Plinth Completion Certificate

Sr #	Requirements
	<ul style="list-style-type: none"> • NOC for Trade and Electricity • Department process for services <ul style="list-style-type: none"> ○ Verification of uploaded documents by Municipality and informing the confirmation/ discrepancy in documents if any. ○ Scrutiny of the applications as per the levels finalized by Municipality. ○ Accepting payments online/offline upon in-principal approval if required. ○ Approval/ Rejection of the application. ○ Sending interim letters informing discrepancies and asking for additional information/ document submission ○ Facility to digitally sign and authorize the final approval letters • Upload of existing technical person associated with the Municipality if data is available in digital format • Data entry of existing technical person associated with the Municipality if data is not available in digital format • Government Development Plan: • Allow users to identifies land to be developed by reviewing information of land to be developed based on the broadly marked area with khasra, GIS mapping through Smart City System • In case of no available information additional Information can be updated by concern sections related to Status of Land, ownership, Khasra no, Rakba, etc in Smart City System • Planning section will be able to creates the layout, based on info. received from various depts and uploads in Smart City System • Planning section seeks approval from various NRDA department like Land, Estate, Project and rehabilitation through automated application process • Land, Estate, Engineering and rehabilitation should be able to provide approval or seek further clarification on the plan through system. • Planning department will be able to update the respective information in the Smart City System for any clarification raised. • Allow user to seek NRDA CEO Approval, Board and Town and Country Planning dept through system • Development plan by Private entity • System will allow Private entity to submits plan for approval after necessary authorization (login creation etc); • Smart City system on receiving the application sent it to Planning, Estate, Projects & T&C planning for NoC approval simultaneously. • Planning department may ask for additional Information on Land use, development norms etc. through system • Estate department may ask for Information on ownership, pending dues, etc through system • Project department may ask for development and tender conditions • The Applicant can submit additional information through system for any clarification

Sr #	Requirements
	<p>raised by the individual department approval for NoC issuance</p> <ul style="list-style-type: none"> • Request moves for CEO Approval • Post CEO Approval, Smart City System generates NOC certificate • Private entity downloads the development plan approval certificate from Smart City System through his credentials • Building Plan approval • System allow Private entity to submit approval application through Smart City System along with pre-established Scrutiny cost; • A single combined application form to be developed to capture all details of the building proposal. The Combined Application form should cater to the following purpose: • Creation of Application <ul style="list-style-type: none"> ○ A common application form must be developed as a front face for the through web Portal and Mobile application to capture exhaustive information about the building proposal. This common application form will form the basis for all further workflow and processing ○ The applicant should be allowed to create an application with a temporary transaction number without having to submit the same. The applicant should be given the option of initiating certain NOCs prior to submitting the application to the Building Proposal department. Workflow for the same should be triggered accordingly. • Submission of Application <ul style="list-style-type: none"> ○ Submission of application should only generate transaction ○ The BP department sub engineer should have the option of selecting from a list of internal and external NOCs to which the application has to be sent. Once selected, a separate workflow should be generated for each of these NOC providing departments. An email/SMS notification should also be sent to them to notify them of this application. • Combined Scrutiny Fee Payment <ul style="list-style-type: none"> ○ Once the application is submitted, the combined scrutiny fee should be calculated and displayed for the user. The scrutiny fee structure will be provided by the BP department. Only once the fee is paid should the permanent proposal number be generated. Application will be considered to be submitted only after payment of scrutiny fees. • Document Upload <ul style="list-style-type: none"> ○ Each phase will need to have a section for uploading documents. An exhaustive list of documents required per phase will be provided by the department. The application should also provide flexibility to upload documents other than the ones asked for. • The documents uploaded by the applicant should be commonly available • Scrutiny officer visit site after receiving information and prepare report through system on-site inspection • System will allow Scrutiny Officer forward the approval for Construction, with Minor Changes/with Major Changes/No changes • The application which require changes is sent back to applicant to submit additional document with suggested changes • System will allow the Application with no changes to sent for Concerned officer approval who can provide approval or seek clarification through system.

Sr #	Requirements
	<ul style="list-style-type: none"> • After CEO approval the System calculate the difference of fees of Scrutiny and Labor cess based on the FAR • System will allow Private entity to pays the fees and other dues . • System will allow to generate Building Approval Certificate and revised map • System will allow Private entity to downloads the building approval certificate from Smart City System through his credentials • Occupation Certificate and Building Completion Certificate Module • This phase will form the last phase of the construction permit process. The phase should be initiated once the building completion certificate is submitted by the builder to the Sub-Engineer (BP). The applicant will also need to upload copies of compliance of various NOCs. The SE (BP) will mark the compliances to other departments as he may find necessary or as prescribed by rules.
4.	<p>MIS and dashboard requirement:</p> <ul style="list-style-type: none"> • The MIS module should be available NRDA Officials. The MIS module should be capable of producing various reports based on the following : • Builder Wise Details • Proposal wise details (Only proposals currently in progress i.e. between Application and OC) • NRDA officials should be able to get a quick overview of any proposal and its current status. This will help to track proposals, track remarks from various departments/officials and expedite approvals when required • Citizens should be able to track various building construction proposals as it will help them understand the current status of constructions which they are interested in. • Applicants/Developers/Architects should be able to track their applications and plan in advance for further activities that they may need to perform. • Develop an SLA system for the departments and for various phases along with the appropriate escalation mechanism.
Rehabilitation Module	
1.	<p>Scope: Rehabilitation section is responsible to make settlement of the affected family and individuals who are required to be shifted due to various development/construction activity of NRDA.</p>
2.	<p>Interfacing and Integration requirement:</p> <ul style="list-style-type: none"> • The module will be used in integration with GIS and Document Management Platform. • The module will be used in integration with Finance and Account module.
3.	<p>Functionality:</p> <ul style="list-style-type: none"> • System shall allow the Land Section to populate and shares the list of citizens whose land is acquired by NRDA and needs rehabilitation • System shall allow to capture following information of the affected land parcel owners: <ul style="list-style-type: none"> ○ Name ○ Khasra no

Sr #	Requirements
	<ul style="list-style-type: none"> ○ Rakba ○ Address (total no. of land from all villages) through Smart City System ● System shall pre-populate above information if already available in database ● System shall allow RI (Rehab) to prepare the list of applicants with required land for each application and their respective village; ● System shall allow capturing multiple preferences for preferred village in case multiple lands are being procured from villager. ● System shall allow user to initiate land allotment process ● System allow user to freezes the land requirement after completion of objection settlement ● System allow user to send request for details like map etc from planning section ● SMARTCITY application shall performs the lottery for allotment of land. Results are stored and same is moved for approval from various stakeholders through approval mechanism. ● System generate the allotment letters ● Performs necessary actions and updates records in Smart City System; reinstate approval process. <p>Rehabilitation of Individual</p> <ul style="list-style-type: none"> ● System allow the user to calculate the cost of rehabilitation based on the various scenario ● Based on the inputs provided by the user, SMARTCITY Application will calculate the cost and concerning provisions ● System allow user to initiates application processing ● System allow user to prepares draft report in Smart City System of field survey ● System allow user like GM (Admin) and CEO to approve the report ● System allow user to marks the land requirements and identifies the region on which required land needs to be provided ● System automatically allocates land based on requirement fetched, charts revised map. ● System generate allotment letter <p>Training requirement processing</p> <ul style="list-style-type: none"> ● System allow user to create Application for training program ● System allow user to review completeness of information in Smart City System ● System shall allow user to approve, reject or send back the request ● System shall allow to maintain list of panelled training provider ● System allow empanelled agencies to submits application for interest & proposal for conducting the training, ● System shall allow user to allocate the training to any of the interested empanelled training providers ● System shall generate the cost of training based on the agreed rates,

Sr #	Requirements
	<ul style="list-style-type: none"> • System shall maintain the detail of invoice raised by training agency • System should allow user to process the payment of training agencies and maintain the details of check issued.
4.	<p>MIS and dashboard requirement:</p> <ul style="list-style-type: none"> • Generate list of families rehabilitated • Generate list of individuals rehabilitated • Generate list of families objected • Generate details of acquired landwise details of original owner, property detail, address, location of rehabilitation allotted • Generate list of <ul style="list-style-type: none"> ○ Training request received ○ No of request cleared ○ No of request pending • Generate list of training agency <ul style="list-style-type: none"> ○ Empanelled ○ Training conducted ○ Payment invoice raised ○ Payment received • NRDA officials should be able to get a quick overview of any training request and its current status. This will help to track proposals, track remarks from various departments/officials and expedite approvals when required.
Water and Sewerage Connection and Billing	
1.	<p>Scope: The water supply department is involved with supplying of water from the reservoir to the consumer. The major responsibilities of the Water supply (distribution) department are:</p> <ul style="list-style-type: none"> • Issuance of new water connection • Water disconnection, Transfer • Billing & Collection • Plumber registration <p>The application module will be used to calculate size of Water Connection based on various parameters like pressure in source line, length of water connection, no. of families, etc. A workflow can be integrated in the application for online sanction and scrutiny of application.</p>
2.	<p>Interfacing and Integration requirement</p> <ul style="list-style-type: none"> • The module will be used in integration with GIS and Document Management Platform. • The Module shall be required to be integrated with Property Tax Module.
3.	<p>Functionality</p> <ul style="list-style-type: none"> • System shall allow registered user to apply for: <ul style="list-style-type: none"> ○ New water/sewage Connection ○ Closing of Connection (Permanent/Temporary) ○ Change of use ○ Reconnection

Sr #	Requirements
	<ul style="list-style-type: none"> ● Citizen Service: Application for New Water Connection <ul style="list-style-type: none"> ○ System should have downloadable version of application form on NRDA website ○ System should be able to provide list of documents needed to accept certain type of applications (new connections, disconnections etc) ○ System should have electronic forms to be filled online on NRDA website ○ System should have capability to upload attachments like proof of identity, ownership and affidavit of applicant etc while submitting the application form ○ System should direct the submission of keyed-in data and application forms to the authorized user (s) at Zonal level. Electronics forms should be segregated on the basis on zonal codes and directed towards the respective zone's officer. ○ System should generate a unique reference number for the customer to track application status ○ System should be able to take request of new connection through phone calls to Customer care group ○ System should schedule a representative to visit the applicant premises for collecting the application form and required documents ○ System should have the capability to scan and attach a new connections form to the workflow process in appropriate file format and must be compatible with scanners ○ System should generate a unique reference number for the customer to track application status ● Water Connection details given by Citizen: <ul style="list-style-type: none"> ○ Support Metered and non-metered connections ○ Capture details of multiple owners with Aadhar no. ○ Maintain details of usage, no. of families, no. of taps, connection size, plumber's name. ○ Billing address ○ Property no. for which connection is being applied for ● Water connection details given by department: <ul style="list-style-type: none"> ○ Distribution line, road digging details if any, meter make, meter no., initial reading, maximum reading supported, and installation date. ○ Details of security deposit if any ○ Generation of Work Order ● Citizen Service: Closing of connection (Disconnection) ● Citizen Service: Reconnection ● Citizen Service: Change of ownership ● Citizen Service: Change of usage ● Citizen Service: Issuance of Duplicate Water Bill. ● Citizen Service: No Due Certificate for arrears of water ● Citizen Service: Meter Testing ● Registration for Plumber. (New registration and Renewal of license) ● Meter reading entry <ul style="list-style-type: none"> ○ Capture and print meter reading picture on bill ○ Flexibility to capture meter reading at any instance irrespective of any fix reading schedule. ○ Facility to mark meter cut-off and restoration

Sr #	Requirements
	<ul style="list-style-type: none"> ○ Handle scenarios where meter reading is not possible – meter is not working, stolen, tampered and apply standardized rules for calculating consumption and billing. ● Meter reading data upload. ● Water Billing <ul style="list-style-type: none"> ○ Metered and non-metered billing. ○ Define billing schedule and billing cycles ○ Support fixed rates, slab-wise rates. ○ Support multiple tax/ charges ○ Consider advance payments, penalty/ interest, arrears and rebate on early payments, meter rent where applicable. ○ Facility to generate bill for one connection/ multiple connections ○ Pro rata Billing ● Collection – handling rebate on early payments. ● Support for integration with Hand-held device for collections ● Disputes registration and resolution ● Facility to upload existing water connection records and outstanding as on cut-off date that is available in digital format ● Data Entry of existing Water connection records and outstanding as on cut-off date that is not available in digital format ● System shall allow authorize user to defining Various Charges for: <ul style="list-style-type: none"> ○ Water consumption Charges for metered and non-metered connections ○ Water connection charges ○ Scrutiny Charges ○ Deposit for various connection size & category. ○ Water testing rates ● System shall allow generating bills for all type of users ● System shall allow users to pay the bill. ● System shall allow to capture of various details of the Water/sewage Connection <ul style="list-style-type: none"> ○ Consumer Details- Property Details, Owners Details, Link to Property Number. ○ Metered/ Non Metered Connections ○ Multiple Usage type - Domestic, Commercial, etc .Tariff Category ○ Connection Details- Connection Size, Distribution Line, Pressure ● System should not accept any new connection form if development charges for the property are not paid ● System should not accept the application form for bulk new connection in case sewerage connection is not applied by the applicant ● System should be able to provide list of documents needed to accept certain type of applications and list of documents that the customer has actually submitted. ● If the proof of ownership is missing, system should treat the application as temporary water connection application ● System should be able to distinguish between applications submitted for new permanent connection, new temporary connection, regularization, reopening, sewerage connection,

Sr #	Requirements
	<p>bulk connections etc.</p> <p>Upon digitization of the application form, system should check the application on certain parameters such as:</p> <ul style="list-style-type: none"> ○ Technical feasibility of giving a water connection ○ Whether the applicant has an existing water connection <ul style="list-style-type: none"> ○ Whether unauthorized usage has been reported against the applicant name or property ○ Connection requested is in colonies developed by NRDA or regularized colony where operationalisation of sewerage lines has been notified by NRDA to the residents ○ If the connection is found to be unauthorized, system should initiate regularization process <ul style="list-style-type: none"> ● If the connection is found to have unpaid dues, system should have capability to calculate all applicable dues for the old connection. It should provide facility to assign the representative. ● System should send alerts through SMS/email/phone calls on various events, such as (indicative): <ul style="list-style-type: none"> ○ About the time and date of visiting representative ○ For regularization of connection ○ Status of new connection application ○ To get the boring done within fixed time period of getting sanction of water connection ○ About the time and date of water meter installation, field staff's name etc - About faulty meter and visit of concerned authority for meter check ○ Non payments of charges ● System should check the new connection request against unauthorized connection list ● If the application is for renewal of temporary connection which has been disconnected due to non-payment of renewal fee, then system should reject the application ● System should generate reminders to call the customer in advance before the meter installation date to check the status of boring ● System should inform the relevant personnel/entity through SMS/ email/ phone call to collect their work orders from the concerned authority ● System should be able to generate alert to the respective official (s) in case of any failure to meet the target of meter readings ● System should generate alerts if no action is taken on faulty meters for a fixed time period ● System should be able to generate all bilingual (English and Hindi) notices/reminders ● System should have capability to keep the status of new connection application as approved, pending, payment awaited, rejected, personalization required etc. <p>Workflow (New Connection)</p> <ul style="list-style-type: none"> ● System should schedule the date and time for the visit of representative. It should allow the same to be modified by authorized user. ● System should provide facility to assign a representative to the requests which are: <ul style="list-style-type: none"> ○ Technically feasible ○ Not an existing connection ○ Existing connection with no dues and ○ Not found in unauthorized usage list

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	<ul style="list-style-type: none"> • System should have facility to capture the findings (including connection fees) of customer visits against the reference number of the application form. • System should keep the status of request as paid or to be paid depending on the input from representative • System should have feature to suggest rejections of the applications which are technically infeasible • System should be able to generate the inspection report for each request • System should store the mode of payment by the applicant i.e. cheque/ cash/ debit/credit etc to the NRDA office or to the third party • System should be able to start generating bill for all complete connections • System should generate a list of temporary connection to be expired in next billing cycle • System should be able to calculate the dues on the expiring temporary connection • The bill generated for expiring connection should include the dues, water charges, renewal fees etc. • If renewal fees is paid, system should renew the connection with next expiry date • If the renew charges are not paid, system should raise alert for the concerned authorities for further action • If relevant proofs are available, system should allow the conversion from temporary connection to permanent connection <p>Workflow (Regularization)</p> <ul style="list-style-type: none"> • If the connection is found to be unauthorized system should reflect the same in inspection report and send alert to concerned authority • System should be able to capture the details of unauthorized connections found while processing the new connection application or during field visit team • Concerned personnel would check for any proof of charges being already paid by the customer and not registered with the system. In this case, system is updated with the payment received and a unique KNO/Customer ID is assigned under the proper category • If there are no payments made, the system should produce the bill with due charges and fees for regularization • In case of non-payment of bill, system should generate notice to be sent to the customer • In case of non-payment of bill for more than a fixed period, system should alert the concerned authority for disconnection • In case unauthorized connection is identified by field visit team, system should generate a notice for the connection holder • System should track the receipt of new connection request by the unauthorized connection holder for whom notice has been generated • If the request is not received in fixed interval, system should alert concerned authorities for disconnection <p>Workflow (Sewerage Connection)</p> <ul style="list-style-type: none"> • System should be able to segregate applications for sewerage connection from other

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	<p>applications</p> <ul style="list-style-type: none"> • System should generate reference number for the submitted application • System should calculate the fees for sewerage connection based on the colony type • System should have capability to reject the application if the colony does not fall under the purview of NRDA • System should be able to schedule the visits of the representative • System should capture the findings of visiting representative against the reference number of the application form • If an applicant has submitted application for new water connection as well as sewerage connection, scheduling by the system should be such that only one visit is required by the visiting representative for checking both connections <p>Workflow (Meter Installation)</p> <ul style="list-style-type: none"> • When the sanction of the water connection is approved, system should alert the concerned personnel for the meter installation • System should allocate the field staff to the sanctioned KNO/Customer ID • System should store the serial number of the meter installed against the KNO/Customer ID • System should capture the details of meter installed such as: <ul style="list-style-type: none"> ○ Type of meter ○ Allocated To • If the customer does not get the boring done in time, system should levy late charges on the customer and maintain status of customer as pending <p>Workflow (Meter Reading)</p> <ul style="list-style-type: none"> • System should be able to generate Work order including the late charges if applicable. The work orders will contain the information such as: <ul style="list-style-type: none"> ○ Customer details ○ Field Staff's name, contact information, license number ○ Meter details that is issued ○ K.NO/Customer ID ○ Date and time of installation ○ Time of issue of work order (work order is printed) ○ Time of collection of work order by Field staff ○ Time installation started ○ Time installation completed ○ Satisfactory score by customer (over 100%) ○ Customer confirmation for complete installation • System should be able to update the status as completed when work orders and payments are handed over to concerned authority by the field staff • System should be able to flag outstanding late charges zone wise • System should be able to allocate relevant official based on zones and respective areas for meter reading • System should be able to export data to the handheld device for the customers for which the respective field staff has to take readings

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	<ul style="list-style-type: none"> • System should be able to generate the list of all customers for which the respective staff has to take readings • System should support the input data exported from handheld devices • System should have capability to capture the meter reading against KNO/Customer ID • System should be able to capture meter reading from the meter diary maintained by the meter reader • System should have pre-defined reasons such as dusty meter, meter nonfunctional, etc. for the condition of meters • System should be able to capture all the inputs from the respective official such as change in category of meter, unauthorized meter etc. In such case, system should generate notification form to be sent to concerned personnel • System should have maker – checker engine to check the readings entered by meter reader with the help of a) pre-defined checks b) other personnel to check the reading data <p>Workflow (Meter Testing, Repair & Replacement)</p> <ul style="list-style-type: none"> • System should generate a unique complaint no. for all faulty meters • System should capture the visit details of the field team and generate the work order • System should be able to maintain the status of meter as tested, repaired, replaced • When a meter is replaced by test meter for validation of readings, system should update the new meter details against the KNO/Customer ID and inventory of test meters should also be updated <p>Workflow (Disconnection)</p> <ul style="list-style-type: none"> • System shall have capability to capture the application form details for the disconnection of water connection • On submission of the application, system shall have capability to provide acknowledgement receipt to the applicant for future reference. • System shall have capability to capture the reason for the disconnection of water connection, e.g. on request of customer or due to non-payment of dues • Once the application for disconnection is accepted, system shall have capability to send the application details to the concerned personnel to verify the completeness and correctness of the data • System shall have capability to calculate all applicable dues, payments, fines before the connection is disconnected. • After the calculation of total charges, system shall have capability to generate bill for the disconnection of the water connection • On payment of bill by customer, system will have capability to issue disconnection work order to the field staff • System should have facility to assign a required field staff against the request for disconnection • Application should support parameterized, configurable and user friendly workflow definition/creation

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	<ul style="list-style-type: none"> • Facility to create multiple workflows for various types of business, and shall be used by different/common group of users. • Application must have the facility to create and edit multilevel/multistep workflows • Application must provide the facility of configurable Queuing and allocation logic • The Application should provide a mechanism for configuring multiple business rules for routing of jobs for actions (approvals, disapproval, rejects) in GUI to a workflow step/node. • The Application should allow the users having appropriate rights to add/edit/delete and participate in the workflow process • The Application should provide a mechanism to configure job sharing between the users based on the users, roles and reporting manager. • The Application should provide automatic allocation of jobs to the users upon submission of present job • System must provide both (Automated ‘FIFO’ and Manual ‘On Priority’) options of workflow job/case allocation • The application must have the provision of validations to be set as part of application process, where without entry of mandatory field’s data, the application process cannot be completed. e.g.: <ul style="list-style-type: none"> ○ Mandatory fields check by user ○ ID Proof check ○ Address proof check • The application should have the storage repository for storing Scanned image data along with meta data (index information) • Application should have the functionality of storing the completed jobs/cases into the system data repository for future retrieval • When the status of reference number is “paid” or “approved”, system should generate a unique KNO/Customer ID and should have facility to assign a field staff • System should generate separate series of unique IDs for permanent & temporary water connection, sewerage connection etc which are linked with KNO/Customer ID • System should update the status of the KNO/Customer ID when the application is sanctioned based on inspection report • System should intimate the concerned authorities about the sanctioned KNO/Customer ID for further actions • When the process of boring and meter installation is completed, the status of KNO/Customer ID is updated accordingly. • If the installation is not complete, the status of KNO/Customer ID should be kept as pending with reasons for the delay • In case of replacement, system should update the record of new meter against the KNO/Customer ID • After disconnection, system should update the record against the KNO/Customer ID <p>Meter Reading Data Management</p>

Sr #	Requirements
	<ul style="list-style-type: none"> • System should have facility to enter meter reading data manually • It should be easy to configure interfacing handheld device for getting information into the system • System should have automated process for validating and correcting invalid data • System should have sophisticated graphical analysis tools for comparing the raw data to system edited data, and for tracking any manual user changes • It should be possible to do Data Validation, Cleaning and Estimation for ensuring that downstream systems will get the data they need • System should have different validation parameters for different entities • Reports should show how many meter reads have failed and passed the validations • System should have functionality to interface with metering systems including traditional systems as well as AMI/Smart Meters which employ two –way communications infrastructure. • System should have Standard Usage Validations – Gap checks, negative value checks, zero (0) value checks, data spike checks, high/low checks, sum checks, etc. • System should store meter data in one (1) central repository and acts as a service to other applications, users, and customers. • System should be able to scale to support increased meter counts and any technology changes that require converting existing meters to advanced meters. <p>Bill Generation</p> <ul style="list-style-type: none"> • System should be able to take input of the meter reading from Metering Module • System should be able to maintain tariff for various types of customers including tariff based on level of consumption • System should allow the authorized personnel to manually enter the tariff and taxes applicable for the KNO/Customer ID in exceptional circumstances • System should be able to calculate the bill based on the input meter reading, tariff, taxes applicable etc • System should calculate the bill amount in such a manner that amount due to consumption and that due to arrears should be clearly segregated • System should be able to configure dates for billing cycle (such as bimonthly for one category, monthly for another) and set the payment due date accordingly. System should also be flexible to change the billing cycle • System should be able to generate bill against the unique KNO/Customer ID • System should support automatic detection of implausible meter readings termed as exceptions • System should detect negative bills as a category of exceptions (i.e. where amount payable is negative implying NRDA owes to customer) • System should highlight the exceptions to the concerned personnel for taking necessary action • System should maintain the bill history and payments for all customers

Sr #	Requirements
	<ul style="list-style-type: none"> • System should maintain the pre payments made by the customer and should be adjusted in next billing cycle • System should be able to generate duplicate bills for consumers. The log of all the duplicate bills shall be maintained in the system • System should support interim billing for customers in case of disconnection • System should also support consumption estimates where metering is not used or meters are not in working conditions or fails high – low validations or other such instances • Should provide bill cancellation and rebilling capability from individual customer to mass and for any past period • Should have a capability to trigger workflow in case of billing errors during batch runs. Bills without errors should be finalized and processed without any manual intervention • System should, at a minimum, be able to include the following on a bill: - Internally computed charges (computed by the system’s tariff engine) - Externally computed charges (passed through from another system) - Billing in advance of service provision • Billing of metered services • Billing of non-metered services • Fees, such as flat rate (for example, a connection charge). System should also allow for the calculation of fees as a percentage of another charge (for instance, a late fee on an overdue balance) • Arrears due, etc. • System can add permanent or one-time messages to bills, including meter reading remarks and ad hoc comments. • In case of disputed bills, the system shall provide facility to update it in the database as per the requirement • In case of incorrect generation of the bill, bill must be cancelled and fresh bill should be generated • System should have ability to include details of challans, penalties or other actions taken against consumer.
4.	<p>MIS and dashboard requirement:</p> <ul style="list-style-type: none"> • Connection Outstanding Register • Bill Acceptance Register • Meter reading/ Water Consumption statement for a period • List of consumers ward, category & size wise • List of connections • List of closed connections • Ward-wise/Zone-wise Recovery reports • Top Defaulters Report • Tax-wise Recovery Details • Tax-wise Demand Details

Sr #	Requirements
	<ul style="list-style-type: none"> • Advance Payment Reports • Bill status for bill generation • Faulty Meter Report • Illegal connection reports (Based on complains) • Water quality test report • Ward wise/zone wise/line water pressure report • Plumber Register • Security Deposits Register • Advance Register • Outstanding Register
Licensing Module	
1.	<p>Scope: NRDA as Municipal body will be issuing various types of licenses like Food Licenses, Shop Licenses, Trade Licenses, etc. License department's main objective will be issuance of new license keeping in mind various pre-requisite factors. Also renewal of the existing licenses will be undertaken.</p> <p>The solution will be part of the citizen services delivery module. Citizen can submit the application online and once approved will be able to pay the license fee online through Payment gateway. Also the citizen will be able to see the status of its application online.</p>
2.	<p>Interfacing and Integration requirement:</p> <ul style="list-style-type: none"> • This Module will be integrated with existing eDistrict Application of State for all the license service available in the Application. • The module will be used in integration with Document Management Platform. • The system should interface with Account System to update the details about the license fees/dues collected. • The system should interface with the Web portal and Mobile app to process the application online • The system should be able to interface with the messaging system for sending email notification, SMS.
3.	<p>Functionality:</p> <ul style="list-style-type: none"> • The user shall be able to raise request for new license , renewal of license etc through Smart City System • In case the service is already available in eDistrict Application than the service request should route to eDistrict Workflow for processing • The final certificate shall be delivered through Smart city System • The system should maintain the details about, <ul style="list-style-type: none"> ○ Licenses - category wise, like factory, rickshaw, Hawkers, Weekly bazaar etc. ○ License holder details, like, owner name, shop/factory/restaurants/rickshaw, address, purpose, date of issuance, license number, fees paid etc. ○ Information on various documents submitted by the applicants • The system should provide:

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	<ul style="list-style-type: none"> ○ Facility to download form, online filling and submission of form ○ Separate applications forms for all the departments specific licenses ○ Facility to upload the scanned documents that are required for issuance, with checklist to confirm that required documents have been uploaded before submitting. ○ Unique ID for all licenses/applications, which will be used for all future transactions of the license/applications ○ Facility for online payment of license fee and generation of receipt for the payment ○ Facility to applicant to track the status of their application online ○ Facility to create/edit/update the deficiency/Inspection report against the application ○ Facility to assign the application to respective Inspector for survey and verification ○ Facility to escalate the issue, automatically if file is not cleared within stipulated time by the inspector. ○ Facility to print or generate license online (if file is cleared and approved) ○ Facility to sign off the license with digital signatures by the concerned officer. ● The system should generate the list of licenses that are due for renewal within set number of days ● The system should be able to send reminders, via email/SMS/letter to license holders for renewal, before expiry ● The system should harbor the following functionalities: <ul style="list-style-type: none"> ○ Online payment of renewal fee and generation of receipt ○ Online generation of renewed license copy on validation of old license identification number and payment of fees and facility to sign-off digitally ○ Facility for applicant or NRDA to cancel the license ○ Facility to track and generate the list of defaulters ○ Maintain the details like premises, date, officer's name, license owner etc. for the inspections carried out randomly(Raid) ○ Maintain the inspection details and action taken against the defaulter ● Old licenses to be renewed only after reviewing of past pending certificates as listed in the previous year's license
4.	<p>MIS and dashboard requirement:</p> <p>The System shall generate following reports:</p> <ul style="list-style-type: none"> ● License Register ● List of Defaulters ● Reminder Notice for Renewal ● Demand/Collection Register ● Reports showing Changes in License Types, Business Partners, Cancellation Licenses, etc. ● Facility to forecast the impact of reduction/deduction of License Fee ● Reports w.r.t. Bills/Notices generated ● E-Mail/SMS to be sent to the owner upon transactions
HRMS	
1.	<p>Scope: The department is responsible to maintain the employee details working for corporation on regular basis or contractual basis. The department keeps record of the transfer, leaves, salary, pension</p>

Sr #	Requirements
	<p>etc. Also the department is responsible for new recruitment.</p> <p>HRMS module which will take care of the salary processing of each of the employees on payroll of the NRDA. HRMS will be able to hold the complete details of all the employees, even after retirement.</p> <p>List of main activities of department</p> <ul style="list-style-type: none"> • New Recruitment • Promotions • Appraisals • Leave Management • Transfer • Career Development • Maintenance of Service book • Retirement related formalities
2.	<p>Interfacing and Integration requirement: The Module will be integrated with Account and Payroll module.</p>
3.	<p>Functionality:</p> <ul style="list-style-type: none"> • System shall have facility for Recruitment and Manpower Planning <ul style="list-style-type: none"> ○ Facility to carry out recruitment for different types of employees separately viz, Officers, Special Officers, Clerks, subordinates, Sanitation Staff, etc. ○ Provision to define requirement plans (periodic) in terms of specific skills, Qualifications, experience, designation, etc. Provision for mainstream, specialist and part time employee recruitment ○ Provision for Compassion 'Anukampa' recruitment ○ Support to analyze the cadre-wise/ward or office-wise /department - wise staff strength - sanctioned/working strength and the gap for which recruitment is required ○ Facility to capture the data relating to resignations /retirements/VRS/suspend etc. • System should be able to record and store Master Data Information for an Employee. • System should have capability of General Provident Fund Management <ul style="list-style-type: none"> ○ Issuing GPF no. to employees ○ Application acceptance for advances/Loan against GPF ○ Scrutiny of the applications ○ Payment of Advance/Loan to Employees ○ Interest Rate for GPF calculation ○ Repayment Instalment adjustment against salary ○ Generation of various MIS (Monthly/Yearly) • System should have capability of managing Employee Promotions/Transfers and Development <ul style="list-style-type: none"> ○ Transfers ○ Time bound Promotions ○ Grade and Pay changes ○ Ability to create standard career paths in the Development Authority in terms of various

Sr #	Requirements
	<p>possible moves from the current level/grade in the Development Authority</p> <ul style="list-style-type: none"> ○ Ability to define grade advancements within a level on the basis of time based as well as merit based criteria ○ Ability to define the rules for promotion eligibility in terms of tenure, consistent achievement of high performance grades, etc. ○ Ability to define additional rules specific to service in terms of suspensions, disciplinary actions ○ Facility to intimate employees of promotion/rejection through mail/workflow/letters ○ Facility to create offer letter on promotion ○ Ability to define short/long term goals for employees and provide a framework to assess and update completion of the same ○ Ability to identify key positions for the purpose of succession planning ○ Ability to plan for vacancy of the key position in advance ○ Identify the gaps/developmental areas between the slated employees and requirements of the key position ○ Maintenance of complete history of employee transfers since his recruitment ○ Transfer/redeployment of officers based on requirement/sanction strength of different regions/zones ○ Generation of seniority list ○ Posting/transfer of officers upon their promotions ○ Maintenance of records for officers transferred out of parent state and also officers to be transferred back to home state on completion of required tenure ○ Maintenance of transfer records of specialist transfer, identification of vacancies and issue of transfer orders based on the recommendations received from the respective specialist departments ○ Provision to maintain lateral transfer details and transfers on promotion ○ Generation of list of eligible staff members for transfer based on the user defined criteria ○ Maintenance of exemptions given in transfers with a facility to record the reasons for the same ○ Provision to record the transfer orders cancelled/deferred/modified and follow up with the respective regional/zonal offices for implementation ○ Capture of details of officers on deputation to outside agencies, etc. <ul style="list-style-type: none"> ● System shall have facility of Time Management and Leave Management ● Support attendance entry from various sources such as direct entry, rule-based and automatic (through biometric device/swipe card/smart card) ● Definition and maintenance of leave calendars for different types of leave depending upon the scales of the employee <ul style="list-style-type: none"> ○ Provision to maintain all types of leave like CL, PL, ML SL extra-ordinary leave, special leave etc ○ Ability to maintain leave eligibilities for each type of leave depending on the rules specified by NRDA ○ Ability to maintain rules for leave taken ○ Ability to record actual leaves taken ○ Ability to calculate actual leave balance at any point in time Link Leave management to payroll and employee history

Sr #	Requirements
	<ul style="list-style-type: none"> ○ Provision to accounting of leave including automatic credit of leave and also provision with manual credit/debit/modification/cancellation etc. ○ Leave cancellation and leave extension/amendments advancement, postponement of leave ● System shall have facility of Performance Appraisal <ul style="list-style-type: none"> ○ Capability to create Performance documents for employees depending on the cadre/grade in the organization ○ Ability to define competency wise/parameter wise desired levels of performance for each cadre/grade in the organization ○ Ability to define proficiency descriptions for each parameter for each cadre/grade so as to ensure that the same measures of performance are communicated to the appraiser as well as the appraise ○ Ability to define the period for which appraisal is being carried out ○ Capture appraisal details as given by the appraising authority, reviewing authority ○ Support parameter wise ratings, final ratings, strengths/weakness and suggestions/recommendations for improvements by the appraising/reviewing authority ○ Increments released should automatically be integrated with the payroll module and other relevant modules ○ Support to generate reminder letters/mails/workflows to the employees/appraising authorities in case of non-submission of self-appraisals, etc. ○ Support memo letters/mails/workflows to be issued to the employee in case of unsatisfactory performance ● System shall be have Employee Self Service facility <ul style="list-style-type: none"> ○ Ability to allow employee request to modify personal, skill, family details ○ Employee should be able to make leave requests ○ Supervisory officer should be able to get an alert when any Self Service Request of subordinate staff is received by him ○ Supervisor authorization of modification of the employee requests or leaves application ○ Employees should be able to view the status of their requests Ability to facilitate self-appraisal by employees ○ Ability to undertake online appraisal of the sub-ordinates (CRs) Ability to define customized NOC requests (like NOC for Passport application, etc.) ○ Various health benefits available to employee ○ Register Employee Complaints ○ Allow employees to request any other information from any other department
4.	<p>MIS and dashboard requirement</p> <ul style="list-style-type: none"> ● Reports on Vacancies ● Report on Employees Salary Details ● Report on Leave Availed ● Report on Leave Entitlements ● Employee Attendance List for a Business Event ● Headcount Report ● Report on time spent in a grade/employee tenure ● Transfer List

Sr #	Requirements
Payroll	
1.	Scope: This application will automate the employee related operations of the NRDA such as payroll processing, loans, benefit administration etc.
2.	Interfacing and Integration requirement: The Module will be integrated with the HRMS and account modules.
3.	<p>Functionality:</p> <ul style="list-style-type: none"> • System shall have Payroll Management with: <ul style="list-style-type: none"> ○ Ability to define flexible periods such as day, week, month for pay calculation ○ Ability to enable multiple payrolls that are generated based on employee's assignment ○ Ability to define payroll for pensioners ○ Ability to define the employee bank to credit the salary ○ Facility for Electronic Clearing system (ECS) ○ Bank-wise/Bank branch wise summary statement ○ Ability to provide automatic calculation of deductions/earnings based on leave, bonus declaration, GPF Loan, Home Loan, Computer loan, tax deductions, etc. ○ Ability for rule based pay calculation in case of pay hikes/Pay Commission with retrospective effect., ○ Reimbursements, deductions, tax deductions, PF, etc. Pay elements should be also classified as Recurring & non-recurring ○ Ability to apply the payment rules at personal/department/designation/organization leave ○ Ability to automate increments ○ Provision to allow deductions for specific purposes (like earthquake relief fund, CM relief fund, etc.)
4.	<p>MIS and dashboard requirement:</p> <p>System shall be able to generate following MIS for:</p> <ul style="list-style-type: none"> • Salary Slip • Form 16 with Form 12 BA • Income Tax related reports • Form 24 • Provident Fund Returns
Asset Management	
1.	<p>Scope: Assets reflect the wealth of the Development Authority. Based on the nature of the assets it get appreciated or depreciated. Also for the double entry accounting system asset register is must. Asset register is required to prepare the balance sheet.</p> <p>Various assets of NRDA includes:</p> <ul style="list-style-type: none"> • NRDA buildings • Infrastructure developed by NRDA like bridges, Roads, Gardens etc. • Vehicles, Buses, Trucks and other machines. • Computers, printers, servers and other IT hardware.

Sr #	Requirements
	<ul style="list-style-type: none"> • Furniture and Fixtures. • Land owned by NRDA
2.	<p>Interfacing and Integration requirement:</p> <p>The module will be used in integration with GIS</p> <p>The Module shall be required to be integrated with Building plan Permission, Land and Estate management system, Account Modules</p>
3.	<p>Functionality:</p> <p>The functionality of this module is mentioned below:</p> <ul style="list-style-type: none"> • System shall allow to create –add, modify delete new assets as per Classification of Assets <ul style="list-style-type: none"> ○ Immovable Assets –Land, Building, etc. ○ Movable Assets-Plant and Machinery, Vehicles etc. ○ Investments • System shall allow to capture various details for the Assets like <ul style="list-style-type: none"> ○ Ownership ○ Cost Details (construction/Purchase/Transfer) • System shall allow preparation of Opening Balance for Asset Valuation • System shall allow to capture Asset Transactions • System shall allow to represent Asset location on GIS map
4.	<p>MIS and dashboard requirement:</p> <p>The System shall generate following reports:</p> <ul style="list-style-type: none"> • Asset Register • Revenue Report • Outstanding Register • Search facility for various information (like search for name of road)
Finance Management	
1.	<p>Scope: All the financial matters and management of income and expenses of NRDA are carried out by this department. The planning & budget provisions of development work of the city projects and schemes etc are also being handled by this department. All the monetary transactions of the Naya Raipur Development Authority are being taken up by this department.</p> <p>ERP accounts module will have help the department to perform the Accrual based double entry. ERP accounts module will have help the department to integrate with other software solution to give the exact and real time report of the collection and issuance.</p>
2.	<p>Interfacing and Integration requirement:</p> <p>The accounts module will also have the integration with the all revenue generation based services of the NRDA like Asset, Property/Water tax, Building permission, license, HRMS, Payroll etc.</p> <p>The System shall integrate with existing Tally system of the NRDA</p>
3.	<p>Functionality:</p>

Sr #	Requirements
	<ul style="list-style-type: none"> • System shall allow to manage Master data for the System like: <ul style="list-style-type: none"> ○ Account Head Definition ○ Account Grouping and Sub-Grouping ○ Bank Account Details ○ Vendor Details • System shall allow Budget Preparation, Distribution and Management System including: <ul style="list-style-type: none"> ○ Budget Classification ○ Department-wise estimated provision, revision for income and expenditure ○ Budget Appropriation between different budget heads through approval process ○ Administrative approval/dis-approval of works linked to budget availability • System shall have Payment Management facility including: <ul style="list-style-type: none"> ○ Bill/Liability Entry ○ Payment Authorization ○ Payment Voucher (Full or Partial Amount) ○ Maintaining Check details, Check Printing ○ Recording of Check Issuance Details ○ Recording of Cheque Cancellation details • System shall have Security Deposit/Earnest Money Deposit Management • System shall have Loans and Grant Management facility including: <ul style="list-style-type: none"> ○ Maintenance of Loan, Grant Details ○ Alerts for Loan, Grant Instalment Payments ○ Loan, grant Instalment Payments • System shall have Investment management facility including: <ul style="list-style-type: none"> ○ Maintenance of Investment Register ○ Alerts on due dates ○ Comparison of different options for Investments • System shall be able to: <ul style="list-style-type: none"> ○ Define Chart of Accounts as per the guidelines ○ Maintain Bank Account Details ○ Maintain Details of Vendors ○ Budget provisioning – Provision for Original and Revised Budget ○ Re-appropriation of Budget between accounting heads ○ Provision to records Receipts ○ Transfer of Receipts – cash/cheque to Bank Accounts ○ Record direct debit/ credit to bank accounts in books of accounts ○ Entry of Bills /Invoice Received from vendors ○ Authorization of bills as per the work-flow defined ○ Payment Vouchers once the payment is approved. ○ Keep track of Cheque books and cheque leaves. ○ Facility for cheque printing ○ Direct Payment upto specific limit ○ Journal Voucher Entry ○ Authorization of Journal Voucher ○ Contra Voucher Entry

Sr #	Requirements
	<ul style="list-style-type: none"> ○ Reversal of Vouchers ○ Provision for Bank Reconciliation at any point in time. ○ Manage Deposits received from vendors, citizens. ○ Keep track of Grants received and expenses made against the specific grant ○ Keep record of Investment made and interest accrued on the investments ○ Loans management ○ Advances management
4.	<p>MIS and dashboard requirement:</p> <p>Following MIS/Register (information) will be generated from System:</p> <ul style="list-style-type: none"> ● Cost Centered Accounting Reports ● Department-wise, Cost Centre-wise Income/Expenditure reports ● Generation of Deposit Slips ● Security Deposit Register ● Grants Register ● Loans Register ● Investment Register ● Advance Register ● Bill Register ● Payment Register ● Outstanding Bill Register ● Reports on Receivables ● Cash Book (Detailed & Summary) ● Function-wise Expense Subsidiary Ledger ● Journal Book ● Ledger Book ● Cheque Issue Register ● Trial Balance, Income & Expenditure Statement ● Balance Sheet, Bank Reconciliation Statement
Property Tax	
1.	<p>Scope: Property tax is one of the main sources of revenue for the NRDA. Residential and commercial properties, situated within the limits of NRDA, are assessed for property tax. Property tax is tax on immovable or tangible real property such as land, buildings and permanent improvements. Based on such assessments, all the property holders are expected to pay the property tax. Property Tax may comprise of basic house/building tax plus taxes such as conservancy tax, water tax, sewerage tax and education Cess.</p>
2.	<p>Interfacing and Integration requirement:</p> <p>The module will be used in integration with GIS and Document Management Platform.</p>

Sr #	Requirements
	The Module shall be required to be integrated with Building plan Permission, Land and Estate management system, Account Modules
3.	<p>Functionality:</p> <ul style="list-style-type: none"> <li>• As soon as the building completion certificate is issued, the same information will be available to the property tax dept. <li>• System will auto calculate the tax for each registered property in NRDA and generate the bills. <li>• System will have relational data base. Any change in the mentioned will be reflected all across. <li>• System shall allow users to capture various details of the Property: <ul style="list-style-type: none"> <li>○ Ward/ Zone/ Block/Route - Administration or Geographical divisions <li>○ Property Holder's Name - One or multiple owners <li>○ Property Holder's Email ID/Mobile No. <li>○ Property Holder's Address (Present Address, Permanent Address) <li>○ Property Location details (Survey No. etc.) <li>○ Property address <li>○ Linkage with Building Permission Module to carry forward building details <li>• System shall allow users to capture details required for Property Assessment <ul style="list-style-type: none"> <li>○ Type and Sub Type of Property <li>○ Usage of Property <li>○ Construction Class/Vicinity Factor/Amenity Factor <li>○ Age of Building <li>○ Property tax as per rent assessment. <li>○ Any other factor required for Assessment <li>• System shall Authorized user to change the tax rule, rate, exemption rule etc <li>• System shall calculate the tax based on parameters like <ul style="list-style-type: none"> <li>○ Demand Notice Generation as per Rate Chart <li>○ Tax Exemptions <li>• System shall have functionality to generate tax offender list, notice etc. <li>• System shall allow user to pay tax online, receipt generation, advance tax payment, duplicate bill, No due certificate <li>• Yearly Bill generation – handling arrears, penalty/ interest, advance payments. <li>• Collection – tax wise bifurcation in predefined proportion or as per priority defined, handling rebate on early payments. <li>• Citizen Service: Self-Assessment of Property by Citizen <li>• Citizen Service: Submission of Property tax in subsequent years with changes or without any changes in the property details like structure, usage etc. <ul style="list-style-type: none"> <li>○ Capture details of multiple owners <li>○ Handle listing of multiple usage types within a property <li>○ Handling rebates, specific standardized rules, and considering various factors while calculating ARV of the property. <li>○ Capturing floor wise details in case of buildings

Sr #	Requirements
	<ul style="list-style-type: none"> • Authorization of Self-Assessment, subsequent assessments filed by the Citizen and making changes if any by the Municipality. • Informing Citizen about the changes done in form of a Notice • Facilitating Citizen to file an objection against the Notice • Hearing Letter informing date of hearing to the Citizen • Capturing proceedings of hearing and generating final Hearing Order • Citizen Service: Mutation (change of ownership) through heredity or by sale of property. • Tracking Objections and hearings against request for Mutation/ transfer. • Revaluation of Property upon survey/ identification of change in property by Municipality. • Citizen Service: Issue of Transfer Certificate. • Citizen Service: Property Tax Assessment Certificate • Citizen Service: Issue of Property Extract • Citizen Service: Issue of Duplicate Bill • Facility to upload existing property records and outstanding as on cut-off date that is available in digital format • Data Entry of existing property records and outstanding as on cut-off date that is not available in digital format
4.	<p>MIS and dashboard requirement:</p> <p>MIS will help generate Ward wise reporting of arrears, Yearly Tax Demand property tax details and ward wise collection details</p> <ul style="list-style-type: none"> • Demand/Collection Register • Assessment Register • Closing Register • Ward-wise/Zone-wise Recovery reports • Top Defaulters Report • Occupancy wise/Flat wise report • Tax-wise Recovery Details • Tax-wise Demand Details • Advance Payment Reports • Objection/Hearing Details • Inspector wise report (Assessment of property as per Building permission/Citizen request/Inspection) • Assessment as per citizen/Assessment as per inspector • MIS reports for self-assessment, concessions. • Alerts from License Module upon New License/change in business
BPM/ Work Flow requirement	
1.	System should support easy workflow configuration, its maintenance, and need based modification,

Sr #	Requirements
	addition alteration of the steps.
2.	System should support process modelling based on BPMN2 notation standard
3.	System should have facility to simulate a process before launching it so that appropriate changes can be made based on findings.
4.	System must facilitate dynamic web form design functionality
5.	System should provide business rule engine and a management platform. Users shall be able to modify the business rules online without any need of deployment. System shall also have business rule connector so that it can talk to any 3rd party business rule engine
6.	System should have complex XML based data management capabilities.
7.	System should allow saving custom BPM templates so that end user can tailor a business process based on any of the custom template.
8.	System should offer performance monitoring features for the business processes. The system shall be capable of identifying, reporting inefficient processes and operations and/or those with high level of error and omission
9.	System should expose W3C standard web services and REST based web services so that it can communicate to any other technology layer seamlessly.
10.	System should have capabilities which will enable business activity monitoring and capture audit trail of all transactions as well. Web based dashboard shall be made available for accessing all reports. The BAM framework shall provide capability to generate various graphical reports on data.
11.	System should provide dashboard view for showing multiple reports. Dashboard view and content can be customized for individuals.
RDBMS Requirement	
1.	All the applications implemented should have provision for optimizing the number of static connections to the database using connection pooling. All the applications implemented should also optimize the duration of connection to the database by using techniques like session time out.
2.	Database should have perpetual and enterprise wide/subscription based licenses. They should have proven scalability credentials to cater to any system load.
3.	It should provide Unicode support.
4.	It should support User-defined Data Types & User-defined Functions.
5.	Database should support advanced data compression, self-healing and deployment in various cluster topology.
6.	The database platform should support enhanced configuration and management of audits.
7.	The database platform should support Failover Clustering and disaster recovery solutions.
8.	It should support online indexing operations and parallel indexing operations
9.	Database should support Schemas, Roles Based Privileges & Authentication.
10.	The data platform should support policy-based system for managing one or more instances across enterprise
11.	It should provide a scripting shell that lets administrators and developers automate server administration
12.	The database should have enterprise level DB- support centre with a 24*7 helpdesk support.
13.	Other than built in database access logic in application, a separate database security layer will be required to control direct access to database server by any unauthorized user.

Sr #	Requirements
14.	The database platform should support defining resource limits and priorities for different workloads, which enables concurrent workloads to provide consistent performance
15.	Database security should provide different layers of database users with overall control of database security administrator, only authorized database administration users with assigned privilege should be allowed to access database.
16.	A separate audit trail should be maintained for any direct modification, deletion and addition in RDBMS database in database structure or records. User, even the database administrator should not be allowed to tamper with audit log. Database server should support most granular column encryption to encrypt sensitive data.
17.	The selected RDBMS should have abilities for fault tolerance, linear scalability, mixed workload capability
18.	Database should support option of different partitioning schemes within the database to split large volumes of data into separate pieces or partitions, which can be managed independently. It should support physical columns. The partitioning should enhance the performance, manage huge volumes of data and should provide foundation for Information Life Cycle Management.
19.	The RDBMS should preferably provide options for Automated/manual performance analysis with diagnosis of the cause of performance related issues with possible resolutions.
20.	RDBMS licenses should be unrestricted and full use licenses (read, write and modify). RDBMS should allow storing scanned images, text documents, XML, multimedia inside the tables. It should be part of the basic database distribution without any additional cost to the organization
21.	RDBMS should support the separation of security functionality from application functionality and database administration functionality.
22.	Any proprietary OEM specific functionality of RDBMS should not be used.
Enterprise Service Bus(ESB) requirement	
1.	The solution should support static/deterministic routing, content-based routing, rules-based routing, and policy-based routing, as applicable in various business cases.
2.	The solution should have capabilities to receive input message in heterogeneous formats from various different systems, interpret those messages, process and transform those messages to generate output and feed them to various different clients as per formats applicable.
3.	The solution should have features to communicate across different services, process them and expose as single aggregate service to facilitate business functionality
4.	ESB should support SOA standards such as XML, XSLT, BPEL, web services standards and messaging standards.
5.	ESB should support all industry standards interfaces for interoperability between different systems
6.	ESB should support the following integration security standards: <ul style="list-style-type: none"> • Authentication • Authorization • Encryption • Secure Conversation • Non-repudiation • XML Firewalls • Security standards support

Sr #	Requirements
	<ul style="list-style-type: none"> WS-Security 1.1 WS-Trust 1.3 WS-Secure Conversations 1.3 WS-Basic Security Profile
7.	The solution should support routing to all internal & external systems.
8.	The solution should have comprehensive auditing capabilities to support any internal or external audits.
9.	The solution should provide configurable logging feature for supporting error handling.
10.	The solution should include feature of service registry for managing all services.
11.	The solution should support Business Activity Monitoring. One should be able to do a real time analysis of the data flowing within the ESB. One should be also able to monitor Key Performance Indicators.
12.	The solution should be able to interoperate and connect with applications deployed on a number of platforms including, AIX, HP-UX, Sun Solaris, Windows, Linux etc.
13.	The solution should support a whole suite of adapters such as Data Handler for XML, Exchange, Lotus Domino, industry standard packaged solutions etc.
14.	The solution should support various messaging patterns e.g. synchronous, asynchronous, pub/sub, multicast, etc.
15.	The solution should support SQL access to relational databases. Integration capabilities with NoSQL databases would be also advised.
16.	The proposed ESB should support Time Control and Notification for messaging
17.	The ESB should have an capabilities of Routing, Enrichment, Update, Transformation Processing
18.	The ESB should support for Message Expiry configuration

II. City Surveillance System

MSI has to supply, install, commission and maintain the required number of camera in the location as mentioned in Annexure IV. MSI has to provision for poles, switch, UPS and other equipment for installing the camera. The MSI should do necessary cabling for electrical supply and connectivity from nearest Power and OFC Duct.

Sr #	Requirement
VMS and Video Analytics	
1.	The VMS shall be used for centralized management of all field devices, servers and client users.
2.	The VMS shall support a flexible rule-based system driven by schedules and events.
3.	The VMS shall be supported for fully distributed solution for monitoring and control function, designed for limitless multi-site and multiple server installations requiring 24/7 surveillance with support for devices from different vendors.
4.	The VMS shall support IP cameras from major vendors.
5.	The System should support LDAP (Lightweight Directory Access Protocol) server
6.	The VMS shall be enabled for any standard storage technologies and video wall system integration.
7.	The VMS shall be enabled for integration with any external Video Analytics Systems.
8.	The VMS shall be capable of being deployed in a virtualized environment without loss of any functionality.
9.	The VMS server shall be deployed in a clustered server environment for high availability and failover.
10.	All CCTV cameras locations shall be overlaid in graphical map in the VMS Graphical User Interface

Sr #	Requirement
VMS and Video Analytics	
	(GUI). The cameras selection for viewing shall be possible via clicking in the camera location on the graphical map. The graphical map shall be of high resolution enabling operator to zoom-in for specific location while selecting a camera for viewing.
11.	The VMS shall have an administrator interface to set system parameters, manage codecs, manage permissions and manage storage.
12.	The VMS day to day control of cameras and monitoring on client workstations shall be controlled through the administrator interface.
13.	Whilst live control and monitoring is the primary activity of the Operator workstations, video replay shall also be accommodated on the GUI for general review and also for pre and post alarm recording display.
14.	The solution design for the VMS shall provide flexible video signal compression, display, storage and retrieval.
15.	All CCTV camera video signal inputs to the system shall be provided to Command and Control Centre, and the transmission medium used shall best suit the relative camera deployments and access to the CCTV Network.
16.	The VMS shall be capable of transferring recorded images to recordable media (such as CD/DVD and/or DAT tapes) in tamper evident and auditable form.
17.	All the streams shall be available in real-time (expecting the network latency) and at full resolution. Resolution and other related parameters shall be configurable by the administrator in order to provide for network constraints.
18.	The VMS shall support field sensor settings.
19.	<p>The VMS shall support the following minimum operations:</p> <ul style="list-style-type: none"> • Adding an IP device • Updating an IP device • Updating basic device parameters • Adding\Removing channels • Adding\Removing output signals • Updating an IP channel • Removing an IP device • Enabling\Disabling an IP channel • Refreshing an IP device (in case of firmware upgrade)
20.	The VMS shall support retrieving data from edge storage. Thus when a lost or broken connection is restored, it shall be possible to retrieve the video from SD card and store it on central storage.
21.	The VMS shall support bookmarking the videos. Thus, allowing the users to mark incidents on live and/or playback video streams.
22.	The VMS shall allow the administrator to distribute camera load across multiple recorders and be able shift the cameras from one recorder.
23.	VMS shall support automatic failover for recording.
24.	VMS shall support manual failover for maintenance purpose.
25.	VMS shall support access and view of cameras and views on a smartphone or a tablet (a mobile device).
26.	VMS shall support integration with the ANPR application.
27.	VMS shall support integration with other online and offline video analytic applications.
28.	CCTV Camera Management – Shall enables management of cameras associated with the VMS.

Sr #	Requirement
VMS and Video Analytics	
29.	Video recording, retrieval and archiving – Shall manages live camera viewing, recording of live feeds for future review, search and retrieval of recorded feeds and archiving of recorded video feeds for optimum utilization of resources.
30.	Video Analytics (VA) alert management – Shall enable defining of rules for handling of alerts using the VA handling of events as per the defined rules.
31.	MIS and Reporting – Shall provide users with business analytics reporting and tools to organize evaluate and efficiently perform day to day operations.
32.	Security and Roles – Shall manages role definitions for internal as well as external access.
33.	The VMS shall be Codec and IP camera agnostic such that it can support devices that are not supplied by the manufacturer/developer of the VMS software and Codec hardware.
34.	All cameras locations shall be overlaid in graphical map in Graphical User Interface (GUI). The cameras selection for viewing shall be possible via clicking in the camera location on the graphical map. The graphical map shall be of high resolution enabling operator to zoom-in for specific location while selecting camera for viewing.
35.	The VMS shall support tamper detection for all cameras to warn of accidental or deliberate acts that disable the surveillance capability.
36.	For alarm interfacing requirements, The designated primary camera shall be automatically displayed as a main GUI CCTV screen. The VMS shall also, on alarm, present associated pre/post event video allowing the Operator to assess the alarm cause. Other associated cameras, when called up, shall be displayed as split-screen images on the other monitor of the operator workstation.
37.	Playback of any alarm related video, (including pre and post alarm video) shall start at the beginning or indexed part alarm sequence.
38.	Video management software incorporates online video analytics on live video images. It shall includes the following video analytics detection tools: <ul style="list-style-type: none"> • Presence detection for moving and stopped vehicles • Directional sensitive presence detection • Congestion Detection • Loitering detection • Improper Parking • Camera Tampering • Abandoned objects detection
39.	Video clips of specific events via the VA or by the operator action shall be capable of being separately stored and offloaded by operator with appropriate permissions on to recordable media
40.	The system shall provide the capability to select duration and resolution of storage by camera, time and activity event and user request. Frequency/trigger of transfer shall be configurable by user.
41.	Live video viewing: The system shall allow the viewing of live video from any camera on the system at the highest rate of resolution and frame rate that the camera shall support on any workstation on the network.
42.	Recorded video viewing: The system shall allow the viewing of recorded video from any camera on the system at whatever rate the camera was recorded.
43.	The system shall provide the capability to manage the video storage to allow selective deletions, backups, and auto aging.
44.	VMS shall have an extensive reporting capability with ability for administrator to define reports in a user friendly manner

Sr #	Requirement
VMS and Video Analytics	
45.	The user interface shall be via a GUI providing multiple video streams simultaneously on multiple monitors.
46.	The GUI shall have the minimum capability of naming locations, users, and cameras events be displayed correctly on users screen.
47.	The system shall have the capability to store and record operator specific options.
48.	The GUI shall conform to standard Windows conventions.
49.	The system shall provide unified GUI camera control at an operator's workstation for all types of cameras installed whether existing or new or connected via another agency.
50.	Unified control of the following functions shall be provided: <ul style="list-style-type: none"> • Selection • Display • PTZ • Setup and adjustment • Determination of pre-sets
51.	All user interfaces shall support English Language and shall conform to standard Windows protocols and practices and allow the control of all functions via a simple easy to use interface.
52.	The system shall support a mode of operation whereby a map of all or part of the map (at operator request) is displayed on a separate or same screen and that status information can be provided via an icon, and access to any cameras shall be accessible by means of an icon on that screen.
53.	These Maps shall be defined so that an operator may make a selection from the same source of mapping that is available to the other systems within the Command and Control Centre suite of systems displaying whichever Map or section the operator needs, and it shall be displayed within one (1) second.
54.	The System should support Maps integration in future with below features; <ul style="list-style-type: none"> • Adding Image Layers to the location map. • Define the location map for each location. • Add cameras to the map images. • Add image layers to the map. • Add a Maps Server • System should support raster format images of jpeg/jpg and png file and Vector (shape files)
55.	The VMS configuration tool shall define: <ul style="list-style-type: none"> • Cameras (whether via codec units or directly connected IP cameras) and text based names • Camera Groups • User Groups • Monitors • Codec parameters • Alarms • Workstations • Storage
56.	The configuration utility shall allow the system administrator to: <ul style="list-style-type: none"> • Install new devices • Configure all aspects of existing devices • Configure and set up users/user groups and their rights/permissions/priorities • To define multiple camera groups • Each group to be defined for combinations of viewing and control rights • Individual Operators to be assigned multiple groups • Each group to be allocated to multiple Operators

Sr #	Requirement
VMS and Video Analytics	
	<ul style="list-style-type: none"> • Each camera may be in multiple groups • Program camera/monitor selection and configuration of the video wall(s) in response to an incoming alarm
57.	User permissions/privileges, to be allocated, shall extend from full administrator rights down to basic operation of the system, and shall include the ability to designate workstations to an operator, and to designate one or more camera groups to an operator for viewing and/or control.
58.	The configuration utility shall store all changes to the system,
59.	A copy of the system configuration shall be stored external to the system to allow system restoration in case of hardware failure. External would mean another site, to be agreed with CLIENT during detail design.
60.	<p>The (MSI) shall request a detailed User Prioritization List (UPL) from the CLIENT during the project.</p> <p>The UPL shall enable the programming of the CCTV management system with the agreed user prioritization.</p>
61.	<p>Over and above user priority, users shall be enabled for the following in varying combinations:</p> <ul style="list-style-type: none"> • Image viewing • Image recording • PTZ control
62.	The system shall accommodate the definition and implementation of adequate priority levels or equivalent feature
63.	All images shall be recorded centrally as a background process at configurable parameters.
64.	It shall not be possible to interrupt, stop, delay or interfere with the recording streams in any way, without the appropriate user rights.
65.	The CCTV recording system shall enable pre and post event (PPE) recording, presentation and storage, initiated automatically in response to system alarm sources received by the VMS.
66.	The PPE recording clips shall be provided by the VMS and retrieved from the central video archive on the buffer storage system.
67.	The information stored shall be full real-time and full resolution from each incoming camera channel. In the absence of a trigger from a manual input or from a programmed alarm source, the PPE video recording shall be written to buffer storage on a FIFO basis.
68.	In the event of a trigger, the VMS shall ensure that the programmed sections of pre and post event video are immediately presented to the Operator to complement the alarm display and simultaneously saved as an identified indexed video clip, complete with time/date stamp, in a reserved and protected area of the storage system. Such PPE recording shall then be capable of later retrieval via search criteria.
69.	Once tagged and saved, the PPE video clip shall NOT be overwritten except by an operator with the required permissions i.e. it is excluded from the normal FIFO regime of the bulk storage system. Recording shall also be initiated on-demand by manual triggers from system operators e.g. keyboard key-stroke.
70.	<p>The VMS shall support the following recording modes:</p> <ul style="list-style-type: none"> a. Total recording – the VMS shall constantly record the video input. The VMS shall allow for continuous recording of all video inputs b. Event based recording – the VMS shall record the video input only in case an event has

Sr #	Requirement
VMS and Video Analytics	
	occurred
71.	<p>VMS shall support the following triggers to initiate a recording</p> <ul style="list-style-type: none"> • Scheduler – the recorder will record the video inputs based on a specified schedule. • The VMS shall allow recording based on a time schedule for all or some of the video channels • The VMS shall allow for multiple recording periods per day, per channel • The VMS shall have the option to set any available trigger in the system (VMD/TTL/Soft Trigger and/or API) to trigger the channel • The VMS shall have the option for individual channel setup of pre/post-alarm recording for defined interval • The VMS shall have the ability to enable/disable triggers through a daily time schedule • Manual – the user shall be able to initiate a manual recording upon request. • The VMS shall work in conjunction to the any previous alarm operations • The VMS shall allow API Triggers • All trigger information shall be stored with the video information in the VMS data set and shall be made available for video search
72.	<p>The VMS recording and replay management systems shall support the following features and operations:</p> <ul style="list-style-type: none"> • Play back shall not interfere with recording in any way • Support either analogue cameras connected via Codecs or IP-cameras directly connected to the network • Stream live images through the network using IP Multi-cast techniques • Store the recording stream from all cameras simultaneously with no degradation to any individual camera recorded image stream unless the system is configured by administrator to allow for change in quality • Deliver live video to VMS workstation within a period of one second from manual call up • Deliver live video to VMS workstation within a period of three seconds from automatic alarm receipt on alarm interface • Storage of each camera’s images at a rate and resolution as defined in the Codec or IP camera configuration. The system VMS programming shall automatically vary these rates in response to time profiles, alarm inputs • Support streaming of recorded files using IP Unicast directly to hardware decoders for display on analogue monitors or software decoder when/if required • Playback multiple, synchronized recorded streams at differing speeds and frame rates • playback a video stream simultaneously at differing speeds and frame rates • Time stamping of every recorded video field based upon Network Time Protocol (NTP) time • Selectable on-screen-display of time and camera title during playback • Configurable granularity of video files • Generate alarm when storage medium has fallen below a user selectable threshold • Stored video files can be “down-loaded” to the systems and then directly CD ROM and/or DVD or WORM for replay using the VMS video replay application, and shall incorporate proof of authenticity • Download video records in common (e.g. AVI) file format for remote, cursory review and assessment prior to generating tamper-evident auditable copies

Sr #	Requirement				
VMS and Video Analytics					
73.	The video alarm handling shall provide the following facilities for the handling and management of video images generated by alarms associated with other systems integrated with the VMS.				
74.	The VMS shall also accommodate operator-initiated recording of a given cameras				
75.	VMS shall be integrated within a consolidated GUI that would include other Command and Control Centre systems as well. All events, activations and alarms that occur with the VMS and its sub systems will: <ul style="list-style-type: none"> Interact seamlessly between the Command and Control Centre sub systems as required shall be sent and Open Source Programming Console3 (OPC1) interface or using Software Development Kit (SDK) 				
76.	The VMS shall enable handling of 200 cameras, on day one, as well as future scalability upto 2000 cameras as may be required.				
77.	VMS Interfaces to Other Systems <table border="1"> <thead> <tr> <th>System</th> <th>VMS</th> </tr> </thead> <tbody> <tr> <td>Geographic Information System (GIS)</td> <td> <ol style="list-style-type: none"> Camera definitions that would be overlaid on GIS map Camera Map and locations </td> </tr> </tbody> </table>	System	VMS	Geographic Information System (GIS)	<ol style="list-style-type: none"> Camera definitions that would be overlaid on GIS map Camera Map and locations
System	VMS				
Geographic Information System (GIS)	<ol style="list-style-type: none"> Camera definitions that would be overlaid on GIS map Camera Map and locations 				
78.	The VMS shall have the capability to utilize unified storage server configurations, in any combination, and shall support a dual redundant system enabling instant control to the standby (slave) server in the event of the main server failure.				
79.	Software to manage the dual redundant modes shall be located in the DC at Command and Control Centre and shall monitor the main (master) server and its parameters. It shall also judge the health of the recording system elements (unified storage) by maintaining and monitoring a database of the status of relevant server parameters.				
80.	The software shall also determine when to switch a drive, should a drive or server failure be detected, in order to maintain the integrity of recording of images.				
81.	This change-over shall be fully automatic but the system shall signal a failure warning to designated Operator workstations or within the GIS (or equivalent) to allow rectification to be initiated.				
82.	The software that manages the server conditions shall either be part of the VMS (i.e. a module) or independent but integrated within the VMS itself, if provided separately.				
83.	The VMS shall provide the capability to configure, monitor and diagnose all CCTV hardware including cameras and encoders. This will include real time errors and warnings generation on operator console via an Open Process Control (OPC).				
84.	The VMS shall have the capability to utilize unified storage server configurations, in any combination, and shall support a dual redundant system enabling instant control to the standby (slave) server in the event of the main server failure.				
85.	Software to manage the dual redundant modes shall be located in the DC at Command and Control Centre and shall monitor the main (master) server and its parameters. It shall also judge the health of the recording system elements (unified storage) by maintaining and monitoring a database of the status of relevant server parameters.				
86.	The software shall also determine when to switch a drive, should a drive or server failure be detected, in order to maintain the integrity of recording of images.				
87.	This change-over shall be fully automatic but the system shall signal a failure warning to				

Sr #	Requirement
VMS and Video Analytics	
	designated Operator workstations or within the GIS (or equivalent) to allow rectification to be initiated.
88.	The VMS shall feature a diagnostics package that provides operation and maintenance personnel with a single interface to review all VMS operating parameters, failure messages and system alarms.
89.	The system shall support and be configured to send SNMP (Simple Network Management Protocol) traps that may be monitored to enable a centralized first line support service. VMS shall support minimum SNMP.
90.	The diagnostics package shall allow for easy system fault analysis in the event of loss of video, system control or network failure.
91.	The system shall also provide the ability to log all operational functions for future investigations and reports. The system shall be fully configurable allowing a selection of parameters that can be optionally logged. Both pre-defined and custom reports shall be available for generation from all system logs and then optionally exported to standard Windows format programs.
92.	VMS systems shall be provided with a method of backing up their software and data bases such that the system can be rebuilt in its entirety from these stored components. This shall be via a specific purpose device and not that used below for the video archiving.
93.	The system shall also be provided with a method of imaging each server and workstation so as to allow a convenient fast restore shall be required. The mechanism shall be shared with the backup device outlined above but not the devices used for video archiving.
94.	A wide array of video analytics shall be deployed based on efficacy of the analytics on –field and their need in Naya Raipur. The minimal functionality expected includes: <ul style="list-style-type: none"> • Presence detection for moving and stopped vehicles • Directional sensitive presence detection • Congestion Detection • Loitering detection • Improper Parking • Camera Tampering • Abandoned objects detection All cameras should support motion detection, camera tampering.

III. Intelligent Transport Management System

MSI has to supply, install, commission and maintain the required number of ANPR in the location as mentioned in Annexure IV. MSI has to install Speed detection device also in the 4 lane at 10 locations (to be decide by NRDA). MSI has to provision for poles, switch, UPS and other equipment for installing the devices. The MSI should do necessary cabling for electrical supply and connectivity from nearest Power and OFC.

Sr #	Requirement
Speed Violation detection system	
1.	The System should be required to accurately capture and store images, establish a chain of custody for the image medium, and process and issue citations for speed limit violations in accordance with the City’s policies

Sr #	Requirement
2.	The system should have the capability to generate clear, easily identifiable images of Infraction for the citations/violations, allowing an unbiased individual to determine fault (including extenuating circumstances).
3.	The system should be capable of accurately measuring speeds, detecting speed limit violations and photographing the incident.
4.	The system should be rugged i.e. the equipment should be capable of deployment in a wide range of operating conditions (heavy traffic volumes, adverse weather conditions, road surface configuration, etc.) and across all moving lanes of traffic.
5.	The system must be tamperproof.
6.	The system should be capable to produce, store and transmit a video component in conjunction with the digital camera system.
7.	The video system must attach a verification video segment to each speed limit violation and each day's full 24 hours of video must be saved and be available to the City for viewing for up to ninety (90) days. Or System should be capable to produce, store and transmit a sequence of at least 10 images of any infraction detected
8.	Speed violations should be automatically detected by the camera setup.
9.	System should use any appropriate sensor technology to trigger the camera during speed Violation
10.	<p>The camera unit must produce an image which contains the following</p> <ul style="list-style-type: none"> • Scene of location where violation occurred • Vehicle during violation (either approaching or departing the camera) • Speed of vehicle during violation • Display of rear Number plate of vehicle • Plate must be readable from the main image • Day, month, and year of the violation • The time of the violation in hours, minutes, and seconds frame sequence number
11.	The camera unit shall produce an image which contains the classification the vehicle (LMV, HMV etc)
12.	The system should have secure access mechanism for validation of authorized personnel
13.	Deletion or addition and transfer of data should only be permitted to authorized users.
14.	Log of all user activities should be maintained in the system
15.	Roles and Rights of users should be defined in the system
16.	All components of the system should culminate at a single onsite processor/central unit
17.	System should be able to store all the data temporally on local server/onsite processor until transferred to the central storage
18.	Apart from Speed violation detection, the system should also be able to perform ANPR on all the vehicles passing the site and send alerts to the central server on detection of any Hot listed vehicles (whose numbers have been marked as Stolen, Wanted, etc. at the Central server).
19.	The system should have an option for the user to enter Hot-Listed vehicles at the Central Server and the same should be promulgated to all the sites automatically over the network.
20.	Alerts should be raised real time, however violation data should be sent in batch mode as per available bandwidth.
21.	System should be able to integrate with RTO database or any other structured database
22.	Centre software should support Easy to use Graphical Interface

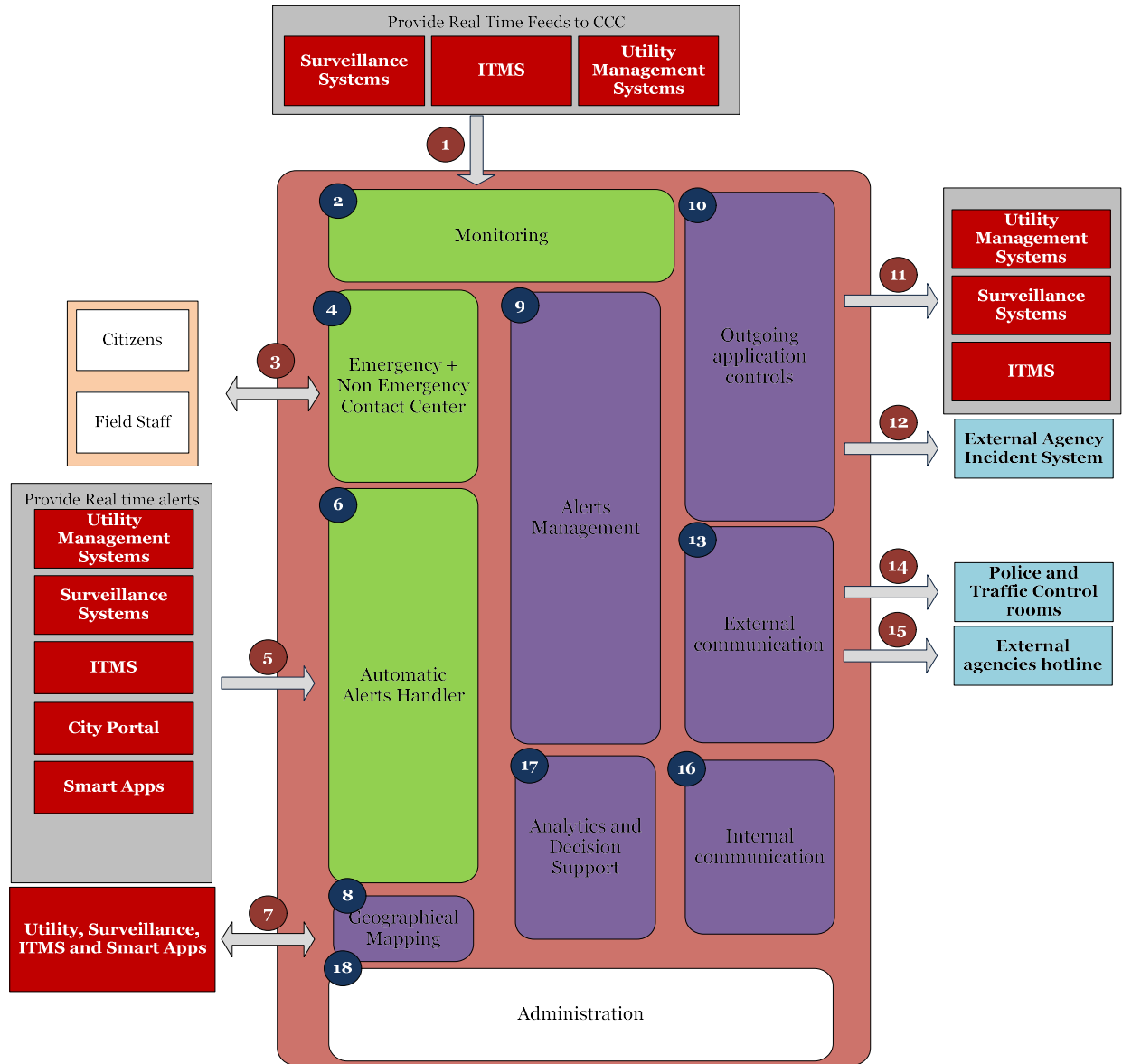
Sr #	Requirement
Integration with BRTS	
1.	The existing BRTS buses already have GPS tracker and CCTV installed in buses. The city BRTS system shall be integrated with the Command and control centre (CCC) for providing the real-time information of buses running on the routes. The Information shall be available on GIS map at CCC. These information should also be accessible to residents/citizen through city portal and Mobile App.
2.	The video feed of Bus shelter is currently available in the control centre of BRTS. Same is required to be monitored at the CCC.
ANPR System	
1.	The ANPR System shall enable monitoring of vehicle flow at strategic locations. The system shall support real-time detection of vehicles at the deployed locations, recording each vehicle, reading its number plate, database lookup from central server and triggering of alarms/alerts based on the vehicle status and category as specified by the database. The system usage shall be privilege driven using password authentication
2.	The System should automatically detect a vehicle in the camera view using video detection and activate license plate recognition
3.	The System shall automatically detect the license plate in the captured video feed in real-time.
4.	The system shall perform OCR (optical character recognition) of the license plate characters (English alpha-numeric characters in standard fonts).
5.	The System shall store JPEG image of vehicle and license plate and enter the license plate number into RDBMS solution (The Application should be based on Standard RDBMS Solution)
6.	System should be able to detect and recognize the English alpha numeric License plate in standard fonts and formats of all four wheelers including cars, HCV, and LCV.
7.	The system shall be robust to variation in License Plates in terms of font, size, contrast and color and should work with good accuracy
8.	Once the OCR read is obtained, the information is then compared against a database of vehicles of interest, typically known as a “hot list.” Hot list information can come from a variety of sources like national database Vahan/CCTNS etc. The purpose of these lists is to alert the officer that a vehicle displaying a license plate number that is included on a hot list has been identified by the ANPR camera
9.	The system shall detect the color of all vehicles in the camera view during daytime and label them as per the predefined list of configured system colors. The system will store the color information of each vehicle along with the license plate information for each transaction in the database.
10.	The system shall have options to search historical records for post event analysis by the vehicle color or the vehicle color with license plate and date time combinations
11.	The system should have option to input certain license plates according to the hot listed categories like “Wanted” ”, “Suspicious”, “Stolen”, etc by authorized personnel.
12.	The system should be able to generate automatic alarms to alert the control room personnel for further action
13.	On successful recognition of the number plate, system should be able generate automatic alarm to alert the control room for vehicles which have been marked as "Wanted", "Suspicious", "Stolen", "Expired". (System should have provision/expansion option to add more categories for future

Sr #	Requirement
	need).
14.	The Instantaneous and automatic generation of alarms. In case of identity of vehicle in any category which is define by user.
15.	The system shall enable easy and quick retrieval of snapshots, video and other data for post incident analysis and investigations.
16.	The system should be able to generate suitable MIS reports that will provide meaningful data to concerned authorities and facilitate optimum utilization of resources.
17.	The system shall have Search option to tune the reports based on license plate number, date and time, site location as per the need of the authorities.
18.	The system shall have option to save custom reports for subsequent use. The system shall have option to export report being viewed to common format for use outside of the ANPRS or exporting into other systems.
19.	The system should provide advanced and smart searching facility of License plates from the database. There should be an option of searching number plates almost matching with the specific number entered (up to 1 and 2 character distance)
20.	The system should have an option to add new category by authorized personnel.
21.	The system should have option to update vehicle status in specific category by authorized personnel. e.g. on retrieval of stolen vehicle, system entry should be changed from "Stolen" to "Retrieved".
22.	The Central Management Module shall run on the ANPRS Server.. It should be possible to view records and edit hotlists from the Central Server.
23.	System should have option to specify maximum time to retain vehicle records in specific categories.
24.	Base Specification of Fixed Box Cameras must be part of the ANPR specifications.

IV. Command and Control Centre

The Smart City System will comprise of various Applications and field level equipment's which will provide data and information to the City Command and control Centre (CCC). The CCC will process these inputs and provide the integrated view to the various decision makers like emergency response team for actionable intelligence. The layout of Ground floor of the building which will be used for setup of Command and Control room cum NoC cum helpdesk (CCTV Monitoring room) and Technical staff seating space is provided in Annexure XIII of this volume.

The below diagram shows the interaction of various entities with the various functions of the CCC:



The proposed functionality of each block, as depicted in the diagram above, is described below (S.No's mentioned in the table below are mapped to the block numbers mentioned in the diagram):

S. No. (Mapped to ref numbers in the diagram)	Type	Description
1.	Interface	The surveillance, intelligent transport and utility management systems will provide real time, at pre-defined frequency and on-demand feeds into the CCC.
2.	CCC Function	Feeds received from systems mentioned in 1 above shall enable CCC to perform real time monitoring of the city operations. The monitoring shall be facilitated by feeds being transmitted on to the individual desktops and the large video wall inside the City Operations Room for collaborative monitoring.
3.	Interface	The contact centre interface will provide citizens and field staff of various agencies with the single point where they will be able to record their grievances / feedback / incidents. This interface will enable citizens to interact with CCC through audio call, SMS, mobile interface and web interface. This will be a two way interface enabling citizens to pass information to CCC and receive updates from CCC on the actions taken by CCC.
4.	CCC Function	The contact centre function will enable CCC to record and update both day to day incidents such as electricity break down and emergency situations such as accidents. The contact centre will receive the information from citizen and record in the database which will trigger the workflow for resolution of the incident.
5.	Interface	The systems deployed throughout the city will be monitoring the various incidents taking place as per the rules defined in the respective systems. The incidents captured automatically by these monitoring systems shall be reported into the CCC via this automated interface. This will enable CCC to create a centralized repository of all incidents reported throughout the city either manually (as in 3 &4 above) or through this automated interface. The envisaged systems that will be generating these alerts are – <ul style="list-style-type: none"> • Utility Management Systems (SCADA) • Surveillance Systems • Intelligent Transport Management System • City Portal (Web Interface for stakeholders to record incidents) • Smart Mobile Apps (Mobile Interface for stakeholders to record incidents)

S. No. (Mapped to ref numbers in the diagram)	Type	Description
6.	CCC Function	This function within the CCC will enable it to receive the alerts, add relevant data to the alerts incident and pass on to next entity as per pre-defined workflow
7.	Interface	Surveillance, ITMS and Utility Management Systems would use the geographical functions and geo-spatial data stored in the central GIS application for implementing their functionality that requires GIS layer. The required data and functionality exchange would be done through this system.
8.	CCC Function	This block refers to the centralized GIS layer that would be created at CCC for access by other systems.
9.	CCC Function	The incidents reported manually through contact centre as well as automatically received through alerts handler shall be handled by functional this block. It will execute the workflow for managing the incident life cycle as per pre-defined business rules and SOPs. This will ensure consistency of response to incidents.
10.	CCC Function	The CCC will control the surveillance, ITMS and Utility Management systems via this interface enabling them to be controlled through a common interface.
11.	Interface	This interface will enable CCC to pass data to be used by various systems e.g. view triggers into various systems such as viewing a specific camera view into CCC, sending SMS through a SMS gateway etc.
12.	Interface	This interface will enable CCC to pass data to intimate the respective agency about incident reported in CCC e.g. creating incident in incident management system of electricity department about power failure
13.	CCC Function	This function will enable CCC to interact with external stakeholders. This block shall use tools such as Video Conferencing, Agency hot-lines etc.
14.	Interface	This interface shall enable transfer of video feeds to traffic and police control rooms
15.	Interface	This interface shall enable audio and video hotlines to agencies and offices in case of emergency situations
16.	CCC Function	The internal communication within CCC shall be managed through video conferencing and IP telephony systems

S. No. (Mapped to ref numbers in the diagram)	Type	Description
17.	CCC Function	This block will enable CCC to perform analytics on the data gathered during lifecycle of various incidents thereby enabling it to make informed changes to its SoPs, business rules and workflows.
18.	CCC Function	This block will enable CCC to define the security access rights, Standard Operating Procedures, Business Rules, and Workflows etc to enable the CCC to function in the desired manner.

The technical components of the CCC solution are mentioned below along with the mapping to functionality that they cater as per the functional block diagram.

S. No.	Solution Component	Functional Blocks Catered
1.	CCC application	1, 2, 5, 6, 9, 10, 11, 12, 17, 18
2.	GIS application with high resolution satellite image (base map) of Naya Raipur	7, 8
3.	Video wall display system	2
4.	Video Conferencing System	13, 14, 16
5.	IP Telephony	13, 15, 16
6.	Contact centre system, appliances and work stations	3, 4
7.	Operator appliances and work stations	2
8.	SMS Gateway	13, 16

In addition to the above mentioned CCC shall be equipped with following facilities:

- Operating facilities for following personnel:
 - CCC operators
 - Contact Center/helpdesk
 - Technical Support
 - NoC
 - Security
- Meeting / conference rooms

MSI has to do civil work for setting up the CCC and install required furniture and fittings. MSI has to provision for necessary power backup for the CCC.

Sr #	Requirements
Command and Control Application (CCA)	
1.	The CCA should be commercial-off-the-shelf applications that are customizable to meet the requirements of the RFP.
2.	The CCA should have the capability to integrate with existing GIS. If certain layers are not available then the MSI should give the details to the owner for creation of the layers.
3.	The system shall provide CCA operators and managers with a management dashboard that provides a regular status and is automatically updated when certain actions, incidents and resources have been assigned, pending, acknowledged, dispatched, implemented, and completed. The above attributes shall be colour coded.
4.	The CCA shall provide the “day to day operation”, “Common Operating Picture” and situational awareness to the centre and participating agencies during these modes of operation
5.	It shall improve scalability for large and geographically distributed environments.
6.	It shall provide complete view of facilities, sensors, and alarms in an easy-to-use and intuitive GIS-enabled graphical interface with a powerful workflow and business logic engine.
7.	It shall provide a uniform, coherent, user-friendly and standardized interface
8.	It shall provide possibility to connect to workstations in order to be displayed in one or more video wall with one or more module/application/solution being independently and/or simultaneously being displayed and functional.
9.	The dashboard content and layout shall be configurable and information displayed on these dashboards shall be filtered by the role of the person viewing dashboard.
10.	CCA should allow creation of hierarchy of incidents and be able to present the same in the form of a tree structure for analysis purposes
11.	The system shall integrate with GIS and map information and be able to dynamically update information on the GIS maps to show status of resources.
12.	The system shall also provide an integrated user interface to other Naya Raipur Smart City systems such as City Surveillance System, Utility Management System and Intelligent Transport as well as other third party information systems.
13.	The CCA shall be available via a VPN as a web-based interface or a thin-client interface.
14.	It shall be possible to combine the different views onto a single screen or a multi-monitor workstation.
15.	CCA should maintain a comprehensive and easy to understand audit trail of read and write actions performed on the system.
16.	System should provide ability to extract data in desired formats for publishing and interfacing purposes.
17.	System should provide ability to attach documents and other artifacts to incidents and other entities.
18.	<p>CCA is required to issue, log, track, manage and report on all activities underway during these modes of operation:</p> <ul style="list-style-type: none"> • anticipation of incident • incident or crisis • recovery • incident simulation

Sr #	Requirements
19.	<p>Core Components</p> <ul style="list-style-type: none"> <li>• Business Rules and SOP Definitions – should enable users to define the business rules around incidents handling as per agreed SOPs for Naya Raipur Smart City <li>• System Platform – The platform should provide a common data integration layer which can collect and contextualize information from disparate data sources regardless of protocol. The platform should support templization to allow “build once-deploy everywhere” functionality. <li>• Workflow and Incidents Lifecycle engine – This function should allow users to define and modify new workflows. The workflow could cut across multiple systems via the interfacing modules. Workflow for operational alerts and escalations should be triggered automatically without human intervention. Workflow approvals should have facility to approve from any device with e-signature. This function should provide facility to trigger a corrective action workflow and define the stakeholders for the same. Should manage the life cycle of incidents and related entities via pre-define workflows. The workflow could cut across multiple systems via the interfacing modules. Workflow for operational alerts and escalations should be triggered automatically without human intervention. <li>• Incidents Planning – should manage the planning preparations of an incident including resource allocation, tasks management etc. <li>• Analytics and MIS – should provide users with business analytics reporting and tools to organize, evaluate and efficiently perform day to day operations <li>• Incidents and KPI Dashboards – should present role filtered critical information pertaining to incidents and KPIs collated in a single view which can be drilled down further for more detailed information <li>• Security & Roles – should manage roles definition for internal as well as external access <li>• Centralized data archiving for operational data : Should provide facility for centralized storage of operational data (time-series or transactional) with high granularity and data compression capability <li>• Mobility: should enable app-based access to monitor alerts, KPI ,KOPs, SOPs and reports to mobile users. Should support popularly user’s smartphone /tablets. App content should be presented in context to the user role.
20.	<p>Planning</p> <ul style="list-style-type: none"> <li>• The CCA software should have a planning, workflow and business rules engine to define the Standard Operating Procedures (SOPs) into the system. <li>• The organization of NRDA and participating agencies should be configured into the CCA solution. The CCA should be able to create the NRDA City Management Centre organization structure together with roles and responsibilities within the system. Access to system

Sr #	Requirements
	<p>functions and data shall be as per define roles and organization structure.</p> <ul style="list-style-type: none"> • The SOPS shall be capable of being converted into editable but administrator protected workflow and tasks. • The CCA shall present the workflow and task information in a clear and logical manner on the incidents screen. • CCA system shall include a section that will contain the Policy and standard operation procedures with easy to search functions to support the Operators during a crisis.
21.	<p>Situational Awareness COP (Common Operational Picture)</p> <ul style="list-style-type: none"> • The CCA should be able to combine data from various sources and present it as different views tailored to different operator’s needs. • The CCA should automatically update the information based on alarms and incidents that are presented to it via the business rules engine. The polling and CCA database refresh cycle shall be configurable to match the status of the situation (whether there is an emergency or crisis or just monitoring only). • Common Operational Picture should comprise of a comprehensive view of the incident or a group of related incidents as on a specific date and time which should include but not be limited to the following: <ul style="list-style-type: none"> ○ Tasks assignment and their status ○ Agencies involved ○ Resources deployed ○ Incident status across relevant parameters of the incident e.g. household affected by a transformer shut down ○ Timeline view of the situation ○ Suggested actions from the system with their status
22.	<p>Warning and Mitigation</p> <ul style="list-style-type: none"> • The CCA should use analytics to create a view of hazards and priorities based on a severity and risk profile. • The CCA shall be able to import data into its analytical tool. • CCA should be capable of easily interfacing with any other external analytical tool that might be required in future to provide warning inputs to Naya Raipur Smart City. • The CCA shall present a prioritized list of key anticipated incidents, actual incidents, and tasks requiring action. • CCA should be capable of performing multi-dimensional analysis on incidents data. This should provide capability to do: <ul style="list-style-type: none"> ○ Trends Analysis ○ Predictive Capability

Sr #	Requirements
	<ul style="list-style-type: none"> ○ “What-if” analysis
23.	<p>Resource Management</p> <ul style="list-style-type: none"> • The system shall provide an object based as well as visual representation of the multi-agency command structure at an incident. This visual representation is to be in the form of an organizational structure diagram. The management of resources, (who is doing what and answering to whom) is a critical part of this system and shall be configured into a particular actors attributes. • The system shall provide the following configuration functions around roles: <ul style="list-style-type: none"> ○ Allocation of roles ○ Creation, Editing and renaming of roles ○ Color coded role definition ○ Symbolic representation of roles ○ Notes and comments against roles • The system should provide a mechanism to define roles that are consistent with Organization Structure defined in CCA as part of requirements defined Planning section earlier. • The system should provide the following configuration functions around resources: <ul style="list-style-type: none"> ○ Building up the resourcing information on the organization structure ○ Creation of resources as different types of assets, (Human, physical, financial, equipment, vehicles, machinery etc.) ○ Assignment of individuals to locations, agencies, tasks, or other resources ○ Creation of call signs and symbols relating to resources. ○ Maintaining relationships between resources. ○ Tracking of availability and movement of resources • The system should provide ability to define attributes of above mentioned resources and their relationships in order to capture the resource definition in a structured manner. • The system should provide ability to create organization structures that could be assigned to a specific operation, incident or a task. Thus assigned organization structure take precedence over the default organization structure
24.	<p>Task Management</p> <ul style="list-style-type: none"> • The system should be able to create, assign, track and report on the lifecycle of tasks during a particular incident. • The system should allow a particular task to be decomposed into sub-tasks. • The system should provide an easy to interpret management dashboard view of the progress of all tasks during an incident. • The system should be able to organise the visual representation of tasks into prioritized list, filtered list, as well as colour coded representation for ease of understanding.

Sr #	Requirements
	<ul style="list-style-type: none"> • The system should be able to perform the following functions around task management: <ul style="list-style-type: none"> ○ Create a task with unique ID. (Subtasks shall follow parent ID with second level numbering). ○ Assign a target completion date and time for the task, either directly or as a time-span from the task's creation. ○ Date and time stamp of the creation of the task. ○ Log and track status of tasks. System should provide capability to define status of tasks during its lifecycle. These status definitions could be mapped to other task attributes such as the task type. ○ Key-word search against task list. • The above attributes shall be colour coded. • The system shall allow the tasks to be filtered on the real-time dashboard by agency then by task status. This filtering should allow an operator to filter for all tasks of a particular state or a combination of state; and by the time remaining until (or time elapsed since) the target completion time. • The system should allow multiple individual workstations to select specific agencies of interest on each workstation simultaneously. • The system should allow the NRDA to display all agencies' tasks simultaneously as well. • The tasks should be displayed on a real-time timeline. • The criticality of tasks should be dynamically changed depending on the performance of the incident response.
25.	<p>Timeline and Charting</p> <ul style="list-style-type: none"> • The system should provide a facility to see incidents and actions (tasks) added to the CCA in a tabular list form as well as GANTT chart format filtered by day, week, month, year or any specific date range. • The system should provide a facility to see incidents, actions and interdependencies between actions in a clear visual graphical manner. • The system should be able to filter the information based on at least the following parameters: <ul style="list-style-type: none"> ○ Incident information ○ Resources information ○ Agency type ○ Tasks ○ Criticality or priority
26.	<p>Business Rules Engine</p> <ul style="list-style-type: none"> • The CCA system should have a built-in alarm handling facility based on configurable cause

Sr #	Requirements
	<p>and effect rules.</p> <ul style="list-style-type: none"> • The CCA system should receive inputs (referred to as “incidents”) from various sources. These incidents when passed through the business rules engine shall trigger an automated response as defined using the business rules engine. • The business rules engine should be able to send and receive messages to other applications running within the CCA suite as well as external systems like the surveillance system. • The business rules engine shall be able to co-relate between different types of incidents or frequency of similar types of incidents. • The business rules engine shall be able to distinguish between “early warning or anticipation” type mode of operation and an “emergency or crisis” mode of operation. • The CCA shall provide capability for users with appropriate rights to define business rules. • Any update to the Business Rules (Add/Edit/Delete) shall go through an approval workflow before the rule gets activated. Workflow approvals should have facility to approve from any device with e-signature. • The CCA shall provide capability to do a simulation run of a newly created/added business rule before it is activated.
27.	<p>CCA Graphical User Interface (GUI)</p> <ul style="list-style-type: none"> • The CCA should present information on standard Windows based workstations and terminals. • The CCA GUI should have the following capabilities as standard: <ul style="list-style-type: none"> ○ The CCA GUI shall be able to present management data such as dashboards, alarm and alerts, resource management information, incident information in colour coded, clear, simple and unambiguous, logical format. ○ The colour coding on the CCA GUI shall represent the different status of a task or incident / alert. ○ The GUI layout and arrangement of windows shall be user customizable. ○ Be able to present information and distinguish between an “early warning or anticipation” type set of data and “emergency or crisis” operating mode. • The CCA should be capable of presenting information in a browser based format such that it is accessible from any terminal with a web-browser. The supported browser should include, but not limited to, Internet Explorer, Chrome, Firefox and Safari • The CCA should be capable of showing still as well as video imagery. • The CCA shall also be able to present information on mobile devices such as tablets, smart-phones and tablet type devices while maintaining the basic UI features such as user friendliness, colour coding etc.

Sr #	Requirements
	<ul style="list-style-type: none"> • The CCA information shall be capable of pushing onto other display devices such as the video wall of the City Management Centre. • The CCA should be capable of providing the following features for still imagery: <ul style="list-style-type: none"> ○ The system shall have a thumbnail gallery to display all imported images ○ The system shall be able to import pictures from still imagery cameras ○ The system shall be able to import pictures from local hard drives ○ The system shall be able to share the imported images with other users ○ The system shall time and date stamp any imported images ○ The system shall have the ability to view each still image full screen ○ The system shall have the ability to zoom in an out of a still image when viewed full screen ○ The system shall allow the image to be imported to the planning whiteboard module ○ The system shall enable users to add tags to images for easy search and retrieval later on ○ The system shall enable users to group and title images together for easy retrieval • The CCA should be capable of providing the following features for video imagery: <ul style="list-style-type: none"> ○ The system shall be able to display video imagery ○ The system shall have a thumbnail gallery to display all video images ○ The system shall allow the video streams to be grouped and titled as per defined requirements. • The CCA presentation server shall have the capability of only refreshing those elements of the GUI that have changed state.
28.	<p>Recovery and Reporting</p> <ul style="list-style-type: none"> • The CCA should have a background function to collect and store the centre’s performance data during an incident. The performance data shall be user configurable. Typical fields for performance shall be: <ul style="list-style-type: none"> ○ Actions-planned versus actual ○ Resources involved ○ Decisions executed ○ Schedule / incident duration performance ○ Incident information, e.g. no. of fatalities, persons recovered ○ Post-incident recovery information • The analytics tool should be able to produce performance analysis and produce dashboard reports on performance. • The CCA should be capable of providing a clear reporting function following an incident for: <ul style="list-style-type: none"> ○ Management and dashboard reporting ○ Analysis of what went well and “lessons learnt”

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	<ul style="list-style-type: none"> • The CCA should allow users to define benchmarks against performance parameters. Performance reports shall have the option to generate reports with or without benchmark comparison • The CCA should provide facility to trigger a corrective action workflow and define the stakeholders for the same.
29.	<p>General System Display Functionality</p> <ul style="list-style-type: none"> • Shall have the facility to view and handle multiple alarms at one time • Shall have the facility to view multiple video windows at one time. Operators shall be able to resize and move video windows. • Shall have the facility to view windows in a single monitor or across multiple monitors • Shall have the facility to access, display and manage incidents/alarms and related sensors data and information from subsystem based on priority and authority level. • Shall view and manage detailed response procedures and tasks • Shall enable a single operator or multiple operators to monitor and control commands from connected subsystems, including all operational capabilities for detection, assessment, notification, entry control, and communications • Shall provide the rapid annunciation and display of alarms to facilitate evaluation and assessment
30.	<p>GIS Display</p> <ul style="list-style-type: none"> • Shall view the environment through geospatial or fixed composite computer-generated (JPEG, BMP, AutoCAD, etc.) map • Should allow user to view sensor and related name from the displayed map • Should allow all resources, objects, sensors and elements on the map to be geo-referenced such that they have a real world coordinate. • Should visually display a camera sensor with related camera orientation, camera range and camera field of view angle. • Should visually display an alarming sensor on map • Should visually differentiate sensor alarm severities on map through different color and icon identifiers • Should immediately view alarm details (including description, video, etc.) and investigate the alarm from the map • Should allow user to choose camera and other sensors from map to view live video and the

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	<p>data</p> <ul style="list-style-type: none"> • Should allow user to choose camera and take live video image snapshot and save to file from any camera • Should allow user to choose camera from map to move PTZ cameras • Should allow user to choose camera to play, pause, stop, fast-forward, rewind, and play recorded video from preset time • Should allow user to choose camera and take recorded video image snapshot and save to file or print from any live or recorded video • Should allow user to jump from one map to the next with a single click of a mouse with map links • Should allow map information “layers” to be displayed/hidden on items such as – <ul style="list-style-type: none"> ○ Sensor names ○ Sensors ○ Sensor range (e.g. camera – orientation, range, field of view angle) ○ Locations and zones ○ Perimeter ranges ○ Resource tracks ○ Allow user to zoom in/out on different regions of map graphic
31.	<p>Video Display</p> <ul style="list-style-type: none"> • Shall view live or recorded video from resizable and movable windows • Should have an ability to perform video controls for video systems from workstation • Shall play, fast-forward, rewind, pause, and specify time to play recorded video • Shall take a video still image (snapshot) from live or recorded video • Shall export video for user specified time and duration • Shall have the capability to move PTZ cameras • Shall view Video in Video Matrix • Shall display in 1x1, 2x2, 3x3 and 4x4 window formats • Shall enable operator to specify video windows to be displayed in matrix • Shall enable matrix settings to be saved per user • Shall view either live or recorded video can be displayed in the video matrix window. • Shall enable video snapshot to be taken and saved from any window pane in the matrix

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	<p>view</p> <ul style="list-style-type: none"> • Shall rotate video in “virtual” video guard tour • Shall rotate through multiple video views based on predefined video camera sequence and duration. • Shall enable the user to pause the rotation of video and resume the video rotation again • Shall enable times between new video to be adjusted • Shall enable both live video and recorded video to be played through the video guard tour. • Shall enable alarms to be generated from any video pane • Shall enable user to only view and control video for which they have been assigned permissions by the administrator • Shall manually create an alarm from the live or recorded video with specified severity and description
32.	<p>Summary Dashboard</p> <ul style="list-style-type: none"> • Shall provide alarm summary of each monitoring zone or monitoring area in graphical chart format • Shall display the following charts per global area, monitoring zone or monitoring area • Shall Open Alert Count by Monitoring Zone/Monitoring Area • Shall have the capability of New vs. Viewed (Opened Alerts) • Shall Open Alert Count by Alert Severity • Should have Highest Severity Alert • Shall enable Monitoring Zone or Monitoring area default to Summary view dashboard or to a map when the zone or area is selected. • Shall provide a tabular list of sensors in each monitoring are
33.	<p>Alarm Display</p> <ul style="list-style-type: none"> • Shall display real time, dynamic, iconic status of alarm point indications, overlaid onto a computer generated or GIS graphic map of the detection area and zone • Shall display textual alarm description alarm status, severity, activity, operator actions, tasks and procedures, and time/date status. • Shall allow users to view digital video scenes, automatically or manually, related to alarm for both live and recorded video

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	<ul style="list-style-type: none"> • Shall allow users to handle alarms based on priority • Shall allow users to handle and view multiple alarms in individual windows or in a list • Shall allow users to view alarm notification in system tray • Shall allow users to view alarm notification and alarm summary in alert list window pane • Shall allow users to view alarm notification in the hierarchical tree view • Shall allow users to view alarm in a specific zone and associated with specific sensor on the map • Shall allow users to view a list of alarms associated to a sensor on the map • Shall sort alarms list by <ul style="list-style-type: none"> ○ time/date ○ severity (i.e. highest severity on top) ○ alarm type ○ location ○ alarm source
34.	<p>Alarm Handling</p> <ul style="list-style-type: none"> • Should have an ability to display alarm condition through visual display and audible tone • Should have an ability to simultaneously handle multiple alarms from multiple workstations • Should have an ability to automatically prioritize and display multiple alarms and status conditions according to pre-defined parameters such as alarm type, location, sensor, severity, etc. • Should display the highest priority alarm and associated data / video in the queue as default, regardless of the arrival sequence
35.	<p>Historical Alarm Handling</p> <ul style="list-style-type: none"> • Should have an ability to view historical alarms details even after the alarm has been acknowledged or closed. • Should have an ability to sort alarms according to date/time, severity, type, and sensor ID or location.
36.	<p>Alarm Reporting</p> <ul style="list-style-type: none"> • Should have an ability to generate a full incident report of the alarm being generated. • Should have an ability to display report on monitor and print report • Should have details of alarm including

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	<ul style="list-style-type: none"> ○ severity, time/date, description and location ○ Captured video image snapshots ○ Relevant sensor data such as SCADA sensors ○ Response instructions ○ Alarm activities (audit trail) ● Should have an ability to export alarm report in various formats including pdf, jpeg, html, txt, and mht formats ● Should have an ability to generate an alarm incident package including the full incident report and exported sensor data from the incident in a specific folder location.
37.	<p>Alarm Policies and Business Logic Administration</p> <ul style="list-style-type: none"> ● The CCA solution should have the following ability to handle the workflow alarms through graphical user interface. ● Should have an ability to match keywords or text from the alarming subsystem's incident description to raise an alarm using criteria including exact match, exact NOT match, contains match, wildcard match and regularly expression match (such as forced door alarm, denied access, door open too long, etc.) ● Should have an ability to optionally match alarming subsystem's incident status, incident severity, and sensor type ● Should have an ability to apply any alarm policy to one or more monitoring area(s) or zone(s) without having to reapplying the policy multiple times. ● Should have an ability to apply any alarm policy to one or more sensors without having to reapply the policy multiple times. ● Should have an ability to assign specific actions for each alarm ● Should have an ability to activate or deactivate alarms as required ● Should have an ability to create exceptions ● Should Create batch-wise rules and process them ● Should Check and rectify logical errors and contradictory rules ● Should have an ability to schedule execution of rules ● Should Suspend or Terminate the application of rule ● Should archive unused or deactivated rules
38.	<p>Availability, Scalability, Performance and Usability</p> <ul style="list-style-type: none"> ● The CCA shall be highly available platform.. ● The system shall be very tolerant to losses or reduction of communication such that the

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	<p>system shall recover gracefully from such incidents, with no human interaction required.</p> <ul style="list-style-type: none"> • Should have a high performance and high availability architecture. • Shall be flexible, modular and tolerant to failures/errors and able to exchange information with other systems • The system must have an open architecture such that additional systems when added can be integrated with CCA without upgrades or disruption to other interfaces. • The communications use standard components that are widely available. • Should allow scalability and flexibility to include more applications / solutions in the future • The CCA server shall refresh CCA GUI within 1 second of an incident trigger requiring a change of state in the information in the database. • The CCA server hardware shall be based on high availability, fault tolerant design and capable of operating in mirrored server configuration. • The CCA shall have a resilient processing architecture such that failure of a single component does not affect entire CCA application. • The system shall be able to operate at network bandwidth down to a minimum of 250 kbps. • The system shall be able to operate at network latencies as long as 2 seconds.
Video Wall Cubes	
1.	It should be able to pre-configure and save various display layouts to be accessed at any given point of time with a simple mouse click.
2.	The large screen should provide real-time clear luminous view to share information between operators and decision makers. The operators whose systems are on the same Ethernet should be able to work on the large screen sitting at their own position with their own workstation.
3.	The large screen should be able to show the images of the monitor, which is connected on the LAN with various OS and the windows should be freely resizable, scalable and repositionable on any part of the large video screen.
4.	The large graphics wall shall be consisting of multiple rear projection modules in multiple rows and columns behaving as a single logical screen.
5.	The large screen should be able to show the various applications in the City Management Centre.
6.	The display wall should be rugged and industrial nature and should be able to work in 24/7 environments.
7.	Should have the scalability and upgradeability to be made up of multiple rear projection modules stacked up in rows and columns to achieve a display wall for better viewing ability in linear or

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	curved configuration.
8.	During the useful lifetime of the illumination unit, it should be possible for color and brightness alignment of different projectors to a common target, resulting in a uniform display wall.
9.	The Projector should support Single link DVI in and Single link DVI out to have a flicker free image on the Large Screen Graphics Wall.
10.	Each cube shall have its own IP address and on board web server to have the access from a standard web page with status, health and configuration information.
11.	Power consumption for each Visual Display Unit / Rear Projection Modules should be less than 220 watts.
Video wall controller with wall management software	
1.	The software should be able to pre configure various display layouts and access them at any time with a simple mouse click or based on the timer.
2.	The software should enable the users to see the desktop of the graphics display wall remotely on the any WIN 7 PC or above connected with the Display Controller over the Ethernet and change the size and position of the various windows being shown.
3.	The software should enable various operators to access the display wall from the local keyboard and mouse of their WIN 7 or above workstation connected with the Display Controller on the Ethernet.
4.	The software should copy the screen content of the WIN 7 PC / workstation or above connected on the Ethernet with the Display Controller to be shown on the Display wall in scalable and moveable windows in real time environment.
5.	The wall management software should support open APIs to enable system integrators to integrate it with their Software.
6.	<p>Video Wall Control Software should be server client Architecture and have following specifications:</p> <p>a. The Wall Control software should perform health monitoring that allows timely detection of faults.</p> <ul style="list-style-type: none"> • Wall health • Cube health • Cube IP-address • Brightness <p>b. Wall Control Software should allow commands on wall level or cube level or a selection of cubes :</p> <ul style="list-style-type: none"> • Switching the entire display wall on or off. • Setting all projection modules to a common brightness target, which can be either static (fixed) or dynamic to always achieve maximum (or minimum) common brightness between projection modules.

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	<ul style="list-style-type: none"> • Fine-tune color of each cube <p>c. The integrated view should provide a database that</p> <ul style="list-style-type: none"> • records all incidents • can record full status at given time intervals • can be exported to excel/html • Show internal patterns <p>d. Log file functions (full Audit trail capabilities) should have the following information</p> <ul style="list-style-type: none"> • Logs are not automatically overwritten • Client logs • Central server logs <p>e. Logs should contain the following information</p> <ul style="list-style-type: none"> • Individual User ID that has control of the video wall at any given time • Name of PC that has control of video wall at any given time. • Time control was taken. • Time control was released • Time stamps in log shall be at the one (1) second interval, or less <p>f. 10 Inputs to the controllers which can be LAN/DVI/HDMI</p>
<i>Video Conferencing software and solution</i>	
7.	Video conferencing systems should be based on ITU's standards and guidelines.
8.	Should be simple user interface with command capabilities.
9.	Should be easy to use, on demand conferencing with always-on virtual meeting rooms Video
10.	One operator should be able to easily manage multiple simultaneous Conferences or several operators can manage one large Conference.
11.	Operators should be able to move participants between Conferences or create sub Conferences for private conversation
12.	The systems should be programmable to facilitate conference set-ups with pre-defined parties using only a few keystrokes.
13.	The systems should support document sharing (PC images, etc.)
14.	The systems should be supplied with a common operational support system that includes browser based system diagnostics.
15.	The systems should support central video server integration for streaming and/or storing sessions.
16.	Should support for various WAN interfaces for ISDN

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17.	Should support for IP backplane about 70Gps or higher
18.	Shall have the ability for fast deployment with web-based wizard, tiered administration levels, and automated hardware systems management.
19.	Must offer an option of integration with external media application server for Automatic failover, full redundancy and high scalability.
20.	It should have seamless integration with any Telephony Platforms (Avaya/Cisco/Alcatel-Lucent/or similar/equivalent) for Video Telephony Integration using SIP (Session Initiation Protocol). This includes seamlessly add video to a voice call by simply dialling a voice extension when both endpoints are video-enabled and permits use of unified voice and video dial plan for convenient calling.
21.	The system's WAN ports should be configurable for different speeds depending on applications.
22.	It must be capable to support symmetric 1080p & 720p HD Calls
23.	Video-conferencing equipment should support H.320 (ISDN Video conferencing) as well as H.323 (LAN Video Conferencing) standards. Should support H.261, H.263 & H.263 ++, H.264 Video standards.
24.	Should support 16:9 and 4:3 aspect ratio
25.	Automatic gain control, intelligent audio mixing.
26.	Should support for multiple Video sources like auxiliary camera, VCR, document camera, white board, dual Video should be direct i.e. abilities to send two simultaneous line Video sources e.g. Desktop Video and presenter's Video.
27.	The system should enable users through a remote device at either end to manipulate the camera angle, focus and various parameters to suit the user requirement.
28.	The camera module and microphones should have omni-directional coverage of 360 degrees.
29.	The network interface should support standard ISDN interfaces and protocols and auto Service Profile Identifier (SPID) and switch detection. Services are to be provided in conjunction with standard ISDN
30.	Should have conference dial out and dial in
31.	Should have an advanced IVR flow
32.	Must have support for both message overlay and closed caption
33.	Should have Conference chairperson
34.	Should have customizable GUI
35.	Should have Speaker Notification

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36.	Should have user and managed mute control
37.	Should have IVR prompts for auto attendance
38.	Should administrator, operator, auditor, and chairperson views
Contact Center Solution	
1.	The contact center solution should be able to route voice/ VOIP calls from centralized Interactive Voice Response System (IVRS) to respective call center (s) along with interaction history of the calling party.
2.	The callers should be able to access the various services through state-of-art centralized integrated Interactive Voice Response System (IVRS). The information is envisaged to be available to the customer through telephone (IVRS) and call centres agents.
3.	The IVRS should establish two way communication on the same channel with customers through recorded synthesized voice in Hindi / English / Regional Language or in combination of languages to give information, reply to queries and provide other.
4.	IVRS should be modular and scalable in nature for easy expansion without requiring any change in the software.
5.	It should be possible to access IVRS through any of the access device such as Landline telephone, Mobile phone (GSM as well as CDMA) etc.
6.	IVRS should support various means of Alarm indications in case of system failures, e.g. Functional error, missing voice message prompt, etc., and shall generate error Logs.
7.	The system should have the ability to define business rules based upon which the system should quickly identify, classify and prioritize callers, and using sophisticated routing, to deliver interactions to the best qualified agent in the any of the connected local/remote call centre, regardless of interaction channel
8.	<p>The application should provide CTI services such as:</p> <ul style="list-style-type: none"> • Automatic display (screen pop) of information concerning a user/customer on the call agent screen prior to taking the call based on ANI, DNIS or IVR data. • Synchronized transfer of the data and the call to the call centre agent. • Transfer of data corresponding to any query raised by any IP agent regarding a query raised by a customer whose call is being attended by the call IP agent. • Call routing facilities such as business rule based routing, skills-based routing etc.
9.	The application should support integration to leading CTI middleware vendors.
10.	Should provide pre-integration with industry standard IVR servers and enhance routing & screen-pop by passing forward the information.
11.	Should provide facilities for outbound calling list management, and software based predictive or preview dialling.

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12.	The application should allow service level plans to be varied by day, time of day, or a specific date.
13.	<p>Call Centre Agent’s Desktop: The agents desktop shall have an application which shall fulfil the following functionalities :</p> <ul style="list-style-type: none"> • It should provide consistent agent interface across multiple media types like fax, SMS, telephone, email, and web call back. • The agent’s desktop should have a “soft-phone” – an application that enables standard telephony functions through a GUI. • It should provide the agents with a help-desk functionality to guide the agents to answer a specific query intelligently. • It should also provide an easy access to agents to previous similar query which was answered successfully. • It should also be possible to identify a request to be a similar request made earlier. • It should be possible for agents to mark a query as complex/typical and put in to database for future reference by other agents. • It should be possible for agents to escalate the query.
14.	System should be able to integrate with e-mail / sms gateway so that appropriate messages can be sent to the relevant stakeholders after the interaction and any updates thereon.
15.	Should intelligently and automatically responds to email inquiries or routes inquiries with skills based routing discipline to agents
16.	Should have an Intelligent distribution of email to agents
17.	<p>CTI Application Requirements</p> <ul style="list-style-type: none"> • The CTI link should allow a computer application to acquire control of the agent resources on the IP EPABX & change state of the agent phone through commands on the CTI link. • The CTI link should pass events & information of agent states & changes in agent states as well as incoming calls to the computer applications. • The CTI link should allow a computer application to take control of the call flow inside the IP EPABX & also allow the computer application to decide the most suitable action / agent for an incoming call.
18.	<p>Automatic Call Distribution (ACD) Requirements</p> <ul style="list-style-type: none"> • The ACD solution should be able to route the call to any remote call center agent using IP phones • Should have an ability to queue or hold the call for an agent if none is immediately available. • Should have an ability to keep the callers informed as to the status of the call and providing information to callers while they wait in queue. • System should be able to perform prioritized call routing
19.	<p>Supervisor Module</p> <p>The call centre should provide a graphical console application program for the supervisor's workstation. This position shall facilitate the following features:-</p> <ul style="list-style-type: none"> • Any supervisor shall be able to monitor or control any group in the call Centre.

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	<ul style="list-style-type: none">• It shall show the live activity of each agent in details as well as in a summarized fashion including information like total number of calls received, calls answered, average response time etc.• The Supervisor console shall also graphically display live status of the call session summary, number of call waiting in the queue, call traffic etc.• Live status of the group shall be shown, including waiting calls and calls being answered currently.• Access to the supervisor console shall be restricted.• It shall be possible for a supervisor to attend calls whenever necessary.
20.	Should have a comprehensive audit trail detailing every user activity including system/security administrators with before and after image

V. *Electrical SCADA, DMS and OMS*

MSI has to provide the SCADA, DMS and OMS for real time monitoring & control of the distribution system, loss minimization/load balancing and considerable improvement in voltage/VAR profiles.

Proposed SCADA system shall monitor, operate and control operations in mentioned substation and DTs. MSI shall study and propose any other gap infrastructure/hardware related to implementing the Electrical SCADA, DMS and OMS in above specified locations. MSI shall Study and implement the motorization of all the RMU's (5 Nos. sub station of 33/11 KV and 20 Nos. 11/0.433 KV).

The RMU drawing is provided in Annexure XI of this volume of RFP.

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Distribution SCADA	
1.	<p>The following SCADA functions shall be expected from the system:</p> <ul style="list-style-type: none"> • 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 (in specified format (OPC / CIM-XML / IEC / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS) GIS adaptor CIM compliance IEC61968(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) • SCADA system shall use the following protocols to communicate <ul style="list-style-type: none"> ○ for RTU, FRTU and FPI - IEC 870-5-104 ○ for MFTs – MODBUS ○ for DR & Other any other SCADA system - IEC/TASE.2 in specified format (OPC / CIM-XML / IEC / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS) <p>for IT Systems - (in specified format (OPC / CIM-XML / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)</p>
2.	<p><i>Information Storage and Retrieval (ISR)</i></p> <ul style="list-style-type: none"> • 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. • All stored data shall be accessible from any time period regardless of changes made to the database after storage of that data • 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.

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	<ul style="list-style-type: none"> • 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. • 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. • SQL-based language shall be used for selecting, retrieving, editing, sorting, analysing, and reporting ISR data stored. <p>i. Circuit breaker status Table</p> <ul style="list-style-type: none"> • 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. <p>ii. Real-time Database Snapshot Tables</p> <ul style="list-style-type: none"> • At the end of each 5 minutes, the following real time snapshot data shall be stored in RDBMS in Real-time Database Snapshot tables: <ul style="list-style-type: none"> ○ 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 ○ 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. <p>iii. Hourly Data tables</p> <ul style="list-style-type: none"> • At the end of each hour information as defined below shall be included in the hourly data tables, in RDBMS database form: <ul style="list-style-type: none"> ○ Selected analog values alongwith their associated quality codes ○ Selected status values alongwith their associated quality codes ○ Results of hourly calculations for selected analog points (atleast maxima & minima with associated time and average) alongwith their associated quality codes. ○ In addition to above a separate hourly energy data table exclusively for energy values shall be created in ISR alongwith their associated quality codes. <p>iv. Daily Energy Data table</p> <ul style="list-style-type: none"> • 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 on daily basis

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	<p>and on demand.</p> <p>v. Load priority table</p> <ul style="list-style-type: none"> • 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. SCADA control centre operator can also assign priorities in load priority table & the priorities assigned by the Billing system. There shall be suitable alarm/event message including user ID for such activity. <p>vi. SOE data table</p> <ul style="list-style-type: none"> • ISR system shall maintain SOE data table which shall store the SOE data for complete distribution system. <p>vii. Data Exchange with Customer Care System</p> <ul style="list-style-type: none"> • The ISR function shall transfer the information available in the "Circuit breaker status table" as defined in this chapter, to the Customer Care centre using SOA/Enterprise Service Bus over CIM/XML Models, or CIM/XML OPC/ICCP /ODBC Adapters / Interfaces. 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 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 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 /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. <p>viii. Historical Information</p> <ul style="list-style-type: none"> • The data stored in the ISR system shall support the following retrieval capabilities: <ul style="list-style-type: none"> ○ The user shall be able to view and edit HI data on displays/Forms and reports. 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 HI retrieval shall expose the ISR Data over SOA / Enterprise Services BUS

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	<p>Supplied by ITIA, over CIM/XML, ICCP or OPC ODBC Interfaces / Adapters.</p> <ul style="list-style-type: none"> ○ The retrieval shall provide 100% accuracy and fidelity of data <p>ix. System Message Log Storage and Retrieval</p> <ul style="list-style-type: none"> • 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. <p>System message log data shall be stored in daily tables & shall be available for minimum two months</p>
Distribution Management System (DMS)	
1.	The DMS applications shall utilise the data acquired by the SCADA application.
2.	<p>Graphical & Tabular display Requirements</p> <p>A network overview display of the distribution system with substations, feeders Colour coded by voltage shall be provided. This display shall present the distribution system in a graphic format. Telemetered and calculated values like active and reactive power flows etc. shall be displayed with direction arrow. Lines, Loads, transformers etc. that have exceeded their loading limits shall be highlighted.</p>
3.	<p>Network Model</p> <ul style="list-style-type: none"> • The DMS applications shall have a common model for the project area comprising of primary substation feeders, distribution network and devices with minimum 10 possible islands, which may be formed dynamically. All DMS applications shall be able to run successfully for the total distribution system with future expandability as envisaged under the specification. The following devices shall be represented in the model as a minimum: <ul style="list-style-type: none"> ○ Power Injection points ○ Transformers ○ Feeders ○ Load (balanced as well as unbalanced) ○ Circuit Breakers ○ Sectionizers ○ Isolators ○ Fuses ○ Capacitor banks ○ Reactors ○ Generators ○ Bus bars ○ Temporary Jumper, Cut and Ground ○ Meshed & radial network configuration ○ Line segments, which can be single-phase, two-phase or three-phase and make up a distribution circuit. ○ Conductors ○ Grounding devices ○ Fault detectors

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	<ul style="list-style-type: none"> ○ IEDs ○ Operational limits for components such as lines, transformers, and switching devices <ul style="list-style-type: none"> ● All DMS applications shall be accessed from graphic user interface through Operator consoles as defined in this specification. Reports, results and displays of all DMS application shall be available for printing at user request. ● The model should support multiple geographic coordinate sets for each device so that, if available, the network can be displayed in custom geoschematic formats. <p>An interface with the already existing Geographical Information Systems shall be developed using interoperability features between the DMS and the installed GIS</p>
4.	<p>Network Connectivity Analysis</p> <ul style="list-style-type: none"> ● The network connectivity analysis function shall provide the connectivity between various network elements. ● NCA shall run in real time as well as in study mode. Real-time mode of operation shall use data acquired by SCADA. Study mode of operation will use either a snapshot of the real-time data or save cases. ● The topology shall be based on - <ul style="list-style-type: none"> ○ Tele-metered switching device statuses ○ Manually entered switching device statuses. ○ Modelled element statuses from DMS applications ● It shall determine the network topology for the following as minimum - <ul style="list-style-type: none"> ○ Bus connectivity (Live/ dead status) ○ Feeder connectivity ○ Network connectivity representing S/S bus as node ○ Energized /de-energized state of network equipment ○ Representation of Loops (Possible alternate routes) ○ Representation of parallels ○ Abnormal/off-normal state of CB/Isolators ● The NCA shall assist operator to know operating state of the distribution network indicating radial mode, loops and parallels in the network... ● NCA function shall also have the capabilities of network tracing when requested by the dispatcher. Dedicated colours shall be used for feeder and circuit tracing and also when information available is not complete or inconsistent. <ul style="list-style-type: none"> ○ Feeder tracing - ○ Circuit tracing- ○ Between Tracings ○ Downstream Trace ● The NCA shall allow temporary modifications at any point in the distribution network to change the network configuration, to isolate faults, restore services or perform maintenance. A Summary shall list the jumpers, cuts and grounds that are currently applied. ● The function performed by the NCA and shall be implemented locally within the client software and has no effect on the operations model or other clients viewing the network

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	<ul style="list-style-type: none"> ○ Cuts facilitated in any line segment in the network. The cut may be applied to one or more available phases of the conductor. The cut could also be applied as a temporary switch inserted in the line ○ The operator should be able to select two points and place the jumper with relevant details. The initial state of the jumper may be set to open or closed. ● Temporary connections between phases on the same line segment, known as a phase jumper shall be supported.
5.	<p>State Estimation</p> <ul style="list-style-type: none"> ● The State Estimation (SE) shall be used for assessing (estimating) the distribution network state. It shall assess loads of all network nodes, and, consequently, assessment of all other state variables (voltage and current phasors of all buses, sections and transformers, active and reactive power losses in all sections and transformers, etc.). ● The symmetrical (per phase) and asymmetrical (three-phase) load of all nodes in the radial or weakly meshed MV network, which are not remotely monitored, that is not directly covered by the SCADA System shall be using evaluated Load Calibration. ● This is the unique function dealing with the unobservable load of the actual network, which is not directly covered by the SCADA System. Function shall be used for balanced and unbalanced networks. ● The function shall be based on an algorithm specially oriented towards distribution networks, with low redundancy of real time, remotely monitored data, and the deficiency of real time data has to be compensated with historical data. ● SE function shall run in all cases from the range of networks where all historical data are known, but also in networks with no historical data available (based on parameters of the network elements). ● Also according to users setting, the SE function shall be able to run: <ul style="list-style-type: none"> ○ With or without verification of telemetered measurements ○ With manual or automatically processing unobservable parts of network ○ With or without fixed measurements ● This shall have real time & Simulation mode both. The SE algorithm shall consider into account the non-availability of real time data and compensates them with historical data, pseudo and virtual measurements, to achieve the minimal set of input data necessary for running a consistent Load Flow. ● The SE algorithm shall consist of the next important steps: <ul style="list-style-type: none"> ○ Pre-estimation ○ Verification of measurements ○ Load calibration ○ Load Flow calculation
6.	<p>Load Flow Application (LFA)</p> <ul style="list-style-type: none"> ● The LFA shall utilize information including real-time measurements, manually entered data, estimated data together with the network model supplied by the topology function, in order to determine the best estimate of the current network state. The Load Flow Application (LFA) shall determine the operating status of the distribution system including buses and nodes. The LFA shall take the following into consideration - <ul style="list-style-type: none"> ○ Real time data ○ Manual entered data

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	<ul style="list-style-type: none"> ○ Estimated data ○ Power source injections ○ Loops and parallels ○ Unbalanced & balanced loads ○ Manually replaced values ○ Temporary jumpers/ cut/ grounds ○ Electrical connectivity information from the real-time distribution network model ○ Transformer tap settings ○ Generator voltages, real and reactive generations ○ Capacitor/reactor bank ON/OFF status value ○ Save case data <p>a. The following general characteristics/ capabilities shall be provided as minimum -</p> <ul style="list-style-type: none"> ● The LF model shall support the different kind of lines such as cable feeders, overhead/ underground lines and different kind of transformers having various vector groups & winding configurations. ● Unbalanced & balanced three phase loads connected in radial and non-radial modes. ● Compute voltages and currents and power factor for each phase for every node, feeder and network devices. ● Compute each phase active and reactive loads and technical losses for the distribution system as a whole, for individual substations and feeder wise with in telemetered zone. ● Use previous save-case to make new save case or use new snapshots to set the base case for LF. ● The results of the LF application shall reasonably match with the operating condition in which ● Distribution system is stable. ● The LFA function shall be executed in real time & study mode. ● It shall be possible to model load either as a percentage of system load or profile base load modelling ● It shall be possible to model individual component of load i.e. Active and Reactive part <p>b. Real-Time LF</p> <ul style="list-style-type: none"> ● The Real-Time LF function shall be executed: <ul style="list-style-type: none"> ○ on event trigger ○ on periodic basis ○ on demand basis ○ on initiation by other DMS Applications functions ○ On placement of Temporary Jumper, Cuts and Ground ● The Event Triggered LF execution shall always have the highest priority. The study mode LF function shall be executed on a snapshot or save case with user defined changes made to these cases. ● Event Triggered Real Time LF Execution: The LF function shall be executed by pre-defined events that affect the distribution system. Some of the events the dispatcher may choose for triggers shall include:

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	<ul style="list-style-type: none"> ○ Power system Topology Change i.e. Alteration in distribution system configuration ○ Transformer Tap Position Change / Capacitive/reactor MVAR Change Feeder Over loadings ○ Sudden change in feeder load beyond a set dead band ● Periodic Real Time LF Execution <ul style="list-style-type: none"> ○ The real-time distribution system load flow application shall be executed periodically as configured by the dispatcher. ● On Demand Real Time LF Execution <ul style="list-style-type: none"> ○ Dispatchers may initiate the real-time LF function at any time through dispatcher command. ● Other DMS functions may initiate the real-time LF function at any time as desired for the execution of the respective functions. <p>c. Study Mode Load Flow Execution</p> <ul style="list-style-type: none"> ● It shall provide dispatchers with estimates of kW, kVar, kV, Amps, power losses and the other information on the distribution system, but not necessarily reflecting its real-time state. ● It shall be possible to prepare and store at least fifty cases along with the input parameters, network configuration and output results. ● The Load Flow function shall provide real/active and reactive losses on: <ul style="list-style-type: none"> ○ Station power transformers ○ Feeders ○ sections ○ Distribution circuits including feeder regulators and distribution transformers, as well as the total circuit loss <p>d. The following output capability shall be provided:</p> <ul style="list-style-type: none"> ○ Phase voltage magnitudes and angles at each node. ○ Phase and neutral currents for each feeder, transformers, section ○ Total three phases and per phase KW and KVAR losses in each feeder, section, transformer ,DT substation & for project area ○ Active & reactive power flows in all sections, transformers List of overloaded feeder, lines, bus bars, transformers loads etc. including the actual current magnitudes, the overload limits and the feeder name, substation name ○ List of limit violations of voltage magnitudes, overloading. ○ Voltage drops ○ Losses as specified above <p>e. Display and Reports</p> <ul style="list-style-type: none"> ● All input and output data shall be viewed through tabular displays and overlay on the one line network diagram. ● The LF outputs shall be available in the form of reports. <p>f. Alarms</p> <ul style="list-style-type: none"> ● The LFA shall warn the Despatcher when the current operating limits are exceeded for any element or when lines are de-energized. <p>g. Load Flow Analysis shall be used for the calculation of the (a)symmetrical steady state in radial</p>

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	<p>and weakly meshed (un)balanced distribution networks.</p> <ul style="list-style-type: none"> • LFA calculation procedures shall be single-phase for symmetrical states and three-phase for asymmetrical ones. The following types of distribution transformers shall be taken into account: <ul style="list-style-type: none"> ○ Three-phase transformers with (grounded and ungrounded) and delta connected three-phase windings. ○ Single-phase transformers with split secondary winding. ○ Single-phase transformers with primary connection to phase and line voltage. ○ Balanced and unbalanced three-phase transformer banks. ○ Open-wye and open-delta connections of transformer banks. • LFA shall calculate states in the network containing phase interruptions on open switch poles or blown out fuses. <p>LFA shall be run automatically during each run of State Estimation power function, or on user request.</p>
7.	<p>i. Volt –VAR control (VVC)</p> <ul style="list-style-type: none"> • This function shall provide high-quality voltage profiles, minimal losses, controlling reactive power flows, minimal reactive power demands from the supply network. The following resources shall be taken into account for voltage and reactive power flow control: <ul style="list-style-type: none"> ○ TAP Changer for voltage control ○ VAR control devices: switchable and fixed type capacitor banks. • The function shall propose the operator solution up on change in the topology of the network switching. The function shall consider the planned & unplanned outages, equipment operating limits, tags placed in the SCADA system while recommending the switching operations. The functions shall be based on user configurable objectives i.e. minimal loss, optimal reactive flow, voltage limits, load balancing. • The VVC function shall have following modes of reconfiguration process: <ul style="list-style-type: none"> ○ Auto mode ○ Manual mode • Detailed reports of complete switching sequence for VVC operation, including voltage / VAR levels before switching & after switching shall be presented. Displays • The User interface for VVC function shall have following summary displays as minimum: <ul style="list-style-type: none"> ○ Network & tabular display to VVC switching <p>Tabular display giving chronological sequence for VVC operation</p>
8.	<p>Performance Indices (PI) shall be provided for determining performance indices of a part or the entire distribution network, for specified network topology (radial or weakly meshed) and state – "Overall performances" module. In addition, the function shall points on operation problems (violations of operation limits – voltage and current as well as relay protection limits) for the considered network topology and state – "Detection of violations" module.</p> <p>PI shall provide insight into:</p> <ul style="list-style-type: none"> • Network state, • Possible problems referred to considered network state, <p>ii. Performances.</p>
9.	<p>Load Shed Application (LSA)</p> <ul style="list-style-type: none"> • The load-shed application shall automate and optimise the process of selecting the best combination of switches to be opened and controlling in order to shed the desired amount of

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	<p>load. Given a total amount of load to be shed, the load shed application shall recommend different possible combinations of switches to be opened, in order to meet the requirement.</p> <ul style="list-style-type: none"> • In case of failure of supervisory control for few breakers, the total desired load shed/restore will not be met. Under such conditions, the application shall inform the dispatcher the balance amount of load to be shed /restore. The load-shed application shall run again to complete the desired load shed /restore process. The result of any Load Shed operation shall be archived in Information storage and retrieval (IS&R) system. • The load shall be shed or restored on the basis of following basic rules: <ul style="list-style-type: none"> ○ By load priority: Each load priority shall be user definable over the scale of at least 1-10. ○ By 24 Hrs. load shed /restore history by Cyclic manner : By number of consumers affected: • The load-shed application shall operate in the following modes: <ul style="list-style-type: none"> ○ Manual load shed ○ Manual load restoration ○ Auto load shed ○ Auto load restoration • Each mode of operation can be enabled or disabled by operator independently. The load can be shed & restore in possible combination i.e. manually shed & auto restore vice versa or both operations in the same modes. • All Load shed & restore operations executed shall be logged in the system as events. In case the supervisory control fails during the operation in predefined time, an alarm shall be generated with the possible reason for the failure. <p>Load shed application shall generate Summary Reports for project area on daily basis. These reports shall be available online for minimum period of two days.</p>
10.	<p>Fault Management & System Restoration (FMSR) Application</p> <ul style="list-style-type: none"> • FMSR shall be capable of handling phase-to-ground and phase-to- phase faults and shall not be restricted by their time of occurrence on one or more feeders. Thus, the ability to handle multiple faults of different types, on multiple feeders, shall be provided. It shall be capable to carry out restoration of large area after a occurrence wide spread faults amounting to substantial outages in the town. • FMSR shall be capable of allowing the substitution of an auxiliary circuit breaker or line recloser that may temporarily function in place of a circuit breaker or line recloser that is undergoing maintenance. • The Operator shall be able to suspend FMSR restoration capabilities by activating a single control point. Otherwise, FMSR shall continue to operate for fault detection and isolation purposes. The Operator shall be able to resume FMSR's normal operation by deactivating the same point. • FMSR shall be capable of isolating faulty sections of network by opening any available line Circuit Breaker that may be necessary, however operating limitations on device such as control inhibit flag shall be respected. • FMSR application shall utilize the results of LF for recommendations of switching steps for restoration where in it should guide the operator for amount of overloading in lines ,bus voltage violations and amount of load that can be restored for various options of restorations ,the operator shall have the privilege of selecting the best restoration option suggested by

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	<p>FMSR before it starts restoration .The operator shall also be to simulate the LF for the recommended switching actions ,so that the necessary violations can be displayed on graphical display also. If an overload condition is expected as a result of the proposed switching, it shall be displayed to the operator on a graphical display and proposed alternative switching sequence to avoid or minimize the overload.</p> <ul style="list-style-type: none"> • FMSR shall be capable of using data derived from substation RTUs/FRTUs /FPIs to recognize faults in substation transformer banks, any fault on the primary side of these banks that cause loss of outgoing feeder voltage and current or any fault occurred on 11KV network. • FMSR shall be capable to make Restoration plans with identification name and respective merit orders & its execution of Restoration plan using network Display and single line diagram of substation. • FMSR shall be capable to find delay in the restoration of network beyond specified time (Despatcher configurable) and shall be able to report separately in the form of pending restoration actions. <p>a) Detection of fault</p> <ul style="list-style-type: none"> • FMSR function shall detect the faulty condition of the network causing CB tripping due to protection operation or FPI indication. The Circuit breakers having auto-reclose feature, the FMSR application shall wait for programmer specified (settable for individual feeders) duration before declaring the network as faulty. On detection of fault in the network, an alarm shall be generated to draw attention of the dispatcher. • Switching device tripping caused by SCADA/DMS applications shall not be considered as a faulty condition. FMSR application shall also not be initiated if the quality flags such as, manually replaced value, and out of scan are set for a switching device. • To avoid potential difficulties during severe storm conditions, the Operator shall be able to suspend FMSR switching sequence of restoration capabilities by activating a single control point. The Operator shall be able to resume FMSR's normal operation by deactivating the storm-mode control point. <p>b) Localisation of Fault:</p> <ul style="list-style-type: none"> • Wherever protection signal or FPI indication is not available, FMSR function shall determine the faulty section by logically analyzing the telemetered data (status of CBs, analog values etc.) as acquired through SCADA system. Minimum of following switch types shall be considered by FMSR system: <ul style="list-style-type: none"> ○ Remote controllable circuit breaker with capability to interrupt fault currents ○ Non-remote controllable circuit breaker with capability to interrupt fault currents ○ Remote controllable circuit breaker with no capability to interrupt fault currents ○ Non-remote controllable circuit breaker with no capability to interrupt fault currents. ○ Remote controllable disconnecter ○ Non remote controllable disconnecter. ○ Fuse ○ Ground/ Earth switch etc.

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	<p>c) System isolation & restoration</p> <ul style="list-style-type: none"> • Once faulty section is identified, the FMSR function shall determine the switching plan to isolate healthy area from unhealthy area. FMSR function shall suggest switching plans for restoration of power to the de-energized healthy sections of the network.. • The FMSR function shall have following modes of restoration process: <ul style="list-style-type: none"> ○ Auto mode of restoration Manual mode of restoration
11.	<p>Loss Minimization via Feeder Reconfiguration (LMFR)</p> <ul style="list-style-type: none"> • This function shall identify the opportunities to minimize technical losses in the distribution system by reconfiguration of feeders in the network for a given load scenario.. • The function shall calculate the current losses based on the loading of all elements of the network. The telemetered values, which are not updated due to telemetry failure, shall be considered by LMFR application based on recommendations of LF Application. • Function shall advise the transfer of load to other elements of the network with an aim to minimize the loss. All such advises shall indicate the amount of loss reduction for present load condition. The LMFR application shall consider the planned & unplanned outages, equipment operating limits, tags placed in the SCADA system while recommending the switching operations. The despatcher shall have the option to simulate switching operations and visualize the effect on the distribution network by comparisons based on line loadings, voltage profiles, load restored, system losses, number of affected customers • LMFR application shall run periodically at every 15 minutes and on demand. Short duration Power Interruption to the consumers during suggested switching operations may be permitted. • The LMFR function shall have following modes of reconfiguration process: <ul style="list-style-type: none"> ○ Auto mode ○ Manual mode
12.	<p>Load Balancing via Feeder Reconfiguration (LBFR)</p> <ul style="list-style-type: none"> • The Load Balancing via Feeder Reconfiguration function shall optimally balance the segments of the network that are over & under loaded. • The Feeder Reconfiguration Function shall be activated either by an overload condition, unequal loadings of the parallel feeders and transformers, periodically or on demand by the despatcher. It shall generate the switching sequence to reconfigure the distribution network for transferring load from some sections to other sections. The LBFR application shall consider the planned & unplanned outages, equipment operating limits, tags placed in the SCADA system while recommending the switching operations. • The function shall have following modes of reconfiguration process: <ul style="list-style-type: none"> ○ Auto mode ○ Manual mode <p>a) Short-Term Load Forecasting (STLF)</p> <ul style="list-style-type: none"> • Short-Term Load Forecasting (STLF) analytical function will be used for assessment of the sequence of average electrical loads in equal time intervals, from 1 to 7 days ahead. The STLF function shall be based on different forecasting methods such as: <ul style="list-style-type: none"> ○ Autoregressive. ○ Least Squares Method

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	<ul style="list-style-type: none"> ○ Time Series Method. ○ Neural Networks. ○ Kalman filter ○ Weighted Combination of these method <p>b) Similar day forecasting</p> <ul style="list-style-type: none"> ● A similar day forecast shall be used that is based on the normalized half-hourly load values stored for each of seven-day types. Provision shall be made for storing day types for the last 24 months. ● The similar day forecast shall search the 24-month file for the same day type whose weather conditions best match. ● Multi-day forecasts shall be constructed by permitting the user to define the input data for each forecast day. ● The results of the previous forecasts will be compared with the actual load realization. The performed differences will be used for updating the forecasting procedure parameters. <p>c) Long Term forecasting</p> <ul style="list-style-type: none"> ● In addition to the above, Long term load forecasting shall also be available for at least 1 year. ● The user shall be able to print and display the forecasts in both tabular and graphical form <p>d) Results of Function</p> <ul style="list-style-type: none"> ● Main input data for the LF will be: Historical Load measurements for specified network points, associated with corresponding weather conditions. <p>Main output data of the STLF will be: Forecasted load for the forecasting period</p>
13.	<p>Operation Monitor</p> <ul style="list-style-type: none"> ● The Operations Monitoring function shall track the number of operations made by every breaker, capacitor switch, recloser, OLTC, isolator and load break switch that is monitored by the System. Devices shall be identified by area of responsibility, substation, feeder, and device ID to provide the necessary information for condition-based maintenance of these devices. ● Each monitored device shall be associated with a total operations counter. This counter shall be incremented whenever the associated device changes state. When a multiple change (such as a trip-close-trip sequence) is reported by an RTU/FRTU, each transition shall be counted separately. In addition, a fault operations counter is required. This counter shall be incremented only for uncommanded trip operations. The date and time of the last operation shall be saved for each device when one of the counters is incremented. ● An Operator with proper authorization shall be able to enter total operations and fault operations limit for each counter. An alarm shall be generated when a counter exceeds its limits. <p>The ability to reset individual counters shall be provided.</p>
14.	<p>Planning Functions - Capacitor placement</p> <ul style="list-style-type: none"> ● Capacitor Placement (CP) power function shall be used for determining optimal locations, types, sizes and switching status of capacitor banks, which have to be installed in the distribution system for the purpose of reactive power compensation, real power (energy) losses minimization, reduction of the reactive power supplied from transmission network, power factor correction and voltage profile improvement.

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	<ul style="list-style-type: none"> • This optimization application shall be based on the cost-benefit analysis. • All types of capacitors (fixed, switchable and mixed banks) shall be encompassed. • The CP Function shall be used in Simulation mode. • Main inputs for the CP application shall consist of the following: <ul style="list-style-type: none"> ○ Internal Model, foundation for running all power applications ○ Options for calling the load flow power application. ○ The selected part of network used for capacitor placing. ○ Number and type of capacitors available for placement. • The main outputs of the CP function shall be: <ul style="list-style-type: none"> ○ An overview and comparison of different capacitor placement variants, ○ Detailed performance indices per variant before and after capacitor placement. ○ The number and locations of placed capacitors. <p>An applicable plan with the proposed capacitor placement that enables further analysis.</p>
15.	<p>Planning Functions -Breaker capacity</p> <ul style="list-style-type: none"> • Breakers/Fuses Capacity (BFC) power function shall be used for checking of circuit breaker and fuses capacity in distribution networks. The checking will be performed for one arbitrary selected circuit breaker or for all circuit breakers in the network. Also, this function shall be used for calculation of the required capacity of circuit breakers. • The following values shall be taken in consideration during the checking procedure: <ul style="list-style-type: none"> ○ Breaking current. ○ Peak current. ○ Thermal current. ○ Aperiodic time constant (for DC component). ○ Operating current value. ○ Operating voltage. • One or all checks could be performed for one selected circuit breaker or for all circuit breakers. All checking shall be performed in accordance with IEC 56 standard. • The function will be used for checking of capacity of circuit breakers in the actual network topology or for studied states (e.g. any state selected from Saved cases). • This function could be of special interest for areas where are new generators or motors added which has significant influence on fault current value and parameters. • Results of circuit breaker checking shall be given in two ways: <ul style="list-style-type: none"> ○ The entire network display. ○ Individual display. • The Breaker Fuse Capacity application provides the following results for each type of considered switching devices: <ul style="list-style-type: none"> ○ Calculated value of the selected criteria, ○ Required (rated) value for each selected criteria, <p>A quality index denoting if the criterion is satisfied or not</p>
16.	<p>Planning Functions - Voltage Regulator placement</p> <ul style="list-style-type: none"> • Voltage Regulator Placement (VRP) power function shall be used for determining optimal locations for placement of additional regulation resources and selection of position of existing tap changers in order to reduce the voltage drop, experienced at critical points of medium voltage networks, and keep voltage profile of all customers to pre-specified minimal and maximal technical limits to reduce energy losses.

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	<ul style="list-style-type: none"> • The VRP function shall provide option to select: <ul style="list-style-type: none"> ○ Feeders in the network that require voltage regulator reconfiguration, by setting all positions to maximal values and finding all network parts with voltage problems ○ Feeders on which voltage regulator should be installed, by setting all positions to middle values, finding all network parts with voltage problems and analysing previously formed states with previously defined list of priorities for VRs installation. • The VRP Function shall be used in Simulation mode. • Main input for the VRP application shall consist of the following: <ul style="list-style-type: none"> ○ Internal Model, foundation for running all power applications. ○ Options for calling load flow power application. ○ Selected part of network for voltage regulator placing. ○ Type of voltage regulators available for placing. ○ Selected network state: ○ Information whether user has overridden consumer voltages and their values. ○ Information whether unbalanced (per phase) or balanced (phase to phase) placement of voltage regulators is expected. • Main outputs of the function shall be: <ul style="list-style-type: none"> ○ Detailed performance indices before and after voltage regulator placement. ○ Number and locations of placed voltage regulators. ○ Overview of consumer voltage violation before and after the proposed voltage regulator placement. <p>Applicable plan with proposed voltage regulator placement that enables further analysis.</p>
17.	<p>Planning Functions - Network Reinforcement</p> <ul style="list-style-type: none"> • Network Reinforcement (NRI) application shall be used in cases when Network Reconfiguration and Phase Balancing do not provide sufficient benefit in terms of preparing the power grid for the advanced optimization such as Loss Optimization. NRI shall be used for strengthening laterals where overloading and under-voltage occur in specific time periods. • Network Reinforcement application shall be used in 2 different modes: <ul style="list-style-type: none"> ○ Resizing Wires (RW) mode <p style="margin-left: 40px;">RW mode shall provide a list of candidates for strengthening by replacing an old wire with a new one with greater cross section.</p> ○ Adding Wires (AW) <p style="margin-left: 40px;">AW mode shall provide a list of candidates for improvement by adding a new wire in the phase that is unused at the time.</p> • The following items shall be the main outputs of the NRI application, RW mode: <ul style="list-style-type: none"> ○ Power losses for selected circuit, before and after RW execution, ○ Number of changed overhead and underground spans, ○ Total distance of changed overhead and underground spans, ○ Cost-benefit analysis of the RW calculation (cost of operation, achieved benefit and cost-benefit ratio), ○ Voltage profile graph for all consumers on selected circuit (with initial and optimal values), ○ List of sections with details about cross-section recommended changes,

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	<ul style="list-style-type: none"> ○ List of overloaded sections (initial and final state), ○ List of consumers with voltage violations (initial and final state).
18.	<p>Planning Functions - Network Reinforcement</p> <ul style="list-style-type: none"> • Customer Placement (CP) power function shall provide feasibility of verification of new distributed generators or consumption in medium voltage, as well as low voltage networks. • The CP Function shall analyse customer placement in four characteristic points: <ul style="list-style-type: none"> ○ Minimum consumption – Minimum production, ○ Minimum consumption – Maximum production, ○ Maximum consumption – Minimum production, ○ Maximum consumption – Maximum production. • Voltage violations on every node and customer, as well as overloads on every section and service transformer shall be checked for all four characteristic points. Apart from adding generation or consumption, it shall be possible to select location for customer placement and their type. • The outputs of this function shall be: <ul style="list-style-type: none"> ○ Injected current for state with new customer, ○ Injected active power for state with new customer, ○ Injected reactive power for state with new customer, ○ Initial and final results for the most critical elements in network (minimum voltage on consumer, maximum voltage on consumer, maximum overload on section, maximum overload on service transformer), ○ Location of these critical elements in network, ○ Phase balance for every phase, ○ Solution feasibility for every circuit, ○ ‘Create plan’ functionality.
<i>Outage Management System (OMS) for HT (above 11kv) & LT system (upto 230v)</i>	
1.	<p>An Outage Management System shall form an integral component of the DMS system. It shall allow operators to manage unscheduled and scheduled outages from within a unified operating environment that integrates real-time DMS, SCADA, crew monitoring and switching orders.</p> <p>Network Performance Indices</p> <ul style="list-style-type: none"> • System performance indices (e.g. SAIDI, SAIFI) give a standardized measure of the performance of the distribution network with regard to the frequency and duration of unplanned outages. • The calculation of system performance indices shall be performed and based on the IEEE 1366-2003. The indices shall be calculated using a batch process that is run at regular intervals or on-demand. <p>Performance indices such as CAIDI, CAIFI, CMI and momentary outages (MAIFI and MAIFI) required for regulatory reporting shall also be included in the performance index reports although they may be calculated in a separate process depending on the data sources.</p>
2.	<p>Unplanned/Planned Outage Management</p> <ul style="list-style-type: none"> • A high level of integration of the DMS application suite shall be provided to ensure that unplanned and planned outages are handled in a consistent manner..

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	<ul style="list-style-type: none"> Combined with the network view, the operator shall have access to displays that coordinate Outage Incidents, Switching Orders, work crews and scheduled outages. Switching Orders for scheduled outages and emergency restorations shall all be managed in the same way.. <p>Prediction Analysis is required.</p>
3.	<p>Outage History</p> <ul style="list-style-type: none"> A Historical Reporting function shall be provided to ensure complete records of all outages are available for future analysis. The Historical Reporting tool shall be usable to perform extensive research on: <ul style="list-style-type: none"> Cause Analysis Customer Reliability Indices Division/Operating Center Outages Trouble Summary by Division/Operating Center Overhead and Underground Summary Recurring Trouble Summary Worst Performing Devices Worst Performing Feeders Crew Assignments Closed Cases of Trouble
4.	<p>Crew Monitor/Assign</p> <p>The assignment of crews to outages and the monitoring of their current location and status shall be performed directly on the Outage Management Displays</p>
5.	<p>Switching Order & Work Order Management</p> <ul style="list-style-type: none"> Switching Order Management (SOM) shall provides a software framework for managing different types of switching, tagging and temporary elements placement/removal. Work Order Management (WOM) shall provide the tools for managing planned work. DMS supports work flows in which the work requests originate outside the control room, in the less secure environments and the system replicates them to the production environment in which the operators are notified of the existence of new work requests. Safety documents, clearances and permits are documents issued to ensure that a given safety condition exists and will remain on the network, e.g. that high voltage conductors or mechanical equipment is isolated, or that reclosing is disabled on all reclosable devices affecting the work area. They are highly customizable to fit the expectations of different utilities regarding work on the isolated and no-reclosing network portions. Only one user interface should be provided for SCADA DMS & OMS system. The term "user" is applied to the personnel interacting with the SCADA – OMS. Through Field Client following functions has to be performance <ul style="list-style-type: none"> Instructions through OMS system Work Permit Estimated Time of Repair Switching plan for HT & LT Network GIS view to Visualise / locate the faulty equipment Web Client Request for Outages through web client facility and get the view of OMS in read only mode. The Employer shall be able to assign the operation of certain functions, or features of

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	<p>functions, to specific user modes. Each individual user shall be assignable to any one or more user modes.</p> <ul style="list-style-type: none"> • WEB Server <p>ADMS Web Client application should be a lightweight application that will enable web-based read-only access to an up-to-date distribution system data and provides a subset of UI client application functionality. The application will be accessed through standard web browsers. It shall enable insight into the distribution system state to both corporate users and field crews. Different network views and supporting tools shall enable easy and intuitive user experience.</p> <p>The Web Client application will be intended to be used for distribution system monitoring and easy access to distribution network parts and information. The application shall be used by a variety of corporate users as well as field crews; therefore the client-side hardware choices will be limited. Hardware devices running the client-side application must be simple to use, comfortable to carry (laptop), with a medium to large screen, with a keyboard or a multi-touch screen.</p> <p>The client software platform will require either Windows 7 or Windows XP operating system or Internet Explorer 8 or later. The Web Client application shall be designed to run under Internet Explorer 8 which supports the HTML 4.01 specification.</p> <p>Web server shall enable viewing of the network, panning, zooming, detaching (all basic actions), etc. Besides, it shall enable users to see all network updates and dynamic changes, tags, notes and trending. User shall be enabled to change the network coloring.</p> <ul style="list-style-type: none"> • The user interface for SCADA/DMS system shall be web enabled. The system shall work with the graphical user interface provided and shall allow windows created on the workstations to communicate with processors equipped with X Windows-compatible software on their respective local area networks (LANs) and with future remote applications over the wide area network (WAN). • The user interface software shall be based on state-of-the-art web-based technology to present interactive, full-graphics views of system data via LAN, corporate intranet or the internet. The same displays shall be used. • It is essential that the same web-based user interface (same navigator, same tools) be available to the operator either for local use in the dispatching center or remotely. • Events shall be recorded in the form of an event message. The event message format shall be similar to the alarm message format. The same message format shall be used for displaying and printing events. Event messages shall be displayed on an events summary. • The summary display shall list all items being trended. The list shall include the item name, trace number or Colour, trend orientation, and trend range. • The summary display shall list all items being recorded for tabular trends. The list shall include the item name and the file name. • Graphic and tabular displays shall be provided that allow the user to: <ul style="list-style-type: none"> ○ Monitor and revise the configuration of the computer system ○ Monitor the system's resource utilization statistics • RTU/ FRTU/FPI Communication Channel Monitoring and Control Display: shall show information on the status of the system's communication interface devices (including

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	<p>communication channels), the accessibility of each RTU/FRTU/FPI in a graphical form. The user shall be able to Enable/Disable any communication channel from this display.</p> <ul style="list-style-type: none"> • SCADA/DMS/OMS Application Program Displays: Application program displays shall be provided to satisfy the user interface requirements of the system functions stated throughout this Specification. Application program displays shall be based on a standard user interface design across all applications to provide a common look and feel. • The SCADA/DMS/OMS RTDB (Real Time Data Base) shall be an active process model. i.e. It shall initiate actions or events based on the input it receives. • The SCADA/DMS/OMS shall include a single logical repository for all data needed to model the historical, current, and future state of the power system and SCADA/DMS – the Source Database (SDB). • Any database update, whether due to local changes or imported network model changes, shall be able to be placed online in a controlled manner without causing undue interruption to network operations, including without losing any manually entered data. • The SCADA/DMS/OMS shall provide a consistent interface to accept XML format data for updates from other database applications; and provide a consistent interface to import & export data in XML format <p>User Interface</p> <p>Only one user interface should be provided for SCADA DMS & OMS system. The term "user" is applied to the personnel interacting with the SCADA – OMS. These users shall be required to login in one or more of following user modes, which include:</p> <ul style="list-style-type: none"> ○ Supervisor: Personnel responsible for SCADA – OMS administration and management such as assigning the access area to users, creating users etc. ○ Dispatcher: Personnel responsible for real-time Power system operations including study ○ Engineer: Personnel having access to certain SCADA – OMS functions and database and responsible for support activities such as post fault analysis, report generation, regular backup of database ○ Programmer: Personnel responsible for continuing development and maintenance of the SCADA – OMS functions, databases, displays and report formats ○ External Users: Persons accessing system for published information e.g. report, status etc. ○ Field Client: Field Client 10 numbers (Web View of OMS system) to be provided to the crew to visualise the network on their TAB / mobile (Optional) to accept the instruction and locate the predicted device without any telecom. Also they should be able to close the complaints with providing the reasons for the outage for future analysis and corrective actions. <ul style="list-style-type: none"> • Through Field Client following functions has to be performance <ul style="list-style-type: none"> ○ Instructions through OMS system ○ Work Permit

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	<ul style="list-style-type: none"> ○ Estimated Time of Repair ○ Switching plan for HT & LT Network ○ GIS view to Visualise / locate the faulty equipment ○ Web Client Request for Outages through web client facility and get the view of OMS in read only mode. <p>Call Centre Client: -</p> <p>Outage management system shall have in built call centre facility to support up to 100,000 consumers for managing outages. This call centre facility will have minimum following data</p> <ul style="list-style-type: none"> ○ Name of the consumer ○ Contact details of the consumer. <p>Location of the consumer on the electrical network and physical location on GIS maps.</p> <p>User interface applications within ADMS environment have to serve a variety of tasks – they have to provide easy access to data, data editing, network visualization in form of single-line, logical or geographical schemes, summary reports and printing, performing complex analyses, etc. In ADMS software, the distinction shall be made on the basis of a typical structure of tasks in a distribution utility:</p> <ul style="list-style-type: none"> • Data management: data stored in the database about the network elements must be accurate and reflect the actual state in the field, as well as coherent mutually. Thus, only a relatively small group of users are devoted to maintenance of the network and appropriate synchronization of the database. ADMS shall contain an application which will be used for maintenance of congruent static data in the database. • Network management: larger and more divers group of users will have to perform various tasks on the network; for example, Dispatchers operate the network 24 hours a day and other engineers perform various analyses, reports, and run offline ADMS functions. Data which change frequently (such as switchgear statuses or measurement values) are referred to as dynamic data and they will have to be updated on-line, either via SCADA interface or by direct communication with field crews. ADMS should provide application that will encompass all the tasks of dispatching (including dynamic data management), real-time operation, and off-line analyses, simulations and ADMS power functions. <p>Regarding to the stated above, ADMS solution shall contain graphical user interface application which will be used for creation and management of the network Data Base, i.e. editing of parameters of network elements, their connectivity, and finally, their graphic representation in form of network diagram. In a case when Data Base is not integrated into the ADMS Software, this application shall create the internal data base model as main data source for calculation application.</p> <p>Two logical parts shall exist:</p> <ul style="list-style-type: none"> • Data editing – will be used for creation and editing of basic network elements (such as transformers, sections, switches etc.), as well as their connecting into objects (e.g. substations). • Graphic Editing – will be used for creation of the network mimic diagram, i.e. orthogonal or geographical visual arrangement of elements into the diagram. This diagram will be used

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	<p>in the main user interface – calculation application.</p> <p>Data editing</p> <p>ADMS shall provide creation and editing of basic network elements (sections, busbars, circuit breakers, switchgear, transformers, loads, relays etc.) and complex network elements (joints, distribution substations, fault detector in supply substations). This application shall provide catalogues for elements such as transformers and sections, as well as copy/paste capability, which will enable the user to enter a large number of elements very efficiently.</p> <p>Graphical editing</p> <p>ADMS shall contain a graphical tool used for creation of network diagram. With this graphical editing, the user will arrange elements entered by tool for data editing (substations, joints, sections, etc) in order to create or edit the network diagram.</p> <p>The main features of graphic application shall be:</p> <ul style="list-style-type: none"> • Continuous and dynamic zoom, • Scrolling and panning ability. • Navigator window, which displays reduced diagram of the entire network along with a rectangle representing the actually visible part, and which can be used to quickly navigate through the diagram. • Drag and drop moving of elements. • Move/rotate/mirror capabilities for HV/MV substations as well for a selected group of objects. • Creation and management of several layouts defined over the same set of data (for example, presentation of 35 kV and 10 kV parts of the network on different layouts). • Finding the elements by name or by identification data. <p>ADMS shall also provide specialized tool for geographic editing of distribution network. Its open architecture shall enable import and drawing of GIS schemes from various sources.</p> <p>Editing symbols</p> <p>ADMS shall contain an application that will be used for creating symbols of elements in a distribution network. This application shall enable a user to create and modify (full customization) shapes for distribution network elements. Each symbol will represent an appropriate element in the network. Symbols could be modified in accordance with electrical and dynamic attributes of elements. That means that symbol of elements – global symbol could be defined as a group of graphic entities – simple symbols. Simple entities could be modified according to changes of dynamic data of considered element. Each simple entity will present one element which will be characterized by its dynamic state: visibility, line width, line colour.</p> <p>If symbols are not created for some elements, that elements shall be represented with default symbols.</p>
6.	<p>Software Maintenance and Development Tools</p> <ul style="list-style-type: none"> • A set of software shall be provided to enable maintenance of application software and development of new software in software development mode. All hardware and software facilities shall be provided to allow creation, modification and debugging of programs in

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	<p>all languages that are supplied. The following shall thus be possible:</p> <ul style="list-style-type: none"> ○ Program and data editing ○ Program compiling and assembling ○ Linking ○ Loading, executing and debugging program. Version management ○ Concurrent development ● The following features shall be provided: <ul style="list-style-type: none"> ○ Library management ○ Programs allowing to copy and print any data or program files ○ Backup and restore ○ File comparison ○ Sort and merge ○ Programs that allow to partially save and recover volumes Core and memory dump.
7.	<p>Database Development software</p> <ul style="list-style-type: none"> ● Database development software shall be provided which shall contain database structure definitions and all initialization data to support the generation of all relational, real time database (RTDB) non-relational run-time databases required to implement the functions of SCADA/DMS/OMS system. ● All the facilities required for generating, integrating and testing of the database shall be provided with the SCADA/DMS/OMS system. The delivered SCADA/DMS/OMS database shall be sized for the ultimate system as described in this Specification. ● The database development function shall locate, order, retrieve, update, insert, and delete data; ensure database integrity; and provide for backup and recovery of database files. The database development function shall generate and modify all SCADA/DMS data by interfacing with all database structures. The location of database items shall be transparent to the user performing database maintenance. ● Extensive reasonability, integrity, and referential integrity checks shall be made on user entries to detect errors at the time of entry.
8.	<p>Run-Time Database Generation and Maintenance</p> <ul style="list-style-type: none"> ● The database development software shall generate incremental database changes as well as run-time (loadable) databases from the global source database (user entered database) Incremental structure changes in the source database such as addition of a bay or a substation shall not require regeneration of the entire run-time database. ● All errors that were not detected during data entry time but are encountered during run-time database generation shall be flagged. The database generation routines shall continue processing the database in an effort to detect all errors present in the database before terminating the generation task.
9.	<p>Data Retention</p> <ul style="list-style-type: none"> ● The database generation process shall retain and utilize data from the current SCADA/DMS database in the newly generated database, even when a newly generated database contains structure changes.

<i>Sr #</i>	Requirements
	<ul style="list-style-type: none"> Data to be retained across database generation cycles shall include, but not be limited to, quality codes, manual entries, tags, historical data, and tuning parameters.
10.	<p>Making Database Online</p> <ul style="list-style-type: none"> After an error-free database generation, the user shall be able to test the database in an off-line server prior to its use in an on-line server. The previous runtime database of the server shall be archived such that it is available to replace the new database upon demand. The archived database shall be deleted only when directed by the user. Newly generated run-time databases shall only be placed on-line by user command. Following the assignment of a new database to a server and on user demand, the database management software shall access each SCADA/DMS server to ensure that all databases are consistent. Inconsistencies shall be announced to the user.
11.	<p>On-Line Database Editing</p> <ul style="list-style-type: none"> Selected database management functions and changes to a run-time database shall be possible without requiring a database generation. These shall be limited to viewing functions and changes to the contents, but not the structure of the database. Hardware and software failures nor shall it require suspension of exchange of data among servers for backup purposes.
12.	<p>Tracking Database Changes</p> <p>The database manager utility shall maintain Audit trail files for all changes made by all users.</p>

VI. *Water Utility Management System*

A smart water system is proposed and designed looking at NRDA current requirement that will help NRDA to gather meaningful and actionable data about the flow, pressure and distribution of a city's water supply system and help in better city water management and operations.

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	<p>Study the requirement of software applications, hardware and instrumentation (flow meters, electrically actuated control valves, level transmitters, residual chlorine analyzers, pH meters, turbidity analyzers etc.) for designing a comprehensive Water SCADA system, Water management and Leak detection for:</p> <ul style="list-style-type: none"> ○ Intake Well (at Tila village) ○ Raw Water pumping main , approximate length = 21 kms ○ 52 MLD Water Treatment Plant (at Pacheda village) ○ Clear Water gravity main line, approximate length = 51 kms. ○ 9 UGRs with Pump House at various locations across Naya Raipur ○ Sector 19 and 27 Internal distribution network ○ AMR metering for 200 domestic consumers and integration with water billing module <p>The existing drawings and instrumentation (provided in Annexure IX and X) are comprehensive while Proposed Instrumentation is illustrative. All of the existing instruments may not be required for the Proposed solution and some additional instruments may need to be installed by MSI. Based on proposed solution requirement as mentioned in this volume, MSI has to suggest additional (proposed) instrumentation and design and implement city level Water SCADA system, Water management and Leak detection System.</p>
Water SCADA	
1.	<p>The supplier shall offer a smart water network solution, including hardware and software, able to deliver a set of network management functions described below:</p> <p>The solution shall provide the required advanced simulation capabilities and shall enhance and expand the SCADA functions, by combining historical, real-time and forecast data within the SCADA interface, without any other middleware module for the operator.</p> <p>The SCADA solution shall be used to monitor and control the water supply and distribution network. Following are the functions required in the solution:</p> <ul style="list-style-type: none"> ● Enhanced network monitoring: the system shall provide information about flow, pressure and water quality conditions in the water distribution network for all the nodes and customers, including those that are not measured by field sensors/devices. ● Forecast water network behaviour: the system shall be able to predict the behaviour of the water distribution network's hydraulic and water quality parameters for the following 48 hours and raise alarms based on the future state of these parameters when required. This prediction shall be dynamically generated based on the real time data gathered by the SCADA. ● What if scenarios: the system shall allow the operator to create operational what if scenarios and

	<p>visualize the results of these scenarios for easy comparison and decision making.</p> <ul style="list-style-type: none"> • Single point of information for control room operators: the system shall present all the information directly in the existing SCADA HMI, by incorporating in the SCADA alerts related to level of service breaches (outage, pressure and water quality issues), thematic maps related to current and future operating conditions of the network, option to simulate the effects of what-if operational scenarios, possibility to notify alarms to water network managers and field technicians on duty. • Utility wide view: in order to share relevant data to other stakeholders within the organization, the system shall include a web based HMI where input data and simulation results for the entire network can be visualized, in the form of thematic maps, time series graphs, tables and longitudinal profiles. • The MSI should survey all the sites before preparation of requirement specifications. • Study and propose any other gap infrastructure/hardware related to implementing the Water SCADA in above specified locations. • Supply, Configure, Install, Test and Commission comprehensive SCADA system for complete Naya Raipur Water Supply System. • Proposed SCADA system shall monitor, operate and control operations of all units/systems and associated equipments/devices/instruments etc. at Intake Well, Raw Water pumping main pipeline, Water Treatment Plant, MBR, Clear Water gravity main pipeline, 9 UGRs with Pump House at various locations across Naya Raipur. • Proposed System shall be able to calculate water loss level and locate leakage across the entire water network including District Metered Areas (DMA). The system shall be able to pre-locate bursts/leaks by analyzing hydraulic parameters along the pipelines. • Proposed system should provide the option to generate alerts/messages/alarms with respect to specific configurable parameters. It should be possible for the Engineer-in-charge (and a few other senior officers) to monitor the complete water network from any PC/laptop/tablet/mobile on the network using a standard browser. • Develop asset management for Water supply equipment with the capability to integrate with leakage management module and Geographic Information System (GIS) to streamline pipe repair management and monitoring.
2.	<p><u>User Interface</u></p> <p>a. Operational view - Web based HMI</p> <p>In order to help the water distribution department's activities, the SCADA add-on shall provide information at least on the following aspects:</p> <p><i>Day to day operation</i></p> <ul style="list-style-type: none"> • Data on flows, pressures, tank and reservoir levels, water age and disinfectant concentration for the next 48 hours. • View at a glance the current levels of services (outage, pressure, water quality) in the distribution network zones. • Analyze in detail the behavior of a specific zone over the last 48 hours. • Check the status of all the storage points (tanks, reservoirs) and their trends over the last 48 hours.

	<ul style="list-style-type: none"> • Alarms based on the expected situation of hydraulic and water quality parameters. <p><i>Service disruptions</i></p> <ul style="list-style-type: none"> • View at a glance what distribution network zones and how many customers are likely to experience disruptions over the next 48 hours. • Evaluate the impact of planned maintenance on levels of service (number of customers affected). • Analyze the results of an alternative what-if scenario and compare it with the business as usual scenario. • Notify issues to the staff in charge of the zone/asset where the problem is located. <p><i>Service performance</i></p> <ul style="list-style-type: none"> • Zones with the lowest standard of service in terms of pressure supply. • Zones with the lowest standard of service in terms of supplied water quality. • Zones with the highest cost of energy associated to water distribution. • Zones with the greatest potential for active pressure management. • Pumping stations with the highest energy consumption. • Most inefficient pumping stations.
3.	<p>Results within the SCADA HMI</p> <p>As part of the enhancement of the SCADA monitoring capabilities to be provided by the solution, the SCADA operator shall automatically get relevant information from the simulation and optimization results, giving him/her support when making operational decisions. This shall be provided on the SCADA interface itself. Information from the on-line simulation shall be shown in the right mode, format and time on the SCADA client, through built-in navigation capability:</p> <ul style="list-style-type: none"> • The SCADA operator shall be able to navigate through the network hydraulic map view from within the SCADA client and zoom in and out. He/she shall have the possibility to select preconfigured views and themes for specific scenarios in the hydraulic and water quality results. • The SCADA operator shall have capability to scroll back and forth along a time bar and the contents in the map view from within the SCADA HMI shall change accordingly. The operator shall therefore be able to compare the current situation with forecast results, and take action accordingly. • The SCADA operator shall be able to examine data such as attribute information, pressure and flow figures and forecasts for a selected object, and to display object time series or other predefined time series. • The system shall be able to generate alerts associated to: ongoing breaches of service levels (pressure and water quality); forecast breaches of service levels; data anomalies.. A context-sensitive menu shall be available, allowing the Operator to acknowledge, comment or disable these alerts. • The SCADA operator shall be able to notify the alerts to network managers and field technicians so to take immediate actions to prevent or minimize service disruptions. • It should be possible to scroll back and forth and obtain data for pressure, flow and water quality at any given time - in the past, now or in the future, anywhere in the network. Predict the network behavior and see what will happen before it happens • Improves service and planning: Plan ahead and save time and money

	<ul style="list-style-type: none"> • Builds on your existing data and IT: Gives existing software systems new functionalities • It should be possible to simulate scenarios to see operation & maintenance impacts in advance, making easier to choose the best option for a smooth and risk less operation • It should be possible to monitor Water quality and early warning on pollution/bad quality cases to reduce health threatening events. • It should also possible to combine with weather forecast data to predict future consumption – even during periods of changeable or extreme weather conditions. • The hydraulic model built in the software should comprise all or some of the following functions: <ul style="list-style-type: none"> ○ Hydraulic calculations of the complete pipeline network resulting in calculated flows in all pipes and calculated pressure in all nodes (pipe connections). ○ Calculation of water age and chlorine propagation (Optional). ○ Leak size estimation is conducted if possible when a leak alarm is raised (Optional). ○ Leak location estimation is conducted if possible when a leak alarm is raised (Optional). ○ Pump optimization (Optional) ○ Demand Forecast (Optional) ○ Retrieving measurements to be used for hydraulic simulations. ○ Retrieving calculated results from the Demand Forecaster ○ Returning raised leak alarms and estimated leak sizes and leak locations (Optional).
4.	<p><i>Architecture</i></p> <p>The SCADA architecture shall provide the following:</p> <ul style="list-style-type: none"> • Client / Server architecture based on TCP/IP networking and report-by-exception (RBE) technology • Standalone single server operation. • Symmetric main-standby & capacity for triple standby server functionality. • Additional servers for client load sharing and remote locations. • Permanent Standby Server designed to be placed outside corporate firewalls providing a read-only access to the server while ensuring corporate security. • Fully automated data transfer between servers to provide complete server redundancy. This transfer shall include configuration, real-time data, historic data and event lists. Database updates shall be on an incremental basis with tuneable parameters • A scalable fully distributable architecture providing: <ul style="list-style-type: none"> ○ Unlimited number of server systems. ○ Unlimited number of display clients. • Where multiple servers are deployed, the system shall be capable of being configurable from a single client. • All redundancy shall be handled by the database, with the operational state of systems preserved through a server changeover. The system shall not rely on driver redundancy for data transfer when providing redundant server. The system shall present a uniform view of data including communication status after a fail over. • Forced changeover between main and standby allowing seamless changeover between main and standby servers without shutting down either server. • Clients to connect to a synchronizing server as soon as the configuration and current data in the database has synchronized. Incomplete data sets as per clients request on event or trend provide

	<p>indications that the synchronization is still in progress to ensure that conclusions are not drawn from incomplete data sets.</p> <ul style="list-style-type: none"> • Configurable compression of data communications between client/server and server/server to allow optimisation of communications performance over WAN networks. • Change reporting on Client/Server and Server/Server links rather than polled communication to permit operation on WAN networks. • Capable of operating Client/Server and Server/Server links over low to medium speed channels depending upon database size (e.g. 128K)
5.	<p><i>Database</i></p> <ul style="list-style-type: none"> • The SCADA database shall be of true relational database design and optimized for real-time SCADA operation. The database shall be object oriented and organized in a hierarchical structure. It shall support user-created “Templates” that allows management of common configuration from a single point in the database. Instances of templates shall be used for repetitive, standard configuration. • Templates of standard configuration shall support multiple object types including, but not limited to: <ul style="list-style-type: none"> ○ Point / Tag objects ○ PLC or RTU objects ○ Mimics or Graphic display objects ○ Trend objects ○ Logic programs ○ Schedules ○ Link objects • The SCADA database shall allow users to extend the database schema to store custom data, in either the configuration or data stream. These changes can be performed online without need for server restart.
6.	<p><i>Event Journal</i></p> <ul style="list-style-type: none"> • The system shall provide, as a built in feature and without the requirement for custom or external software, facilities for event logging. These facilities shall be separate from the alarm list and include the capability to insert user comments at any place in the event list. • Event lists shall be obtainable through an SQL-like query or filtered through user entry on a forms-based display. • Event data is to be stored in a time-series relational database. Each event record shall comprise a timestamp, responsible user, point name, message, and reason for event log. • The event journal shall support the following: <ul style="list-style-type: none"> ○ ODBC / SQL interface to event data ○ Filter and browse via full function display client ○ Filter and browse from Web client interface
7.	<p><i>Historical Data</i></p> <ul style="list-style-type: none"> • The SCADA system shall provide a built in data historian with the following facilities as standard features. These shall be provided without the addition of external software modules:

	<ul style="list-style-type: none"> ○ Time-series relational database ○ ODBC / SQL interface to historical (trend) data ○ Historical data to be stored with time-stamp, point quality, alarm status ○ Historic storage is to be based on configurable criteria including time between samples, alarm state change ○ Compression capability ● Historical files supporting fixed interval sampling only will not be accepted. ● Where historic data can be retrieved through communication devices such as PLC/RTUs, the historic data sub-system shall natively provide the capability to backfill this data in to the historian. ● No loss of data or gaps in data as a result of communication or server failure shall be accepted. The vendor must demonstrate its ability to ensure data integrity and history data recovery. ● The historic data subsystem shall provide fixed and user configurable views of the historic data tables. These views are required to provide SQL pre-processing and present historic data in aggregate format.
8.	<p><i>System Security & Access</i></p> <ul style="list-style-type: none"> ● The SCADA system shall provide a high level of inherent security. To this end the SCADA software shall provide security access down to data point level, and support individual Users, User Groups and a matrix of system capability and access to any level of the SCADA database. ● Full function Rich & Web client interfaces shall require explicit administrative configuration to valid connection to the SCADA server. ● Web interface facilities shall provide the capability to operate the Web interface using SSL and encrypted data. The Web functionality shall be provided in an integrated way with the web server facility tightly coupled with the SCADA database. It is not acceptable for the system to utilize IIS or similar external web interfaces, or require web pages to be “published” from the SCADA system. Changes in configuration to the SCADA system shall not require additional steps in order to provide modified information to the SCADA Web interface.
9.	<p><i>Open Connectivity</i></p> <ul style="list-style-type: none"> ● To provide easy access for customized reports and external data manipulation the SCADA software shall provide inherent OPC and ODBC database connectivity without the need for additional software options or modules. ● The following Open interfaces shall be provided as integrated components of the SCADA system are required: <ul style="list-style-type: none"> ○ OPC Data Access (OPC-DA) to the SCADA server real-time and configuration database ○ ODBC and OLE-DB to the SCADA server real-time database, historian, event / parameter journal and configuration database ○ OPC Historic Data Access (OPC-HDA) to historian ○ OPC Alarm & Event (OPC-AE) to event sub-system ○ OLE Automation interface to the SCADA server database
10.	<p><i>Reports</i></p> <ul style="list-style-type: none"> ● An integrated reporting package shall be able to generate, print and export reports: <ul style="list-style-type: none"> ○ Triggered by SCADA events ○ On user demand

	<ul style="list-style-type: none"> ○ On timed schedules ● Report generation shall use latest technology in database access and be capable of combining data from multiple databases via ODBC/SQL. This shall include SCADA and non-SCADA databases.
11.	<p><i>Standard Drivers</i></p> <p>The SCADA system shall provide native support for fully integrated Wide Area SCADA PLC/RTU protocols. This shall include the capability for supporting all protocols in redundant SCADA server configurations and support redundant communication paths.</p>
12.	<p><i>Protocol Support</i></p> <p>Wide area PLC/RTU protocols shall support:</p> <ul style="list-style-type: none"> ● local serial port communication ● terminal server serial port communication ● Ethernet LAN communication via TCP and UDP ports ● time synchronisation ● presetting output configuration points where configured ● fully integrated incorporation of events from a PLC/RTU ● unsolicited exception reporting ● Where RTUs utilise the DNP3 communications protocol, those devices must support the DNP3 Secure Authentication standard.
13.	<p>Real-time visibility of assets</p> <p>Bidder will import a logical or representative schematic of the water supply system from NRDA with assets such as ESRs, reservoirs, flow sensors, pressure gauges into Bidder's software. This map will be used as the central navigation tool by NRDA engineers. Smart Water Management Software will connect to the operational technology system database server and retrieve data for processing and display.</p>
Water Management & Leak Detection	
14.	<p>Leakage Calculations</p> <ul style="list-style-type: none"> ● The system shall be able to calculate water loss level and locate leakage across the entire water network including District Metered Areas (DMA). ● The system shall provide tools for real-time calculation of water loss and leak detection in the transmission and primary distribution network (upstream of DMAs) based on SCADA data.
15.	<p>District Metered Area Management</p> <ul style="list-style-type: none"> ● The system shall calculate leakage at DMA level through the analysis of the minimum night flow. ● The system shall provide multiple operator configurable options to calculate the minimum night flow: <ul style="list-style-type: none"> ○ Minimum rolling period. ○ Fixed time.

	<ul style="list-style-type: none"> ○ Absolute minimum value. ● The system shall calculate the customers' night consumption using information coming from measured consumption of sample customers, the customer information/billing system, and manual inputs. ● The system shall calculate the pressure correction factor using information coming from pressure measurements, hydraulic model simulations and manual inputs. ● The system shall provide the option to select days to be excluded from the leakage calculation (week-ends, public holidays). ● The system shall make available several configurable options for converting daily leakage into weekly, monthly and yearly leakage. ● Where a meter has failed on a boundary zone the system shall be able to temporarily merge the two surrounding zones together and calculate leakage for the wider area.
16.	<p>Active Leakage Control</p> <ul style="list-style-type: none"> ● The system shall have the capability of managing Active Leakage Control (ALC) activities and resources (field staff and equipment). ● The system shall provide a calendar-based view allowing a resource planner to envision the resources (human and materials) usage in a given time period highlighting resource usage conflicts. ● The system shall recommend the leak detection techniques to be applied to each DMA based on its characteristics. ● The system shall allow the user to raise a work order and move the job to work into the Computerized Maintenance Management System (CMMS) for: <ul style="list-style-type: none"> ○ Leak detection. ○ Leak repair. ○ Equipment check-up and maintenance.
17.	<p>Pressure Management</p> <ul style="list-style-type: none"> ● The system shall be able to manage pressure across the entire water network including Pressure Zones (PZ). ● The system shall be able to monitor PZ performance in terms of: <ul style="list-style-type: none"> ○ Level of service to customers (pressure of supply within an optimal range). ● The system shall provide PZ optimization tools that recommend the operator changes in the setting of PZ pressure regulating devices and also automatically send the recommended set points of PZ pressure regulating devices to the SCADA system. ● The system shall calculate the results of the proposed pressure optimization in terms of leakage and burst reduction and water and cost savings.
18.	<p>Asset Management</p> <ul style="list-style-type: none"> ● The system shall have the capability to integrate with CMMS, Outage Management System (OMS) and Geographic Information System (GIS) to streamline pipe repair management and monitoring. ● The system shall identify the most critical infrastructure from a leakage/burst risk occurrence point of view and make recommendations for areas of the network which would benefit from mains and service connections replacement.

	<ul style="list-style-type: none"> Information shall be made available in the system with regard to leakage repairs, history and status. The system shall show this information in dashboards/reports. These reports shall be available at all levels of the hierarchy.
19.	<p>Alarm Management</p> <ul style="list-style-type: none"> The system shall be able to identify and alert the operator on the occurrence of different types of anomalies in the water network normal operation in a real time environment including: <ul style="list-style-type: none"> Bursts/leakage. Faulty metering equipment. Anomalous consumption. Unreported network operation. Zone boundary breach. Anomalous behaviour in network operations and faulty metering equipment. The system shall propose to the operator a set of default alarm associated to specific network assets. The system shall allow the operator to configure the default alarms and create ad-hoc alarms. The system shall allow alarm thresholds to be profiled by time: <ul style="list-style-type: none"> Time of the day. Day of the week. Period of the year/season. Bank holidays.
20.	<p>Data Validation</p> <ul style="list-style-type: none"> The system shall use an engine to automatically validate each data stream entering the system. Data shall undergo a series of comparison tests against discrete values, historical values, and averages/totals. The outcome of these tests determines the data quality flag of each measurement reading. The system shall be able to recognize anomalies in the data streams and flag them as erroneous. The system shall provide the operator with the results of all the validation tests and sort the results based on the data quality flag. If the data failed the validation check, the system shall flag the data or mark it invalid. These values will not be used in calculations. Operators shall be able to review all failed data and decide whether accept their values or to discard and substitute them with an estimated value.
21.	<p>Reporting</p> <ul style="list-style-type: none"> The system shall provide a comprehensive set of water balances, standard reports and performance indicators regarding water loss. Reports shall be made available in the system at various hierarchical levels and zone aggregations. The system shall contain dashboards summarising real time key performance measurements. Each user shall be able to configure these dashboards by selecting the content to be displayed. The system shall provide visual and spatial information on maps, GIS layers and network schematics. Each layer shall be able to be switched on or off to adapt to the user's visualization

	needs.
22.	General Requirements <ul style="list-style-type: none">• The system shall be a web-based application.• The system shall run in a technical environment using computing resources that are hosted at client or client service provider premises, and be accessible over the client's network.• The system shall provide support for mobile devices.• The system architecture shall be scalable to allow for future growth in both data volumes and user volumes.• Access to all functions shall be controlled on an individual user basis and on a grouping basis where users with similar roles can be easily assigned the same functions.• The system shall provide additional authentication for the execution of critical functions.• All actions carried out within the system shall be recorded for audit purposes.• The system shall embed a network management system with online hydraulic modeling and simulation capabilities or have the ability to link and integrate seamlessly with the hydraulic models for real time simulation.

VII. Data centre

1. Backup Software

#	Description
1.	The proposed Backup Solution should be available on various OS platforms such as Windows, Linux and UNIX platforms and be capable of supporting SAN based backup / restore from various platforms including UNIX, Linux, and Windows etc.
2.	Centralized, web-based administration with a single view of all back up servers within the enterprise. Single console must be able to manage de-duplicated and traditional backups.
3.	The proposed backup solution should allow creating tape clone facility after the backup process.
4.	The proposed Backup Solution has in-built frequency and calendar based scheduling system.
5.	The proposed backup Solution supports the capability to write multiple data streams to a single tape device or multiple tape devices in parallel from multiple clients to leverage the throughput of the Drives using Multiplexing technology.
6.	The proposed backup solution support de-multiplexing of data cartridge to another set of cartridge for selective set of data for faster restores operation to client/servers
7.	The proposed backup solution should be capable of taking back up of SAN environment as well as LAN based backup.
8.	The proposed solution also supports advanced Disk staging.
9.	The proposed Backup Solution has in-built media management and supports cross platform Device & Media sharing in SAN environment. It provides a centralized scratched pool thus ensuring backups never fail for media.
10.	Backup Software is able to rebuild the Backup Database/Catalogue from tapes in the event of catalogue loss/corruption.
11.	The proposed Backup Software should offer online backup for all the Operating Systems i.e. UNIX, Windows & Linux etc.
12.	The proposed Backup Solution has online backup solution for different type of Databases such as Oracle, MS SQL, MySQL and Sybase / DB2 etc. on various OS.
13.	The Proposed backup solution shall provide granularity of single file restore.
14.	The Proposed backup solution shall be designed in such a fashion so that every client / server in a SAN can share the robotic tape library.
15.	Backup Solution shall be able to copy data across firewall.
16.	The backup software must also be capable of reorganizing the data onto tapes within the library by migrating data from one set of tapes into another, so that the space available is utilized to the maximum. The software must be capable of setting this utilization threshold for tapes
17.	The backup software should be able to support versioning and should be applicable to individual backed up object's
18.	Should have the ability to retroactively update changes to data management policies that will then be applied to the data that is already being backed up or archived
19.	There should be seamless movement of data between primary and secondary storage, transparent to application or users

2. EMS (Enterprise Monitoring System)

The Monitoring system should be able to provide automated consolidated SLA reports for all the SLAs as mentioned in this RFP including real time status of various service levels achieved. The report to be available through a centralised web access / dash board the access for this to be given to at least 5 users of NRDA.

MSI will implement dedicated EMS solution to meet the SLA monitoring and other requirements as mentioned in the RFP. The implemented EMS solution to help NRDA in data driven decision making. In case the MIP uses any OEM product(s), the implementation should be as per best practices of the OEM. NRDA may engage STQC/Other independent auditors for validating the deployment of EMS facilities as per RFP requirements, specially their capabilities for measuring and reporting SLAs & KPIs as defined in RFP. The entire EMS implementation shall be certified by the MSI also for its correctness, adequacy to meet RFP requirements and measurement of SLAs & KPIs etc.

3. Network Monitoring Requirements

#	Description
1	The Solution should provide capability to monitor any device based on SNMP v1, v2c & 3
2	The Solution should monitor bandwidth utilization.
3	The solution should monitor utilization based on bandwidth.
4	The Solution must be capable of monitoring the availability, health, and performance of core networking devices including but not limited to CPU, memory, temperature.
5	The Solution should have the ability to issues pings to check on availability of ports, devices.
6	The Ping Monitoring should also support collection of packet loss, Latency and Jitters during ICMP Ping Checks
7	The Port Check for IP Services monitoring should also provide mechanism to define new services and ability to send custom commands during port check mechanism.
8	The Solution should have the ability to receive SNMP traps and syslog.
9	The Solution should automatically collect and store historical data so users can view and understand network performance trends.
10	The solution should be capable of monitoring network delay/latency.
11	The solution should be capable of monitoring delay variation
12	The solution should be capable of monitoring packet loss, Packet QOS, Packet Errors on one or more ports
13	The solution should allow users to access network availability and performance reports via the web or have those delivered via e-mail.
14	The solution should support auto-discovery of network devices
15	The solution should have the ability to schedule regular rediscovery of subnets.
16	The solution should provide the ability to visually represent LAN/WAN links) with displays of related real-time performance data including utilizations.
17	The system should provide discovery of heterogeneous physical network devices like Layer-2 & Layer-3 switches, Routers and other IP devices and do mapping of LAN & WAN connectivity .
18	The solution should provide capability to mask the default port speed for accurate % port utilization reporting
19	The system shall support monitoring of Syslog or equivalent
20	The solution should provide capability to add an IP device or IP Range or IP subnet with functionality supporting multiple SNMP strings.
21	The solution should provide capability to add devices from word/excel/csv/text file by importing IP

#	Description
	address from any of the file type.
22	The system should support the configuration of at least 5 second polling for critical link and devices for troubleshooting issue.

10. Annexure III-Hardware Specifications

ONVIF Support

All Cameras, Video Management System, Video Analytics Solution/Software and any video/image processing solution within overall project offering should be ONVIF Core Specification '2.X' or 'S' compliant and provide support for ONVIF profiles such as Streaming, Storage, Recording, Playback etc

10.1. Outdoor/Fixed Box cameras (High Definition)

#	Parameter	Minimum Specifications or better
1.	Video Compression	H.264
2.	Video Resolution	1920 X 1080
3.	Frame rate	Min. 25 fps
4.	Image Sensor	1/3" Progressive Scan CCD / CMOS
5.	Lens Type	Varifocal, C/CS Mount, IR Correction
6.	Lens#	Auto IRIS 8 – 40 mm, F1.4
7.	Minimum Illumination	Colour: 0.5 lux, B/W: 0.1 lux (at 30 IRE)
8.	IR Cut Filter	Automatically Removable IR-cut filter
9.	Day/Night Mode	Colour, Mono, Auto
10.	S/N Ratio	≥ 50 Db
11.	Auto adjustment + Remote Control of Image settings	Colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, Wide Dynamic Range
12.	Audio	Audio Capture Capability
13.	Local storage	Minimum 64 GB Memory card in a Memory card slot
14.	Protocol	IPV4, IPV6, HTTP, HTTPS, FTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, UPnP, QoS
15.	Security	Password Protection, IP Address filtering, User Access Log, HTTPS encryption
16.	Operating conditions	0 to 50°C (temperature), 50 to 90% (humidity)
17.	Casing	NEMA 4X / IP-66 rated
18.	Certification	UL/EN, CE,FCC

10.2. Pan, Tilt and Zoom cameras (PTZ)

#	Parameters	Minimum Specifications or better
1.	Video Compression	H.264
2.	Video Resolution	1920 X 1080
3.	Frame rate	Min. 25 fps
4.	Image Sensor	1/3" OR 1/4" Progressive Scan CCD / CMOS
5.	Lens	Auto-focus, 4.7 - 94 mm (corresponding to 20x)
6.	Minimum Illumination	Colour: 0.5 lux, B/W: 0.1 lux (at 30 IRE)
7.	Day/Night Mode	Colour, Mono, Auto
8.	S/N Ratio	≥ 50Db
9.	PTZ	Pan: 360° endless/continuous, 0.2 to 300°/s (auto), 0.2 to 100°/s (Manual) Tilt: 90°, 0.2 to 100°/s (Auto), 0.2 to 40°/s (Manual) 20x optical zoom and 10x digital zoom 64 preset positions Auto-Tracking Pre-set tour
10.	Auto adjustment + Remote Control of Image settings	Colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, Wide Dynamic Range
11.	Protocol	HTTP, HTTPS, FTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, UPnP, QoS, IPV4, IPV6
12.	Security	Password Protection, IP Address filtering, User Access Log, HTTPS encryption
13.	Operating conditions	0 to 50°C (temperature), 50-90% humidity
14.	Casing	NEMA 4X / IP-66 rated
15.	Certification	UL/EN,CE,FCC
16.	Local storage	Minimum 64 GB Memory card in a Memory card slot

10.3. Infrared Illuminators

The infrared illuminators are to be used in conjunction with the Fixed Box cameras specified above to enhance the night vision.

#	Parameter	Minimum Specifications or better
1.	Range	Min. 100 meters, with adjustable angle to cover the complete field of view at specified locations
2.	Minimum Illumination	High sensitivity at Zero Lux
3.	Power	Automatic on/off operation
4.	Casing	NEMA 4X / IP-66 rated
5.	Operating conditions	-5° to 50°C
6.	Certification	UL/EN/CE/FCC

10.4. Field Junction Box

#	Parameter	Minimum Specifications
1.	Size	Suitable size as per site requirements to house the field equipment
2.	Cabinet Material	Powder coated CRCA sheet/ Stainless steel
3.	Material Thickness	Min 1.2mm
5.	Number of Locks	Two
6.	Protection	IP66 / NEMA 4X
7.	Mounting	On Camera Pole / Ground mounted on concrete base
8.	Form Factor	Rack Mount/DIN Rail
9.	Other Features	Rain Canopy, Cable entry with glands and Fans/any other accessories as required for operation of equipment's within junction box.

10.5. Camera Poles

#	Parameter	Minimum Specifications
1.	Pole type	Hot Dip Galvanized after Fabrication with Silver coating of 86 micron as per IS:2629; Fabrication in accordance with IS-2713 (1980)
2.	Height	5-10 Meters, as-per-requirements for different types of cameras & Site conditions
3.	Pole Diameter	Min. 10 cm diameter pole (bidder to choose larger diameter for higher height)

#	Parameter	Minimum Specifications
4.	Cantilevers	Based on the location requirement suitable size cantilevers to be considered with the pole
5.	Bottom base plate	Minimum base plate of size 30x30x15 cm
6.	Mounting facilities	To mount CCTV cameras, Switch, etc.
7.	Pipes, Tubes	All wiring must be hidden, through tubes/pipes. No wires shall be visible from outside.
8.	Foundation	Casting of Civil Foundation with foundation bolts, to ensure vibration free erection (basic aim is to ensure that video feed quality is not impacted due to winds in different climatic conditions). Expected foundation depth of min. 100cms. Please refer to earthing standards mentioned elsewhere in the document.
9.	Protection	Lightning arrester at select sites as per the requirements
10.	Sign-Board	A sign board describing words such as “This area under surveillance”

10.6. Network Switch


#	Parameters & Minimum Specifications
1.	<ul style="list-style-type: none"> • Switch should have atleast 4 x 10/100 combo ports and 8 x 10/100 PoE ports. • Switch should have wire rate switching fabric of minimum 20 Gbps or more. • Should support Improved resiliency with support for ring protection protocol for ring topology • Switch should support IGMP v1/v2/v3 as well as IGMP snooping and minimum 500 IGMP Multicast Groups • The switch should support following IPv6 Features: 128-Bit Wide Unicast Addresses, DNS for IPv6, ICMPv6, Neighbor Discovery, SNMP and Syslog Over IPv6, HTTP over IPv6 and IPv6 MLD snooping • The switch should support layer 3 routing protocols such as OSPF, EIGRP, BGPv4, IS-IS, RIPv2, Policy-Based Routing (PBR), HSRP • The switch should support for GOOSE Messaging or similar fault diagnosis mechanism • The switch should have Utility Specific Smart Port Macros/Templates • The switch should be minimum IP30 certified. • The switch should be IEC 60068-2-27 (Operational Shock, Non-Operational Shock) certified or shall be supplied with required mounting for handling shock / non-shock. • The switch should be IEC 60068-2-6, IEC 60068-2-64, EN61373 (Operational Vibration, Non-operational Vibration) certified or shall be supplied with required mounting to handle operational and non-operational vibrations. • The switch should support Ethernet OAM (802.3ah) and CFM (802.1ag)

10.7. Standardized Signs for CCTV Camera Locations

It is necessary that the CCTV Camera locations put some standardized signs informing the public of the existence of CCTV cameras. This will bring about the transparency on installation of CCTV cameras and no one would be able to later complaint for breach of privacy. The international standards with respect to sign types need to be adhere to for all camera locations.

Sign Specifications

#	Item	Minimum Specifications
1	Size	Board Width = 8" / 12" (For type A and B) Board Width = 12" / 18" / 24" (For type C and D)
2	Plate Material	Corrosion resistant Aluminium Alloy as per IRC 67:2001 (Code of Practice for Road signs)
3	Plate Thickness	Minimum 1.5 mm
4	Retro-Reflective sheeting for sign-plate	Weather-resistant, having colour fastness
5	Other Specifications	As per IRC 67:2001 (Code of Practice for Road signs)
6	Mounting	Can be mounted on wall or pole (appropriate mounting brackets to be provided)
7	Design	As per following signage diagrams

Sign Design	Remarks
	<p>This may be used on a select few places in the city, usually on the main pole of the location where multiple cameras are installed. Text should be in English & Hindi in majority of places.</p>

10.8. Junction Boxes

The junction box shall be fitted in secure locations (not easily accessible to the general public) and shall be fitted with a standard cabinet lock. Roadside cabinets shall be secured with anti-tamper fixings in addition to the standard cabinet lock.

- Each Junction box shall be fitted with sufficient screw type terminals to terminate all pairs used and unused. The terminal blocks shall be certified for use with the box.
- Each box shall be equipped with certified cable glands/plug and with earthing bar.
- Cable continuity shall be through junction box dedicated terminals.
- Junction box shall be weather proof to IP 65 as minimum.

10.9. Earthing

- All junction boxes, Poles, local cabinets and field mounted instruments shall be connected to the nearby earth bus bar/earth pit
- The metallic housing of electronic equipment/junction box/panel shall be connected to the earthing system
- The active electronic parts of an electronic equipment system shall be connected to the earthing system

10.10. Online UPS -1 KVA

#	Parameter	Minimum Specifications
1.	Capacity	1 KVA
2.	Output Wave Form	Pure Sine wave
3.	Input Power Factor at Full Load	>0.90
4.	Input Voltage Range	305-475VAC at Full Load
5.	Input Frequency	50Hz +/- 3 Hz
6.	Output Frequency	50Hz +/- 0.5% (Free running); +/- 3% (Sync. Mode)
7.	Inverter efficiency	>90%
8.	Over All AC-AC Efficiency	>85%
9.	UPS shutdown	UPS should shutdown with an alarm and indication on following conditions 1)Output over voltage 2)Output under voltage 3)Battery low 4)Inverter overload 5)Over temperature 6)Output short
10.	Battery Backup	1 hour in full load

#	Parameter	Minimum Specifications
11.	Battery	VRLA (Valve Regulated Lead Acid) SMF (Sealed Maintenance Free) Battery
12.	Indicators & Metering	Indicators for AC Mains, Load on Battery, Fault, Load Level, Battery Low Warning, Inverter On, UPS on Bypass, Overload, etc. Metering for Input Voltage, Output Voltage and frequency, battery voltage, output current etc.
13.	Audio Alarm	Battery low, Mains Failure, Over temperature, Inverter overload, Fault etc.
14.	Cabinet	Rack / Tower type
15.	Operating Temp	0 to 50 degrees centigrade
16.	Management Protocol	SNMP Support through TCP/IP

10.11. RTU Specifications for Electrical Utility Management System

The RTU to be selected shall cover the following requirements:

- The proposed RTU shall be based on a truly distributed design allowing any flexible combination and distribution within the various substation areas or building being able to cope new configuration with serial IEDs as well as for refurbished substations where large IO quantities are required (around 20 I/o modules or more, dealing with 2000 data points).
- The proposed RTU shall allow flexible, scalable and reliable integration of control, monitoring, metering, power quality, fault recording and automation functions. It can be used for a wide range of bays from medium-voltage substations.
- The proposed RTU shall comply with latest state of the Art Ethernet Based technology hence using open system standard, at least 32 bit processor on the CPU board, possibility to integrate some Optical Ethernet switches interface under 100Mbit/s technology. Should several racks be used all the required interfaces between racks shall be embedded within the rack hardware and no require any external switches.
- The proposed RTU shall allow latest HMI LCD display technology to be used on main RTU rack allowing operator to access detailed substation alarms and events data without the absolute necessity to use laptop computers. In the meantime laptop port should be available for any major local database changes to be managed.
- The proposed RTU shall comply with applicable standards and equally satisfies the technical requirements stated in European (CE) and International specifications (IEC – International Electro technical commission).
- The proposed RTU shall be rugged and offer cyber-security facilities (NERC compliant) , to avoid unauthorized local access and control.

1.1 TYPICAL ARCHITECTURE

The proposed RTU shall be based on the latest generation of modular substation controllers. As a consequence in addition to the traditional Input / Output management it shall be able to act as a powerful communication gateway/concentrator from Substation IEDs to the SCADA as well as a fast automation center.

The module hardware designed shall be modular enough to cope with large I/Os quantities for substation to be refurbished or limited I/Os quantities for new substations where most of the I/O's are to be collected through serial IEDs. In this later case especially the hardware shall be designed and type tested to cope with the most demanding constraints:

Switchyard environment for substation design for bay control panels are located in kiosks within the Switchyard. The RTU serial communication capability shall be flexible enough to allow retrieval of data from legacy and third party devices such as relays, IEDs and act as a gateway between the LAN upper and lower networks covering multiple standards communication protocols. At least the serial IEC-870-5-103, Modbus and DNP3.0 shall be covered with the RTU existing design to be able to cover any type of IED on these protocols.

The RTU shall offer Ethernet communication capability for being IEC870-5-104 to 2 Ethernet Ports be flexible enough to allow retrieval of data from legacy and third party devices such as relays, IEDs.

For applications where the RTU is used as a dataconrator to other rack, the RTU shall offer the flexibility to offer large bandwidth data exchange (at least 100Mbit/s) in between racks for applications requiring high speed data exchange (in that case the use of optical fiber medium is to be preferred), while keeping the flexibility to use lower speed protocols type IEC870-5-101 or equivalent when lower bandwidth medium are available.

In summary the proposed RTU shall offer the most flexible and innovative communication speeds including atleast:

- Standard open SCADA protocol for data master-slave exchange through lower bandwidth communication medium at least IEC60870-5-104
- Ethernet based substation protocols for substation operator and asset managing engineers (Ethernet IEC 61850)
- For serial interface with Substation IEDs RS485 links using IEC 60870-5-103, DNP3 and MODBUS shall be available. The Modularity of the racks shall be made so that 20 IEDs can be connected serially to a rack through these links without jeopardizing the expected response time at the SCADA level.
- Should local Ethernet communications be required within the Substations the option to include integrated Ethernet switch board shall be available.
- Local scada HMI for local control & monitoring.

1.2 Main RTU Functionality

The RTU functionality shall be highly configurable to suit any specific substation requirement. The minimal system configuration provides basic plant monitoring and controls facilities from remote locations incorporating automatic hardware recognition and self-configuration to form this basic solution.

The functions to be covered are the following:

- IOs Processing (DI, DO, AI, AO, Dummy breaker)
- Substation automation functions
- Data communication with SCADAs (Remote or Local)
- Peripheral communication
 - Local HMI for maintenance and commissioning
 - Event Logger
 - External Clock receiver (IRIG-B/GPS signal)
- Multi-rack communication capability (2 racks)
- Communication with Intelligent Electronic Devices (IEDs), Protection relays
- Time Synchronisation of distributed racks and connected IEDs
- Provision for Power Supply input from Dual Source with Automatic Source Switch feature
- Digital Input Module with Multi voltage (24V-250V DC) & peak current (25mA max.) capability
- Embedded Maintenance Web Server which can be accessed from Internet Browser like Internet Explorer, Mozilla etc
- Redundant database creation capability which helps in reducing un-availability during system upgrade.
- Automatic IEC61850 addressing feature when linked to system configuration tool.

1.3 Communication with SCADA/DMS Master:

- For distributed configuration consisting of several RTU racks, any rack can have the flexibility to be designed as a the data concentrating interface to the upstream SCADA, concentration data from any other rack without jeopardizing the response times expected at the master station level. At least the following serial data port options shall be available: IEC 60870-5-104, IEC 60870-5-101 and DNP3.0 (serial and IP).
- The RTU shall also have the capability to interface with several master stations of different types in the same time, covering the possibility to at least interface through 4 independent redundant ports (more than 8 ports in total).
- Physical interface options shall cover the following possibilities: RS232, RS485, Optical Multi-mode medium or Optical Mono-mode medium.

1.4 RTU Power Supply

- The entire RTU electronic component shall be designed to suite the specific Substation environment as far as EMC constraints. Especially it shall be possible to power them on 48 to 220 Vdc from specific substation battery charger type.
- RTU shall offer capability to be powered from distinct Dual Power Source; internal mechanism shall insure automatic switch between the Dual Sources.

1.5 Digital Input Processing

- All standard processing algorithms shall be provided for the standard signal types such as single digital inputs, double digital inputs, transformer tap indications, etc.

- Each of these signal types shall have the required number of conditioning parameters associated with them, e.g. inversion of input state, filter times, scaling parameters etc. These shall be configurable on a point by point basis.
- All status changes shall be time stamped to a resolution of 1mS.

1.6 Pulse accumulators:

- These are assumed to be either single pulse accumulators / counters. Each pulse accumulator shall be presented to the RTU as a single digital input or a complemented digital input respectively. The points regarding the digital input above would therefore equally apply to these inputs.
- The value of the counter represents the number of pulses counted since the loading of database or since the counter roll over or since a voluntary reset.

1.7 Digital Outputs

- Digital output card shall allow pairs of trip / close outputs. In addition to this, depending on the configuration the output shall be configurable of Transient or Persistent type.
- The outputs shall be presented as single pole Form A contacts. As applicable to the protocol (IEC60870-5-101), the Controls shall be configurable of immediate type or of Select before Operate mode.
- RTU shall support Dummy breaker (simulated CB to check end to end Communication with the Scada).

1.8 DC Analogue Inputs

- The DC analogue input can be acquired by the RTU through transducers; each input is to be isolated and shall be selectable individually among various ranges:
- Current inputs: +-20mA, 4-20mA, 0-5mA, 0-10mA, 0-1mA or Voltage inputs : 0-5Vdc , 0-10Vdc, +-10Vdc
- Analog input accuracy shall be $\leq 0.1\%$. The CAD converter type is: 15bits + Sign.

1.9 IED Interfaces

- The propose RTU shall allow any acquisition of time stamped data (I/O Points) from remote Intelligent Electronic devices such as meters, protective relays or sub-RTUs. This function shall be done in conjunction with conventional I/O processing.
- This communication shall be made through serial data polling from each IEDs. (speed communication to be between 2400b/s to 39,8kbit/s). The RTU rack design shall be made to cater for distribution substation fully equipped with numerical relays, hence shall be able to communicate up to 20 devices per rack while maintaining response times cycles of less than 2 to 4s at the Master Station SCADA level.
- The RTU shall act as a data segregating devices, offering only the required data access to the SCADA level, while offering the option of full data access with the local Substation equipment.

1.10 Time Management

- The proposed RTU shall be synchronized through an external clock(GPS receiver with IRIG-B interface) or through the SCADA/DMS master station.

- The serial data communication between racks and IED should then insure that the main RTU racks properly synchronizes other racks and IEDs. If limitations are due to limited communication capabilities at the IED level, then these shall be clearly highlight within the RTU proposal.
- At each substation a single IRIG-B Interface (BNC Plug) port shall be allocated for the connection of a suitable GPS unit for local synchronization. The True time clock shall be a suitable model from TRUETIME, which will synchronize the RTU to an accuracy of 10-5.

10.12. FRTU Specifications for Electrical Utility Management Systems

The MV/LV station remote control interface FRTU shall include all the functions required to monitor and control RMU cubicles in the 11/0.433 KV DT stations to be remote controlled. FRTU has to be integrated with the existing RMUs in Naya Raipur.

Functions of the monitoring and control enclosure

- The monitoring and control enclosure shall meet following main requirements:
 - Monitoring and control of medium voltage cubicles.
 - Detection of ampere metric faults, adjustable for each feeder in built in FRTU.
 - Load current measurement on the line fitted with a fault detector.
 - Data transmission to the remote control centre.
 - Energy supply and storage with 9-hour autonomy in the event of mains failure for Motor Drives, Control Unit & other accessories inside FRTU
- It shall be possible to view the most important information locally on the front panel of the enclosure and remotely from the control centres. It shall be possible to view LBS/breaker status from the front mimic of FRTU with the help of led indication.
- It shall be possible to issue control command from the front panel of the FRTU with security button.
- It shall be possible to retrieve and display on a laptop PC the time-stamped events recorded at the enclosure. It shall also be possible to retrieve this information from the remote control centre.
- The FRTU shall have remote or local control mode switch on its front panel.
- Possibility of electrical remote control from Control Centre Main SCADA.
- The control unit shall have following communication protocols:
 - IEC 870-5-101 / 104 protocol to transfer information to control center SCADA.
 - Modbus protocol to communicate with field MFM (Multi Functional Meters) on RS485.
- The Standard FRTU shall be capable to monitor and control 3 Way / 4 ways RMU. For monitoring and control of 5 Way /6 Way RMU, the FRTU must be extended to control up to 16 Way RMU, considering future aspects.
- Tentative I/O List is below. It shall be finalized during drawing approval.
- FPI card, Battery/Battery Charger should be an integral part of FRTU. FRTU should be preferably from the OEM of RMU
- Auxiliary Supply of RMU & Motorized from 24V DC motor drive supply voltage. The 12V transmission output will be able to supply a conventional radio without a battery (I trans = 8A) to inform the remote control centre of a battery failure. The standby energy will be provided by a 12V 24Ah battery with a minimum autonomy of at least 9 hours for 10 opening and closing cycles. The batteries will be checked at regular intervals by the slave station and as alarm will be generated and transmitted to the remote control cente in the event of fault.

- The battery and battery charges will be protected against over voltages and over currents. The dielectric characteristics of the supply voltage input in accordance with IEC 60 25564 will be as follows
 - Insulation (50Hz / 1 min) 10KV
 - Impulse wave (1.2/50) 20KV
- Total No. of events to be handled by each FRTU should be minimum 40000 in numbers considering the large upcoming LV, AMI data in future.
- In the absence of FO cables currently, supplier should ensure operation of SCADA through GSM/GPRS with Control Centre. It should be accordingly upgraded to FO when FO cables are made available.
- Possibility of controlling changeover between two network channels or between a network channel and a generating set channel, with control of set start-up before changeover to the set. During changeover, to save switching time, it must be possible to control closing of the set channel at the same time as set start-up is actuated, without waiting until the set's voltage has been actually established. Override setting of operation on the set's channel shall be possible (without any changeover condition), so as to be able to perform regular maintenance operations on the generating set.
- Automatic source Paralleling: Power supply source changeover from a normal channel (channel 1) to a standby channel (channel 2) with coupling of power supply sources (channel 3), to ensure continuity of power supply for the two downstream feeders.
- Self-Healing Grid: The FRTU must be capable to support PLC programming, in order to incorporate self-healing grid logic for faster restoration of supply in absence of control centre SCADA. It should automatically detect the fault and isolate the fault with the help of peer to peer communication with other FRTU without any manual intervention from the control centre. For this it should be considered the following functionality into consideration.

10.13. RTU Technical Specification for Water System

Specifications of RTU

The RTU shall be non-redundant, modular. The controller shall at least include the following base I/O and further expansion shall be possible using expansion modules. The RTU shall be as per the following minimum specifications:

- Digital Inputs: 16 (24 VDC)
- Digital outputs: 16 (24 VDC Transistor/ Relay)
- Analog Inputs: 8 (Min.12 Bit resolution)
- Analog Outputs: 8 channels/ Module

Communication protocol for RTU

- The RTU shall possess a minimum of three built-in communication ports with the following characteristics:
- Two serial port (DTE) jumper-configurable to RS-232 (full or half duplex RTS/CTS control) or RS-485 (two-wire half-duplex) with operation to 115,200 baud
- The RTU shall support the industry standard DNP3 protocol, with the following minimum features:

- DNP3 Level 2 conformant with most features from Level 3 refer to the Device Profile for additional information
- Local and remote configuration via DNP3 and file transfer
- Reporting to up to 3 independent DNP3 Masters
- The RTU shall support the industry standard Modbus protocol, with the following minimum features:
 - Allows up to 5000 stations in one system.
 - Support high data security techniques such as Cyclic Redundancy Check CRC16

Proprietary protocols will not be allowed.

Input and Output Modules

- The I/O module assembly will consist of a mounting base, I/O module, and field wiring connector(s).
- The I/O module will plug into the base, allowing “Hot Swap” capability where the modules can be inserted and removed without removing power or shutting down communications.
- All modules shall be enclosed in rugged plastic housings with an environmental rating of IP20.
- The I/O modules shall be capable of connecting directly to 2 and 3 wire devices and is capable of providing the power for the field mounted sensors and actuators.
- All I/O modules should include a front mounted LED status indicator each input or out point to indicate the state of the inputs and outputs.
- The 24 VDC digital input modules should be able to interface with either IEC type 2 or type 3 field devices
- The digital output modules should include protection against reverse polarity, short circuit, and overload of the outputs, with automatic recovery.
- The digital output modules should include the option for the user to select modes for fault recovery, output polarity, and fall back states.
- The digital input modules should be available in versions that have 16, 32 points that will allow the user to select the number of I/O points that are required at each location.
- The analogue input modules shall have a maximum of 8/16 channels per module and shall accept 4 - 20 mA signals inputs from field mounted transmitters. Input signal conversion shall be a minimum of 12-bit resolution.
- The analogue output modules shall have a maximum of 8 channels per module and shall convert 12-data bits into proportional 4-20 mA analogue output signal.

For temperature measurements the I/O sub-system should include a multi range module of maximum 8 channels of thermocouple input that directly connects to Thermocouples, type B, E, J, K, R, S, and T. There should be a multi range module of maximum 8 channels of RTD input to connect to RTD's type Pt. 100, Pt. 1000, Ni 100, Ni 1000, and Cu 10, as well as a mill volt input, ± 80 mV.

CPU specifications

- Communication Ports: 1 Programming Port, 1 CANopen / Profibus Port & 2 Auxiliary Ports (Protocol configurable)
 - CAN open/Profibus/ Eq. Network: Max 31 Nodes (Up to 500 mtr.)
 - Max. Units per Node: 1 Base + 3 Expansion Units
 - Baud Rate: Auto Baud Detection (10, 20, 50, 125, 250, 500, 1000 Kbps)
- Operating Temperature: 0 to 60 C
- Memory capacity: More than 16 K steps of programming.
- Memory cassette: Shall have facility to install Flash/ EPROM cassette.
- SCAN time: Better than 2 micro second per general Boolean instruction.
- Relative Humidity: 5 to 90% Non-Condensing.
- Noise Immunity: IEC 61000-4-4
- Shock: IEC61131-2 Operating: 15g (DIN rail & Panel Mounting)
- Vibration: IEC61131-2 Operating: 5 to 150 Hz, 1g, 3.5mm Amplitude
- Mounting: DIN rail or Panel Mount
- Protection: IP 20
- Unit Power Supply: 11 to 30 VDC Through 5-pin
- Network Power Supply: 24 VDC, 5 A
- Power Supply Protection: Reverse Polarity
- Digital Inputs: 24 VDC, Sink/ Source selectable. With Input current less than 16mA.
- Digital Outputs: Relay having capacity 230 VAC, 5A. (Optionally interposing relays can be supplied).
- Analog Inputs: 4-20 mA or 0-10 VDC selectable with A/D conversion of min 12 bits.
- All cards in PLCs shall be conformal coated

10.14. Water Treatment Plant PLC

PLC Specifications

- The automated platform processors manage the entire PLC station, which is made up of a set of discrete & analog I/O modules, expert and communication modules, in both local and remote configurations.
- The local IO configuration of the most powerful processor in the range will provide 600 discrete I/O and 1536 analog I/O (cumulative values)
- The remote IO architectures support 31 remote drops.
- The distributed IO on Ethernet supports up to 128 equipment per scanner, up to 7 scanners can be inserted into the CPU main rack.
- The performance of the modules will be independent of their location in the system configuration.

- The system will be designed based on a range of in-rack processors (CPU) with varying performance levels, memory capacity, communication connections, number of I/O

Processor

- The processors must have an internal non-volatile memory to store application and data. Processor must also have a reserved slot for a removable cartridge so that the application and data backup can also be performed also on a mobile device.
- A program written for one CPU can be executed by another CPU in the range as long as it has sufficient capacity.
- It must be possible to connect a PC (programming terminal) or a human-machine interface via a USB port integrated in the processor.
- The range must provide processors with at least 3 built-in Ethernet ports featuring a web server, compliant with various operating systems: minimum is Windows, iOS, and android.
- Embedded web server must provide CPU diagnostic, including detailed information on Ethernet system networking and must be customizable by the user to display application variables and advanced diagnostics features (rack viewer, alarm buffer, complete PLC application)
- The date and time should be managed even when the processor is switched off for 20 days.
- NTP server must be provided within the CPU.
- The performance capacities of the various processor models are to be expressed in terms of execution time for 1K List-equivalent instructions for the two application profiles defined below: Most powerful controller must process at least:
 - 50 Kinstructions / ms for Boolean application²
 - 40 Kinstructions / ms for Numerical application³
- The PLC must be able to load the program without the use of programming software, just with the use of the memory cartridge.
- It must be possible to add modules or add remote I/O islands in the configuration without stopping the controller, as well as changing the application or variables.
- Processor must provide cyber-security features, such as real-time memory integrity control, access control
- The complete environmental footprint of the product must be known, such as equivalent CO2 consumption during each phase of product life.
- All products must be designed with eco-design requirements (Green Premium)

Operating system

- The operating system (OS) must be capable of multitasking with up to 4 periodic tasks and more than 60 event or I/O tasks.

² "Boolean": 100% Boolean/simple instructions (open contact, closed contact, tap-off, output, edge, set, reset, timer, counters)

³ "Numerical": 65% Boolean/simple instructions, 35% complex instructions (operations on single words, double words, logic operations (addition, multiplication, shift) handling of structures and tables, etc)

- The PLC RUN/STOP functions can be remotely controlled by setting the parameters of an input channel.
- It must be possible to assign a chosen physical input to prohibit any modification or downloading of the program.
- It must be possible to maintain the outputs or set them to fall back position when the PLC switches to STOP mode via channel by channel parameter entry.
- Execution of the warm and cold restart procedures is available by system bits which are accessible by the program and terminal.
- It must be possible to perform a functional update of the processor by simply downloading the firmware through the dedicated software or the programming software platform. However, it must also be possible to use a more recent version of the programming software without having to update the firmware of the processor.
- Engineering tool must provide a trending tool embedded to display variables at a minimum of 1ms sampling rate

Memory

- The memory area must consist of an executable internal memory for the application which can be saved both in an internal Flash memory embedded, and in a Flash type removable memory card.
- No battery supply is needed for non-volatile backup.
- The most powerful processor in the range must provide minimum of 16 MB of integrated non-volatile memory to save whole application and data, even in redundant configurations.
- It must be possible to store the program, comments and symbols in the PLC to enable connection of the programming tool without having the application on it. The "empty terminal" functionality must be possible whichever IEC language is used. It must be also possible to use the memory extension to back up files (production data, recipes, etc)
- It must be possible to secure access to application stored on the cartridge to prevent the run of application from any controller

Modules

- All modules (except processor and power supply modules) are hot-swappable separately, i.e. each of them can be inserted and removed alone while powered up.
- There must be a locating device for the modules, and automatic checking of conformity with the system software configuration to ensure that errors are avoided during module replacement.
- The modules are fully configurable by setting parameters in the development and runtime software. The parameters are stored in the PLC application and are automatically reloaded by the CPU if a module is exchanged.
- The catalogue must offer the following input characteristics:
 - 24 VDC
 - 100...120 VAC
- The input & Output must be isolated in accordance with standard IEC 61131-2.

- The catalogue must offer the following output characteristics:
 - 24VDC transistor (current range 0.1 A to 0.5 A)
 - 24VDC relay (current range 3 A)
 - 24...240 VAC relay (current range 3 A)
- The catalogue should offer high density digital I/O, 64 I/O, on one slot width module.
- The catalogue must propose I/O modules with at least two different type of wiring system: terminal blocks or high density connectors.

Power Supply

- The PLC module power supplies must be available in two formats:
 - 24 / 48VDC isolated
 - 100...240 VAC rms
- AC power supplies must have an integrated power supply capable of delivering 24 VDC to the sensors.

Pre-wired systems

- The offer must include a complete pre-wired and interfacing system between the PLC and the detectors and actuators. The system must combine the functions of a terminal block with simplified wiring and the adaptation, protection and distribution of signals.
- The range must include:
 - passive sub-bases
 - sub-bases with soldered or removable solid state relays
 - sub-bases with soldered or removable electromechanical relays
 - cables for connection between the in-rack modules and the sub-bases
 - preformed cables with flying leads
- The range of sub-bases must offer various options:
 - Isolation
 - Fuse protection
 - LED indicator
 - Marking system

The range of sub-bases must also enable the connection of analogue channels, and counter and position control modules.

Distributed & Remote configurations

- The communication functions of IP20 remote I/O modules must be independent of the input and output interface functions. It will therefore be possible to connect any module to the main field bus standards (multi-bus openness) including, amongst others:
 - Ethernet 10/100Mbps
 - Serial links
 - AS-i
- System must support in same network a mix of synchronized and unsynchronized drops and equipment with PLC scan.
- Connection to synchronized or unsynchronized drops must be provided through ring topology to insure quick recovery (<50ms) in case of one cable failure.
- Supplier must provide an opened system where it must be possible to integrate third party device based on standard technologies.
- The supplier must have an IP67 offer. The IP67 dust and damp proof remote I/O modules, equipped with a fast connection system using M23/M12 type connectors, must be able to provide a remote power supply to the modules via a single cable.

Time Stamping

- System must provide the capability to timestamp physical inputs at source with an accuracy of 1ms through a dedicated module. These time stamped variables are then directly forwarded to SCADA system to offer a consistent solution.
- Inputs time stamping can also be managed natively by the system on remote drops with an accuracy of 10 ms without any specific hardware.

Ethernet communication

- System must integrate in its communication layers standard Ethernet.
- Synchronized and unsynchronized drops with PLC scan can be managed over standard and open Ethernet communication.
- Communication network must be the same everywhere in the system, from control level to field level insuring network continuity from top to bottom.
- Offer catalog must offer in rack Ethernet modules to build the entire integrated architecture. For example, offer must provide in-rack switches, Wi-Fi access point, and fiber optic converter.
- The range must offer processors which have multiple integrated Ethernet connections with at least one Web server for diagnostic purposes, and one service port.
- The range must offer separate Ethernet module that extends Ethernet connections with at least one Web server for diagnostic purposes or advanced web server services to control application, local configuration or complete system. System must accept a maximum of 4 of these Ethernet modules.
- The Ethernet connection must support SNMP agent functions for the standard MIB II base (RFC 1213).

- The PLC must be accessible via Ethernet (from a remote site) using a standard Internet browser (Microsoft Internet Explorer type), or any other platform (android, iOS). A Web server must be installed in the PLC. It must provide functions for Ethernet communication diagnostics. These functions must not require any prior configuration or special software. In addition, the use of these functions must have no effect on the PLC scan time.
- The offer must have a solution to enable remote I/O exchanges on Ethernet TCP/IP or EtherNet / IP without any programming in the application. A device must be reconfigured automatically after replacement
- There must be a mechanism for checking the bandwidth in order to simulate the load on the connection when it is configured.

Serial links communications

- The PLC must have serial links which support various types of communication: Modbus or open protocols. The protocol is chosen by the configuration software.
- System must support serial communication from local and remote drops.

AS-i communications

- In rack AS-i field bus master should support in its master connection with 62 devices.
- Embedded field bus master must support AS-Interface V3 standard.
- System must support AS-i communication from local and remote drops.

Standards and certifications

- The PLC must conform to the main national and international standards covering electronic equipment for industrial control systems:
 - CE marking according EN 61131-2
 - CSA 22-2 N° 142 (Canadian Standards Association)
 - UL 508 (Underwriters Laboratories)
 - C-Tick ACA (Australian Communication Authority/Australia)
 - CSA 22-2 N° 213 Hazardous Location (CSA)
 - FCC Part 15 – Class A
 - GOST CEI

High Availability

- The range must at least include a processor designed to be part of a redundant architecture, obeying a principle of redundant controllers which guarantees a switchover without loss of control of the process on occurrence of a failure.
- In case of a redundant processor configuration, the system is designed to have a bump less transition (no unattended spike on the IO during switchover)

- The processors shall have to be dedicated to the services of the redundancy, and won't have to be associated with any specific coupler, configuration, nor specific programs. The implementation of the redundant solution shall be "plug & play" by design.
- The data exchanges between the two redundant processors (Primary and Standby), are using a very high speed link of 1 Gbps.
- The user is able to select which variables are redundant in the application
- The two processors can be distant up to 10 km. The dedicated redundant connection between the 2 processors can either be using fiber optic.
- The application logic program can be modified while the system is running, and without compromising the redundancy function
- The redundant controllers have their own IP addresses that never swap, in order to connect the engineering tool continuously
- The system components internal firmware can be updated while the system is running without losing the redundancy function
- The redundant power supplies used must provide a transparent status of their redundancy without extra hardware or wiring
- The redundant power supplies must provide natively information about their ageing, to be able to be replaced before failure (preventive maintenance)
- The redundant power supplies must use a true redundant technology (one active at a time, the other ready to take full load if needed), not using load sharing technology

Cyber Security

- The system must be compliant with IEC – 62443 standard
- The system MUST be Achilles level 2 certified
- The system must have passed successfully the CSPN test
- The system must be able to secure communication between PLC and engineering workstation as well as SCADA providing authentication and integrity of data
- The system must be able to log any PAC security events into any SYSLOG database
- The internal firmware of the CPU must be digitally signed and encrypted
- The integrity of the firmware must be checked before any application download and at startup of the system and at the same time the integrity of the engineering software must be checked on demand
- The user must be able to disable the following Ethernet services : Any modification of the operating mode of the system (Run / Stop / Program modifications) must be authenticated

10.15. AMR Water meter

- The AMR domestic water meters, inferential type, multi jet, magnetically coupled, having dry dial, Class 'B' conforming to IS-779: 1994 with up to date amendments or ISO 4064:1993 standard with ISI/EEC/OIML certification mark on each meter and shall be with protection class of IP-68 (Copper/Metallic can register)
- The water meters of domestic sizes shall be equipped with RF based AMR technology, wireless direct fitted on the water meter, multi-jet, inferential type, dry dial, EEC/MID approved water meters.
- Water meters of each size should have been duly tested and passed as per the relevant standards and specifications from Fluid Control Research Institute (FCRI) Kerala for performance test supported with test certificate.
- The meters shall be supplied complete with G I fittings, brass nuts and brass nipples. Strainer & sealing shall be provided as per relevant IS provision.

Material of construction:

- The manufacturer shall provide specific details of materials used for various parts of the meter which must meet the specifications for the material of construction of the individual parts of the meters as per IS 779:1994 (latest amendments) or ISO 4064: 1993.
- The body of the meter shall be of either Brass or Bronze. The firm shall specifically mention in the offer, the metal used in manufacturing. Material that come in contact with the water supply shall withstand 2 ppm (parts per million) of chlorine residual in the water supply and shall be resistant to corrosion.
- The water meter and accessories shall be manufactured from materials of adequate strength and durability. The materials, which come in contact with the potable water, shall not create a toxic hazard, shall not support microbial growth, and shall not give rise to unpleasant taste or discoloration in the water supply.
- The spindle and bearings inside the hydraulic chamber shall be made of polished stainless steel with hard metal tip/ sapphire.
- The internal pressure cup shall be made of low-ferrous brass not exceeding 0.02% Fe contents / Engineering plastic. Furthermore the internal pressure cup should overlap the meter body.
- The lower case of the meter shall be painted with thermal painting externally. The painting materials should be safe for human uses and not affect human health (Health certificates should be included in the bidding documents). The painting colour shall be decided in consultation with the department after order of award.
- Variation in weight of the meter will be permissible to $\pm 5\%$ of the weight indicated by the bidder in his technical bid.
- Each meter should be supplied in separate individual box with its accessories and test certificates and guarantee card for free repair/ replacement for duration of 3 years.
- The no. of individual boxes of meters shall not exceed 30 nos in each cartoon.
- Supply shall be made strictly as per the sample meters including the weight as approved by the Board after testing at Fluid Control Research Institute, Kerala.

Markings on the body of the Meter:

- Marking on dial/ cap.
 - Class "B"
 - Multijet/ Model
 - Magnetic Type
 - As per IS: 779-1994 OR ISO: 4064-1993.
 - ISI OR EEC or OIML Code No.
 - Make/Brand
 - Sl.No. / Year of Manufacture.
 - Customer Name
- Embossing/ engraved on meter body.
 - DN Size
 - Direction of flow of water on both sides of the body of meter.

The Totalizer and Totalizer Shield:-

The totalizer shall be designed in such a way that if the totalizer protective glass is broken for a reason or another the totalizer cannot be removed from its place. The totalizer protective cover shall be made of sturdy glass and shall have a thickness of not less than 5mm and shall pass specified tests. Sturdy glass is defined as the ability of the counter protection glass to withstand, without damage, a free fall of a metal ball weighing 27.2 grams from a vertical distance of not less than 70 cm or sturdy Engineering plastic window subject to clear visibility till end of contract period guaranteed by bidder may be allowed.

Totalizer:-

- It shall be of straight reading type
- The totalizer shall register in cubic meter units
- The initial totalizer reading should be less than 1KL
- The totalizer shall consist of a row of minimum four on-line consecutive black digits to read at least 9,999 m³ and at least 2 red digits to read at submultiples of m³.
- The least count/ resolution of Water meter should be at least 0.02L.
- The totalizer should be of closed type.
- The totalizer must be suitable for test on an electronic test bench.
- Totalizer shall be made of Copper Can having 5mm thickness mineral glass (required to maintain IP 68 protection class.)
- Meter will be provided with monolithic seal with copper wire.
- The water meters shall have the anti – magnetic properties / immunity, as specified in ISO: 4064 – 2005, when tested with 400 gauss magnet is mandatory. For AMR system resistivity against application of magnet is not required.
- The remote reading of AMR water meter needs two way communications without affecting battery life and reading perforations throughout O&M period.
- The remote readings of AMR water meter, should be obtainable by either ‘Walk by’ or ‘Drive by’ methods.
- The AMR trans-receivers shall be wireless and have IP 68 protection class i.e. no ingress of water after submerging AMR water meter for 48 hours under 3 meters of water column.
- The AMR trans-receivers shall be used (RF End units/ Wireless RF transmitter/Receiver) for communication and remote reading. If the water meter & AMR trans-receivers are independent units then they must be from the same manufacturer only.
- AMR shall be obtainable even under submerged conditions.

- Remote readings of different water meters shall be obtained with single command. The remote readings shall have instant reading facility. The remote readings and dial readings of water meters shall match at all the times.
- All A. M. R. readings shall show the date and time of the reading recorded.
- The AMR system shall have facility to detect the reverse flow in water meters readings on the Hand Held Device (HHU) i.e. AMR reading device and on computer screen.
- The AMR system shall have the facility to record the abnormalities like application of very high consumptions, water leakages etc. along with necessary alarms in HHU and in software
- The battery life of AMR water meter shall not be less than 7 (seven) years from successful installation of said AMR water meter along with its AMR system, the battery life shall be calculated by considering the monthly remote reading. During remote reading the battery life of AMR water meter shall be displayed / indicated on HHU.
- If the AMR communication frequency is using / operating on paid frequency band, then the AMR water meter manufacturer has to produce the valid copy of license issued by Govt. of India / Deptt. Of Telecom (DOT), for using the said operating frequency band. The cost of the same will be presumed as included in the quoted rates.
- The AMR water meter shall not get affected for its AMR functioning due to High Tension or High Voltage line concentration.
- All the time electronic index of the water meter shall match with mechanical index.
- All water meter shall be fitted with RF based wireless remote trans receivers for AMR reading. It shall be either inbuilt or directly fitted on the water meter without wires.
- The water meters fitted with A.M.R. shall have the facility to transmit reading in maximum submerged condition (as specified for IP-68 compliance) & the remote readings should be obtained outside the meter chamber, with water meter in submerged condition & lid of the chamber closed.
- The manufacturer shall specify the frequency of the AMR operating system & shall possess the necessary license of said operating frequency, as per norms of Department of telecommunication, Govt. Of India issued by Government of India (GOI) / Department of Telecom (DOT). In case, if he claims frequency of the operation in the free band, necessary documents / clearance from GOI / DOT shall be submitted, along with the offer. However, the UUSDIP reserves the right for acceptance of offered frequency & Power subjected to the guidelines issued by DOT / WPC.
- AMR system should be compatible for up gradation to fixed network if required in future.

10.16. Hand Held Unit (HHU)/ AMR Meter Reading Device

- The hand held device or reading device shall have the sufficient memory for storage of maximum data / reading along with sufficient power back up.
- The HHU or reading device shall have the onsite search facility, to locate the exact physical location of water meter in particular area and to obtain the corresponding details of it.
- The HHU or reading device should be adjustable back light, sun light readable, colour display and touch screen.
- The HHU or reading device shall have minimum 64 MB flash memory and 128 MB RAM.
- The battery of HHU or reading device shall give power back up for at least 5 hours continuously.
- The HHU or reading device must be ergonomically designed to be comfortable for handheld meter reading.
- The handheld must come with an integrated intelligent fast charge capability that allows full charge within 5 hours.

- The hand-held must have a 3G/GPRS connectivity for real-time data communication with central server and integrated Global Positioning System (GPS) for route monitoring and configuration.
- HHU software should have at least three different level of security.
- Remote reading of individual water meter, maximum distance of 200 meters with clear line of sight under submergence condition with lid of chamber enclose position, with walk by during field demo as well as after installation main work.
- There shall have the onsite search facility in HHU to identify the meter position in particular area and to obtain the corresponding detail of it. The PC shall be connected Via USB to Hand Held device.

10.17. Software

- The software shall give output, at least in XML format and the data should be in standard format compatible to the PHE's Billing system.
- The Route Management software must be capable of running on a standard PC compatible with minimum Pentium processor; in addition the software must run under Windows95, Windows XP Professional, Windows Vista, Windows 7, windows 8 and / or latest version of windows operating system.
- The software shall allow the PC operator to review and edit any account in Route Manager database. Also, the PC operator shall be able to generate route and activity reports. The 90 days historical data should be available in the route as well as the data along with historical data in the output in the XML/CSV/XLS format compatible to PHE Billing system without affecting the system performance throughout project period.
- The software shall alert the meter reader for unread accounts in that route.
- The software shall enable the user to specify the data to be exported from the database for transferring to billing system.
- The software shall take routes from an existing database for loading into a reading device.
- The software shall select the routes to be read, and assignment of routes to a reading device and dynamic updating of routes and sub-routes to be enabled.
- The software shall upload routes from the reading device.
- The software shall post the reading from the reading device onto appropriate accounts within the database.
- Software shall be able to set meter status such as, meter not okay, reading not reliable, meter maintenance required etc
- The GPS coordinates shall be visualized in the PC software itself.
- The software shall have web portal access, so that user can view customer data (address, meter details, meter reading) through web browser. Also it should have analysis facility of meter data.
- Addition to above specification, software should have facility for individual customer's to view their meter consumption data through web portal.
- Development of software shall be done in coordination with PHE and software shall be property of PHE.
- Reading and billing shall be done with coordination with PHE and as per their project requirement.
- Data should be available in hand Held Unit and Base Computer Software both.
- 90 Days Historical data to be retrieved in normal reading process. However performance of the system is to be maintained throughout filed demonstration as well as O & M Period without a effecting battery life and reading performance.
- There shall be two way communication without affecting battery life and reading performance throughout O & M period.

- Different type of indications such as read meter/unread meter, meter to be read, meter read with observation, meter with alarm, unreadable meter, meter not okay, reading not reliable, meter maintenance required should appear on HHU.
- Since HHU Integration with GPS for route monitoring and configuration is required, Bidder should adopted off field method. However field experience should also be utilized to Optimized the group. HHU should also have the facility to create route, modify route on site and to arrange in desired sequence as per site conditions.
- Preventive maintenance such as cleaning, dusting etc. of the installed meter is to carried out once in two year as per required, whichever is earlier.
- HHU shall have at least 3 different level of security or as directed by NRDA.
- In AMR reading, if reading is not captured due to some reason, HHU should have capability to record data manually along with route data to be downloaded with notification of cause of manual reading. The issue should be resolved within 15 days and no manual reading will be allowed. Next billing cycle meter will be treated as unread and will be attracted action under relevant clause for that particular meter.

10.18. LOCAL HMI for PLC/ RTU

The purpose of Local HMI is to indicate current status of the level, pressure, flow, energy data and water quality etc.at the field stations.

The HMI shall also act as an aid to facilitate Pop up alarms, enter time delays, and operate the necessary equipment. The HMI shall have 1 printer port and 1 USB port as a minimum. The HMI shall be Touch screen with minimum diagonal screen size of 10”

10.19. Speed Violation Detection and Enforcement

General Requirements

- The system should be designed to detect both reflective and non-reflective types of license plates.
- The system should provide a disaster recovering mechanism including automatic restart function after system failure.
- The System should support speed measurement unit - Km/Hr.
- All cameras captured images and other data should be digitally watermarked & encrypted to avoid tampering

#	Parameter	Minimum Specifications or better
Speed Camera		
1.	Sensor	1/3” CMOS/CCD Day/Night Camera
2.	Lens:	Varifocal
3.	Day and Night:	Automatically removable infrared-cut filter
4.	Shutter Time:	Electronic, 1/50 to1 /10000 sec or better
5.	Video Compression:	Motion JPEG, H.264
6.	Video Multicast Streams	Both streams should be configurable to Unicast and Multicast for surveillance

7.	Resolutions:	Minimum 1 MP for Lane cameras
8.	Field of view for License Plate recognition	As per site requirement (installing external IR in front of camera)
9.	Cameras Certification	UL/EN and CE, FCC
Onsite processor		
10.	Construction	Enclosure with fan less design
11.	IP Rating:	IP66 compliant
12.	LAN port	3 x 10/100 Ethernet or more
13.	Internal Storage	The system should have capacity to locally store min than 500,000 vehicle number plate data
14.	Operating System	Linux /Windows
15.	Certifications	The System should be certified by some government body (from country of origin/ministry off traffic) and authenticated by Indian consulate in that country.
16.	Speed measurement Accuracy for Spot and Average speed measurement	Upto100 km/hr (3 % variation) and100 to180 km/hr (3% variation only).

10.20. Multi-Function Laser Printer

#	Parameter	Minimum Specifications
1.	Technology	Laser
2.	Monthly duty cycle/RMPV (pages)	200,000/5K-20K
3.	Print speed – simplex (A4)	Up to 41 ppm
4.	Scan speed – Black/Color simplex	Up to 50/30 ipm
5.	Scan speed – Black/Color duplex	Up to 19/14 ipm
6.	Scan-to destinations	Email, Network folder, USB
7.	Processor (MHz)	600
8.	Memory (MB)	1,024
9.	Hard disk drive (HDD)/Capacity (GB)	Yes/240
10.	Connectivity	2 Hi-Speed USB 2.0; 1 Gigabit Ethernet 10/100/1000T network
11.	Print resolution – Max/Best print quality (dpi)	Up to 1200x1200
12.	Input capacity – Std/Max (sheets)	600/4,600
13.	Output size – Min/ Max (mm)	76.2 x127/312x469.9
14.	Automatic duplex	Yes
15.	Energy Efficiency	BEE or Energy Star certified
16.	Control panel display	20 cm touchscreen

10.21. Laser Printer

#	Parameter	Minimum Specifications
1.	Print speed black (normal, A4)	Up to 25 ppm
2.	Print quality black (best):	Up to 1200 x 1200 dpi
3.	Print technology :	Monochrome Laser
4.	Duty cycle (monthly, A4)	Up to 15,000 pages
5.	Recommended monthly page volume	250 to 2000
6.	Standard memory:	Minimum 128 MB
7.	Processor speed:	Minimum 700 MHz
8.	Paper handling standard/input	Up to 250-sheet input tray
9.	Paper handling standard/output	Up to 150-sheet output bin
10.	Media sizes supported	A4, A5, A6, B5, postcard
11.	Media types supported	Paper, transparencies, postcards, envelopes, labels
12.	Standard connectivity	Hi-Speed USB 2.0 port with USB data cable, Ethernet with RJ45 connectivity
13.	Duplex printing	Automatic (standard)
14.	Compatible operating systems	Microsoft Windows 7 Professional(64bit), Windows 8 Pro(64 bit), Windows 8.1, Windows 10, Server 2008 R2, Server 2012 R2, MAC OS 9.0, MAC OS X, Linux

#	Parameter	Minimum Specifications
15.	Power requirements:	Input voltage 220 to 240 VAC (+/- 10%), 50 Hz (+/- 2 Hz);
16.	Power consumption during printing	Less than 500W
17.	Energy Efficiency	BEE or Energy Star certified
18.	Front operating Panel	Graphical LCD display

10.22. Video Wall

The minimal specifications of video wall cubes are as below -

- 70 Inch display
- The native resolution of each Visual Display Unit / Rear Projection Module should be 1920 X 1080 pixels (Full HD) and should offer min 16.7 million colors.
- The Light source lifetime of LED should be 80,000 hrs.(Eco)
- The brightness uniformity should be > 90%.
- The contrast shall be 1500:1 or higher.
- The Aspect Ratio of each of projection module should be 16:9.
- The screen should have adjustable low inter screen gap 0.2 mm to give seamless viewing experience.

10.23. Workstations (Desktop Computer)

#	Parameter	Minimum Specifications
1.	Processor	Latest generation 64bit X86 Quad core processor(3Ghz) or better
2.	Chipset	Latest series 64bit Chipset
3.	Motherboard	OEM Motherboard
4.	RAM	Minimum 8 GB DDR3 Memory @ 1600 Mhz. Slots should be free for future upgrade
5.	Graphics card	Minimum Graphics card with 2 GB video memory (non shared)
6.	HDD	2 TB SATA-3 Hard drive @7200 rpm
7.	Media Drive	NO CD / DVD Drive
8.	Network interface	10/100/1000 Mbps autosensing on board integrated RJ-45 Ethernet port.
9.	Audio	Line/Mic IN, Line-out/Spr Out (3.5 mm)
10.	Ports	Minimum 6 USB ports (out of that 2 in front)
11.	Keyboard	104 keys minimum OEM keyboard
12.	Mouse	2 button optical scroll mouse (USB)

#	Parameter	Minimum Specifications
13.	Monitor	Min. 22" (<i>or 21.5"</i>) TFT LED monitor, Minimum 1920 x1080 resolution, 5 ms or better response time, TCO 05 (or higher) certified For Command Control Centers : 2 LED Monitors <i>attached to the same workstation (multi monitor)</i>
14.	Certification	Energy star 5.0/BEE star certified
15.	Operating System	64 bit pre-loaded OS with recovery disc
16.	Security	BIOS controlled electro-mechanical internal chassis lock for the system.
17.	Antivirus feature	Advanced antivirus, antispymware, desktop firewall, intrusion prevention (comprising of a single, deployable agent) which can be managed by a central server. (Support, updates, patches and errata for the entire contract/ project period)
18.	Power supply	SMPS; Power supply should be 90% efficient with EPEAT Gold certification for the system.

10.24. Television Set (Meeting room)

46 Inch Full HD LED

10.25. Projector

#	Item	Minimum Specifications
1.	Display Technology	Poly-silicon TFT LCD
2.	Resolution	HD 1080p
3.	Colours	16.7 million Colours
4.	Brightness	2500 or more ANSI lumens (in Normal Mode)
5.	Contrast Ratio	2000:1 or more
6.	Video Input	One computer (D-Sub, Standard 15 pin VGA connector) One S-Video One HDMI
7.	Audio	Internal speaker
8.	Output ports	External Computer Monitor port, audio ports
9.	Remote Operations	Full function Infrared Remote Control
10.	Other features	Auto source detect, Auto-synchronisation, Keystone Correction

10.26. IP PABX System

#	Description	Parameter
1.	Technology	PCM-TDM , IP, Non-blocking
2.	Interface	Should support all telecom interfaces in Indian Telecom Service provider offerings
3.	Type of Interface	ISDN interface for digital, basic interface for Analog lines
4.	No. of lines - ,ISDN PRI lines & Analog / Digital Extensions	1 PRI from BSNL, 32 Extensions (IP / Analog / Digital)
5.	Type of Extension Support	Analog , Digital and IP
6.	Expansion of Extensions	Multiples of 8 / 16
7.	Run Distance	Not less than 800 mtrs. on 0.5mm dia. Cable
8.	Max. Loop resistance for analog trunk lines Extensions	2500 ohms including telephone
9.	Requirement at the time of supply	01 ISDN PRI, 24 Analog Ports & 8 Digital extension ports.. Expected to handle at least 30 external lines.
10.	Contact center Expansion available (Max. capacity)	It must support at least 16 Call center Agents
11.	Max. loop resistance for analog trunk lines	1200 ohms at -48 Volts DC
12.	Other	<ul style="list-style-type: none"> • ISDN supplementary services for Digital phone • Support for digital trunk lines • Working on 230v AC mains and DC voltage • Support for ACD call center with CTI and advanced call routing
13.	Design of EPABX System	Modular with universal slots, wall mountable
14.	Conferencing	5 party conferencing to be provided (to be configurable dynamically)

10.27. Civil Work, Safety Instrumentation and Furniture (at command centre

a. Furniture and Fixture

- Workstation size of min. 18" depth made with 1.5mm thick laminate of standard make over 18mm thick commercial board complete with wooden beading including cutting holes & fixing of cable manager etc. complete with French polish. Edges shall be factory post-formed. The desk shall have the necessary drawers, keyboard trays, cabinets etc. along with sliding / opening as per approved design with quality drawer slides, hinges, locks etc.
- Providing & making of storage unit with 18 mm thick MDF board along with 1.5 mm approved laminate colour outside and 2 coat of enamel paint inside the storage of size 1'6"x1'6"x2'4". The same should be provided with all the required accessories including the handle, lock, sliding channel and necessary hardware, etc. complete with French polish
- Cabin table of min. depth 2' made with 1.5mm thick laminate of standard make over 19mm thick commercial board complete with wooden beading including cutting holes & fixing of cable manager etc. complete with French polish.
- Providing, making & fixing 6" high laminated strip using 1.5mm thick laminate over 10mm thick commercial board on all vertical surface in the entire server & ancillary areas including low height partition, brick wall, partition wall, cladding etc. complete with French polish in all respect.
- Providing, making & fixing an enclosure for gas cylinder of Shutters and Partitions along with wooden support and 18 mm thick MDF board along with 1.5 mm approved laminate colour outside and 2 coat of enamel paint inside the shutter. The same should be provided with all the required accessories including the handle, lock, loaded hinges, tower bolt and necessary hardware etc. complete with French polish.

b. Partitions (wherever required as per approved drawing)

- Providing and fixing in position full height partition wall of 125 mm thick fire line gyp-board partition using 12.5 mm thick double fire line gyp-board on both sides with GI steel metal vertical stud frame of size 75 mm fixed in the floor and ceiling channels of 75 mm wide to provide a strong partition. Glass wool insulation inside shall be provided as required. Fixing is by self-tapping screw with vertical studs being at 610 mm intervals. The same should be inclusive of making cut-outs for switch board, sockets, grill etc. It shall also include preparing the surface smoothly and all as per manufacture's specification etc. finally finishing with one coat of approved brand of fire resistant coating.
- With glazing including the framework of 4" x 2" powder coated aluminium section complete (in areas like partition between server room & other auxiliary areas).
- Providing & fixing Fire Rated Wire Glass minimum 6 mm thick for all glazing in the partition wall complete. (External windows not included in this).
- All doors should be minimum 1200 mm (4 ft.) wide.

c. Fire Detection and alarm System

- Fire can have disastrous consequences and affect operations of a Control Room. It is required that there is early-detection of fire for effective functioning of the Control Room.

i. System Description

- The Fire alarm system shall be an automatic 1 ton (e.g. 8) zone single loop addressable fire detection and alarm system, utilizing conventional detection and alarm sounders.
- Detection shall be by means of automatic heat and smoke detectors located throughout the Control Room (ceiling, false floor and other appropriate areas where fire can take place) with break glass units on escape routes and exits.

ii. Control and Indicating Component

- The control panel shall be a microprocessor based single loop addressable unit, designed and manufactured to the requirements of EN54 Part 2 for the control and indicating component and EN54 Part 4 for the internal power supply.
- All controls of the system shall be via the control panel only.
- The system status shall be made available via panel mounted LEDs and a backlit 8 line x 40-character alphanumeric liquid crystal display.
- All system controls and programming will be accessed via an alphanumeric keypad. The control panel will incorporate form fill menu driven fields for data entry and retrieval.
- The system will include a detection verification feature. The user shall have the option to action a time response to a fire condition. This time shall be programmable up to 10 minutes to allow for investigation of the fire condition before activating alarm outputs. The operation of a manual call point shall override any verify command.

iii. Manual Controls

- Start sounders
- Silence sounders
- Reset system
- Cancel fault buzzer
- Display test
- Delay sounder operation
- Verify fire condition
- Disable loop

iv. Smoke detectors:

Smoke detectors shall be of the optical or ionisation type. Devices shall be compatible with the CIE conforming to the requirements of EN54 Part 7 and be LPCB approved. The detectors shall have twin LEDs to indicate the device has operated and shall fit a common addressable base.

v. Heat detectors

- Heat detectors shall be of the fixed temperature (58° C) or rate of temperature rise type with a fixed temperature operating point.
- Devices shall be compatible with the CIE conforming to the requirements of EN54 Part 5 and be LPCB approved.
- The detectors shall have a single LED to indicate the device has operated and shall fit a common addressable base.

vi. Addressable detector bases

- All bases shall be compatible with the type of detector heads fitted and the control system component used. Each base shall comprise all necessary electronics including a short circuit isolator.
- The device shall be automatically addressed by the CIE on power up of the loop without the need of the insertion of a pre-programmed EPROM or setting of DIL switches.
- Detector bases shall fit onto an industry standard conduit box.

vii. Audible Alarms

- Electronic sounders shall be coloured red with adjustable sound outputs and at least 3 sound signals. The sounders should be suitable for operation with a 24V DC supply providing a sound output of at least 100dBA at 1 meter and 75 dBA min, for a bed head or sounder base type device. The sounder frequency shall be in the range of 500Hz to 1000Hz.

viii. Commissioning

- The fire detection and alarm system will be programmable and configurable via an alpha numeric keypad on the control panel.

ix. High Sensitivity Smoke Detection System

- General – The HSSD system shall provide an early warning of fire in its incipient stage, analyse the risk and provide alarm and actions appropriate to the risk. The system shall include, but not be limited to, a Display Control Panel, Detector Assembly and the properly designed sampling pipe network. The system component shall be supplied by the manufacturer or by its authorized distributor.

x. Regulatory Requirements

- National Electrical Code (NEC)
- Factory Mutual
- Local Authority having Jurisdiction

d. Water leak detection System

- Water leak detection System should be designed to protect the Air-conditioned premises and to alert the personnel about the leak in the AC systems. The system should be capable of interfacing to Water leak detection sensors, condensation sensors & I/O modules.
- Events should be clearly reported on LCD/LED display with full English language description of the nature of the fault in the panel. The successful bidder should make detailed working drawings and coordinate them with other agencies at site. Water Leak Detection systems should be integrated with BAS.

i. EQUIPMENT

The Water leak detection system should comprise of Tape Sensors, Water Leak detection modules, Condensation detectors, I/O modules and sounders all connected to a Control Panel.

ii. CONTROL PANEL

- The control panel should be computerized 4/8/12 zone multiplex controller with a facility to add on dialer and speech processor. The system should be programmed, armed or disarmed through a control key pad. The control key pad should have a 16 character LCD display for viewing various events. The code to arm or disarm the system should be changed only by entering a master code.
- The system should have 4/8/12 zones and all the detectors should be connected through a 2 core cable. Each area of the premises should be divided into specific zones such that any zone should be isolated by the user if required.
- The entire system should be backed up by a maintenance free rechargeable battery to take care of system's power requirements whenever power fails.
- The system should be totally tamper proof and should activate an alarm if the control panel is opened, the sensors tampered with or if the system cables are cut even in the disarmed state.
- The system should log 500 events and optionally printer should be connected for generating reports.
- The Detectors, I/O Modules, Remote Keypads and other Devices should be connected to a system on a single 2/4/6 Core Cable Bus to avoid individual cabling of zones.
- The system should have a Buffer memory of minimum 250 events and log each event with exact date and time.
- The controller should have a Serial Port for connecting to a computer.
- The controller should work on 220/240V AC power supply and it should also have a built in battery backup.
- The memory inside the controller should be backed up by a lithium battery. The controller should work effectively over a temperature range of -10 Deg. C to + 55 Deg. C. and 0 to 90% of Humidity.

iii. WATER LEAK DETECTION SENSOR

Water Leak Detection sensors should be able to mount in DIN rails, inside AHU's, power distribution units or other equipment where localized leak detection is required. The detectors should be resistant to oxidation and erosion. The detector should have relay output for

connection to the controller. LED alarm indication should also be provided. The detectors should operate in AC or DC supply.

iv. TAPE SENSORS

Tape sensors are used to detect water leaks usually under floors. Tape sensors for use with water leak detectors should be covered with plastic netting to prevent short circuits when used in metal trays or conduits, and enables the tape to be folded at right angles to allow easy routing.

v. HOOTER / SOUNDER

The hooter / sounder should give audible alarm when any sensor operates. It should be complete with electronic oscillations, magnetic coil (sound coil) and accessories ready for mounting (fixing). The sound output from the Hooter should not be less than 85 decibels at the source point.

e. Access Control System

The Access Control System shall be deployed with the objective of allowing entry and exit to and from the premises to authorized personnel only. The system deployed shall be based on Biometric Technology. An access control system consisting of a central PC, intelligent controllers, power supplies and all associated accessories is required to make a fully operational on line access control system. Access control shall be provided for doors. These doors shall be provided with electric locks, and shall operate on fail-safe principle. The lock shall remain unlocked in the event of a fire alarm or in the event of a power failure. The fire alarm supplier shall make potential free contacts available for releasing the locks in a fire condition especially for staircase and main doors. Entry to the restricted area shall be by showing a proximity card near the reader and exit shall be using a push button installed in the secure area. The system shall monitor the status of the doors through magnetic reed contacts. The system should be designed and implemented to provide following functionality:

- Controlled Entries to defined access points
- Controlled exits from defined access points
- Controlled entries and exits for visitors
- Configurable system for user defined access policy for each access point
- Record, report and archive each and every activity (permission granted and / or rejected) for each access point.
- User defined reporting and log formats
- Fail safe operation in case of no-power condition and abnormal condition such as fire, theft, intrusion, loss of access control, etc.
- Day, Date, Time and duration based access rights should be user configurable for each access point and for each user.
- One user can have different policy / access rights for different access points.

f. Rodent Repellent system:

The entry of Rodents and other unwanted pests shall be controlled using non-chemical, non-toxic devices. Ultrasonic pest repellents shall be provided in the false flooring and ceiling to

repel the pests without killing them. However periodic pest control using Chemical spray can be done once in 3 months as a contingency measure to effectively fight the pest menace.

- Configuration : Master console with necessary transducer
- Operating Frequency : Above 20 KHz (Variable)
- Sound Output : 50 dB to 110 dB (at 1 meter)
- Power output : 800 mW per transducer
- Power consumption : 15 W approximately
- Power Supply : 230 V AC 50 Hz
- Mounting : Wall / Table Mounting

10.28. Public Address System

#	Parameter	Minimum Specifications or better
1	PAS system	Should have the capability to control individual PAS i.e. to make an announcement at select location (1:1) and all locations (1: many) simultaneously. The PAS should also support both, Live and Recorded inputs
2	Speaker	Minimum 2 speakers, To be used for Public Address System
3	Connectivity	IP Based
4	Access Control	Access control mechanism would be also required to establish so that the usage is regulated.
5	Integration	With VMS and Command and Control Center
6	Construction	Cast Iron Foundation and M.S. Pole, Sturdy Body for equipment
7	Battery	Internal Battery with different charging options (Solar/Mains)
8	Power	Automatic on/off operation
9	Casing	IP-55 rated for housing
10	Operating conditions	0° to 50°C

10.29. Digital Phone, Headphone Specifications

#	Parameter	Minimum Specifications
1.	Display	2 line or more, Monochrome display for viewing features like messages, directory etc.
2.	Integral switch	10/100 mbps for a direct connection to a 10/100BASE-T Ethernet network through an RJ-45 interface
3.	Speaker Phone	Yes
4.	Head set	Port for Head set (Headset also to be provided)
5.	VoIP Protocol	SIP V2
6.	PoE	IEEE 802.3af or better
7.	Supported Protocols	SNMP, DHCP, DNS
8.	Codecs	G.711, G.722 including handset and speakerphone
9.	Speaker Phone	Full duplex speaker phone with echo cancellation Speaker on/ off button, microphone mute
10.	Volume control	Easy decibel level adjustment for speaker phone, handset and ringer
11.	Phonebook/Address book	Minimum 100 contacts
12.	Call Logs	Access to missed, received, and placed calls. (Minimum 20 overall)
13.	Clock	Time and Date on display
14.	Ringer	Selectable Ringer tone
15.	Directory Access	LDAP standard directory

10.30. Server (Application / Database/ Recording or Other)

#	Parameter	Minimum Specifications
1.	Make And Model	To be specified by the bidder
2.	Processor	Latest generation x86 processor with highest cache and highest frequency (on processor with highest cache), within the selected category of cores, should be provided, e.g. while selecting 8 core processor, bidder needs to select the processor in 8 core category with highest frequency in the highest cache
3.		Min. 2 Physical sockets or higher

#	Parameter	Minimum Specifications
4.	Main Memory	Min. 8GB per core expandable to 16 GB
5.	RAS Features	Hot Pluggable Disk Drives
6.		Redundant Power Supply at server / chassis level
7.		Redundant hot swappable fans at server / chassis level
8.	Hard Disks	2 Nos. Hot-swap 600 GB or higher SAS/SCSI Disk Drives'..
9.	RAID	Integrated RAID offering Striping, Mirroring (RAID 0, 1)
10.	Network Interface	Minimum 2Nos. 10/100/1000 Mbps Ethernet ports
11.		Minimum 2Nos. 8Gbps FC HBA ports or FCOE ports (wherever connectivity to Storage)
12.		Both Ethernet / FC ports should be in redundant mode
13.	USB	Minimum 1 USB 2.0 ports or an option for connecting USB devices
14.	Virtualization	The server should support virtualization technology and a software defined datacenter network infrastructure

10.31. Blade Chassis

#	Item	Minimum Requirement Description
1.	Blade Chassis	Blade chassis shall be 19" standard Width rack mountable and provide appropriate rack mount kit.
2.	Blade Chassis	The power supply modules should be hot pluggable
3.	Blade Chassis (Redundancy)	The power subsystem should support all of the following modes of power redundancy (No redundancy, N+1 , N+N or grid)
4.	Blade Chassis (Redundancy)	The power subsystem should be support N + N power redundancy for a fully populated chassis with the 2 socket (CPU) servers
5.	Blade Chassis (Redundancy)	Should be configured to provide full redundant cooling to all blade slots
6.	Fibre Channel Interconnects	Shall support fiber interconnects
7.	Management	It should support remote KVM / virtual KVM capability for management and administration.

#	Item	Minimum Requirement Description
8.	Blade Chassis (DVD)	Should support virtual DVD internally / externally'
9.	Interface	The Fabric switches should support the direct connection to FCoE enabled storage arrays
10.	Management	Support a stateless environment where server identity is created by the administrator who defines the server
11.	Blade Chassis	Servers can be automatically assigned to the resource pools based on qualification criteria
12.	Management	Must support the ability to rollback firmware from current active versions to the previous version for the Server BIOS, Adapter firmware and bootcode versions , individual server management chips from the same console
13.	Management	Role Based Access Control so that the resources can be managed by respective resource administrator.
14.	Server Management	Movement of server identity from one slot to another in the event of server failure
15.	Power Management	Administrators have the flexibility to define power policies so that the power can be limited to a specific server
16.	Power Management	Administrators should be able to decide the threshold / cap on the maximum power that the chassis can draw .
19.	Support	The system should not be an end of life / end of service product.

10.32. Storage Specification

#	Parameter	Minimum Specifications
1.	Solution/Type	<ul style="list-style-type: none"> Bidder is expected to provide Unified storage solution (or a Combination of NAS/Scale-out NAS/SAN) supporting all required protocols (IP Based/iSCSI/FC/NFS/CIFS etc.) for the offered storage solution, meeting benchmark performance parameters specified in SLA Solution proposed should yield low cost per TB, while meeting the performance parameters Licenses for the actual protocols used in the storage solution must be provided from day 1.
2.	Storage	<ul style="list-style-type: none"> Primary Storage to have 100% capacity for all cameras and smart solutions of the project for 7 Days as per recording parameters To store video stream and other data as required, to meet the overall requirement for different type of data/information.The storage design must be based on the expected data volume from the project, including the expansion requirement of 5 years Storage solution should be capable of scaling vertically & horizontally
3.	Hardware	<ul style="list-style-type: none"> Rack mounted form-factor

#	Parameter	Minimum Specifications
	Platform	<ul style="list-style-type: none"> Modular design to support controllers and disk drives expansion
4.	Connectivity	<ul style="list-style-type: none"> The storage system shall be capable of providing host connectivity as per solution offered (Unified/SAN/NAS/Scale out NAS) as to meet operational SLA requirements.
5.	Controllers	<ul style="list-style-type: none"> At least 2 Controllers in active/active mode The controllers / Storage nodes should be upgradable seamlessly, without any disruptions / downtime to production workflow for performance, capacity enhancement and software / firmware upgrades.
6.	RAID support	<ul style="list-style-type: none"> Should support various RAID levels, Minimum RAID5 or equivalent (Minimum RAID 6 for cameras data and RAID 5 for all other Data), Should support resilience against double disk failure too..
7.	Cache	<ul style="list-style-type: none"> Minimum 96 GB of useable cache spread across all controllers of the storage system. If cache is provided in additional hardware for unified storage solution, then cache must be over and above 96 GB.
8.	Redundancy and High Availability	<ul style="list-style-type: none"> The Storage System should be able to protect the data against single point of failure with respect to hard disks, connectivity interfaces, fans and power supplies
9.	Storage Management software	<ul style="list-style-type: none"> All the necessary software (GUI Based) to configure and manage the storage space, RAID configuration, logical drives allocation, snapshots etc. are to be provided for the entire system proposed. Licenses for the storage management software should include disk capacity/count of the complete solution and any additional disks to be plugged-in in the future, up to the max disk capacity of the existing controllers/units. A single command console for entire storage solution. Should also include storage performance monitoring and management software Should provide the functionality of proactive monitoring of Disk drive and Storage system for all possible disk failures Should be able to take "snapshots" (or equivalent feature) of the stored data to another logical drive for backup purposes
10.	Data Protection	The storage array must have complete cache protection mechanism either by de-staging data to disk or providing complete cache data protection with battery backup for up to 4 hours
11.	IOPS	The storage IOPS will be designed in such a way that overall operational SLAs complied and adhered too.
12.	Operating system support	The storage system should support latest versions of operating systems like Linux, RHEL, SUSE, Windows, Apple, etc.
13.	Firmware	The storage system should support non-disruptive updation/upgrade of firmware for controllers and disks.

#	Parameter	Minimum Specifications
14.	Diagnostic	The storage system should have facility to report any failures & errors through Intranet for diagnosis and quick resolution of problems.
15.	Interface	The storage management software should come with web-based/CLI interface for configuring the SAN system from anywhere using TCP/IP network.

10.33. SAN Switch

#	Parameter	Minimum Specifications
1.	Power Specification	200-240V, 50-60 Hz
2.	Operating temperature range	0° to 40° C
3.	Operating Relative Humidity range (non-condensing)	10 to 90% relative humidity
4.	Total no. of ports on the proposed switch	24
5.	Throughput of each FC port	8/16Gbps
6.	Support for 4/8/16 Gb/s HBAs	YES
Protocol Supported		
7.	FC	Yes
8.	FCP	Yes
9.	FC-AL	Yes
10.	The overall solution for SAN switch should be designed for high availability with no Single Point of failure	Yes
Power Supply		
11.	Hot Swappable Power supply proposed	Yes
12.	(N+1) redundant power supply proposed	Yes
Cooling Fans		
13.	Hot Swappable Cooling Fans proposed	Yes
14.	(N+1) redundant Cooling Fans proposed	Yes
15.	Capability for streaming the data in multiple paths with Optimization algorithms for streaming data through shortest available path.	Yes
16.	Capabilities for cascading of switches	Yes
17.	Non-disruptive firmware update	Yes
18.	End to end performance monitoring	Yes
19.	Capability to interface with host based adapters (HBA) of multiple OEM, supporting multiple Operating System including but not limited to AIX, HP-UX, Linux, Solaris, Windows, etc.	Yes
Zoning And Security		

#	Parameter	Minimum Specifications
20.	Support for hardware -enforced zoning	Yes
21.	Policy based security and centralised fabric management	Yes
22.	Support for Encrypted password	Yes
23.	Support for PKI Digital certificates	Yes
24.	Support for FCAP authentication	Yes
25.	Support for RADIUS, SSL / HTTPS, SSH, SNMP V3	Yes
26.	Support for LUN masking	Yes
Support For Hardware Based Trunking		
27.	Compatibility with proposed network devices	Yes
28.	Compatibility with proposed servers	Yes
29.	The system should not be an end of life / end of service product.	Yes

10.34. Secondary Storage

#	Parameter	Minimum Specifications
1.	Solution/Type	<ul style="list-style-type: none"> Secondary Storage (Archival/Backup) can be on any media such as Tapes, Disks, Disk systems, etc. or its combination. (so as to arrive at lower cost per TB) May or may not use de-duplication technology Compatible with primary storage Must use latest stable technology platform, with support available for next 7 to 10 years.
2.	Backup Size	To store data as required, to meet the archival requirement for different type of data/information
3.	Hardware Platform	<ul style="list-style-type: none"> Rack mounted, Rack based Expansion shelves
4.	Software Platform	Must include backup/archive application portfolio required
5.	Retrieval time	<ul style="list-style-type: none"> Retrieval time for any data stored on secondary storage should be max. 4 hours for critical data & 8 hours for other data. This would be taken into account for SLA calculation. (Critical data means any data needing urgent attention by the Judicial System or by Police Dept. for investigation / terrorist treat perception).

10.35. Aggregation/ Data center Switches (L3 Manageable)

#	Parameter	Minimum Specifications
1.	Ports	<ul style="list-style-type: none"> 10/100/1000 Base-TX Ethernet ports/FX and extra 2 numbers of Base-SX/LX ports should be one either 24 or 48

		<ul style="list-style-type: none"> FX/TX Splits for a switch as per location requirement <p>All ports can auto-negotiate between 10Mbps/ 100Mbps/ 1000Mbps, half-duplex or full duplex and flow control for half-duplex ports.</p>
2.	Switch type	Layer 3
3.	MAC	Support 8K or 16K MAC address. (as per solution offered)
4.	Forwarding rate	Packet Forwarding Rate should be 70.0 Mbps or better
5.	Port Features	Must support Port Mirroring, Port Trunking and 802.3ad LACP Link Aggregation port trunks
6.	Flow Control	Support IEEE 802.3x flow control for full-duplex mode ports.
7.	Protocols	<ul style="list-style-type: none"> Support 802.1D, 802.1S, 802.1w, Rate limiting Support 802.1X Security standards Support 802.1Q VLAN encapsulation, IGMP v1, v2 and v3 snooping 802.1p Priority Queues, port mirroring, DiffServ Support based on 802.1p priority bits with at least 8 queues DHCP support & DHCP snooping/relay/optional 82/ server support Shaped Round Robin (SRR) or WRR scheduling support. Support for IPV6 ready features with dual stack Support up to 255 VLANs and up to 4K VLAN IDs Support IGMP Snooping, IGMP Querying and Multicasting <p>Should support Loop protection and Loop detection, Should support Ring protection (when used in aggregation location)</p>
8.	Access Control	<ul style="list-style-type: none"> Support port security Support 802.1x (Port based network access control). Support for MAC filtering. <p>Should support TACACS+ and RADIUS authentication</p>
9.	VLAN	<ul style="list-style-type: none"> Support 802.1Q Tagged VLAN and port based VLANs and Private VLAN The switch must support dynamic VLAN Registration or equivalent Dynamic Trunking protocol or equivalent
10.	Protocol and Traffic	<ul style="list-style-type: none"> Network Time Protocol or equivalent Simple Network Time Protocol support Switch should support traffic segmentation <p>Traffic classification should be based on user-definable application types: TOS, DSCP, Port based, TCP/UDP port number</p>
11.	Management	<ul style="list-style-type: none"> Switch needs to have RS-232/USB console port for management via a console terminal/PC Must have support SNMP v1,v2 and v3 Should support 4 groups of RMON

		Should have accessibility using Telnet, SSH, Console access, easier software upgrade through network using TFTP etc. Configuration management through CLI, GUI based software utility and using web interface
12.	Other	<ul style="list-style-type: none"> • Switch should be provided with redundant power supply. • The switch must support policy based routing

10.36. KVM Module

#	Item	Minimum Specifications
1.	KVM Requirement	Keyboard, Video Display Unit and Mouse Unit (KVM) for the IT Infrastructure Management at Data Center
2.	Form Factor	19" rack mountable
3.	Ports	minimum 8 ports
4.	Server Connections	It should support both USB and PS/2 connections.
5.	Auto-Scan	It should be capable to auto scan servers
6.	Rack Access	It should support local user port for rack access
7.	SNMP	The KVM switch should be SNMP enabled. It should be operable from remote locations
8.	OS Support	It should support multiple operating system
9.	Power Supply	It should have dual power with failover and built-in surge protection
10.	Multi-User support	It should support multi-user access and collaboration

10.37. Rack with KVM over IP

#	Parameter	Minimum Specifications
1.	Type	<ul style="list-style-type: none"> • 19" 42U racks mounted on the floor • Floor Standing Server Rack - 42U with Heavy Duty Extruded Aluminium Frame for rigidity. Top cover with FHU provision. Top & Bottom cover with cable entry gland plates. Heavy Duty Top and Bottom frame of MS. Two pairs of 19" mounting angles with 'U' marking. Depth support channels - 3 pairs with an overall weight carrying Capacity of 500Kgs. • All racks should have mounting hardware 2 Packs, Blanking Panel. • Stationery Shelf (2 sets per Rack) • All racks must be lockable on all sides with unique key for each rack

		<ul style="list-style-type: none"> Racks should have Rear Cable Management channels, Roof and base cable access
2.	Wire managers	Two vertical and four horizontal
3.	Power Distribution Units	<ul style="list-style-type: none"> 2 per rack Power Distribution Unit - Vertically Mounted, 32AMPs with 25 Power Outputs. (20 Power outs of IEC 320 C13 Sockets & 5 Power outs of 5/15 Amp Sockets), Electronically controlled circuits for Surge & Spike protection, LED readout for the total current being drawn from the channel, 32AMPS MCB, 5 KV AC isolated input to Ground & Output to Ground
4.	Doors	<ul style="list-style-type: none"> The racks must have steel (solid / grill / mesh) front / rear doors and side panels. Racks should NOT have glass doors / panels. Front and Back doors should be perforated with at least 63% or higher perforations. Both the front and rear doors should be designed with quick release hinges allowing for quick and easy detachment without the use of tools.
5.	Fans and Fan Tray	<ul style="list-style-type: none"> Fan 90CFM 230V AC, 4" dia (4 Nos. per Rack) Fan Housing Unit 4 Fan Position (Top Mounted) (1 no. per Rack) - Monitored - Thermostat based - The Fans should switch on based on the Temperature within the rack. The temperature setting should be factory settable. This unit should also include - humidity & temperature sensor
6.	Metal	Aluminium extruded profile
7.	Side Panel	Detachable side panels (set of 2 per Rack)

10.38. Server Load Balancer

- Hardware based Server Load balancer

10.39. Firewall (Internal/ External)

#	Parameter & minimum specification
	General and Performance Specifications.
1.	The Firewall should have integrated Firewall and VPN functionality.
2.	Firewall packet handling performance should be adequate to deliver the required throughput.
3.	Firewall should have a redundant power supply.
	Operational Modes.
4.	The Firewall should support Layer 2 (Transparent) mode and Layer 3 mode.
5.	Firewall should support static NAT; Policy based NAT and PAT (Port Addressed Translation).

#	Parameter & minimum specification
	Firewall.
6.	Firewall should provide TCP reassembly for fragmented packet protection.
7.	Firewall should support integration with URL/Content filtering systems.
	VPN.
8.	Firewall should be capable of dynamic routing on VPN.
9.	Firewall should support client based SSL/TLS as well as IPSec VPN Tunnels.
	High Availability.
10.	Firewall should support Active/Passive High Availability.
11.	Firewall should support Active/Active High Availability.
12.	Firewall should support Stateful failover of firewall sessions.
13.	Firewall should support device failure detection.
14.	Firewall should support link failure detection.
15.	Firewall should support authentication for all members.
16.	Firewall should support encryption of all traffic.
	Routing.
17.	Support for OSPF and BGP routing protocol
18.	Firewall should support static routes
19.	Should support Multicast with features like RPF, IGMP/ IGMP Proxy, and PIM.
	IPv6 Support
20.	Should support dual stack IPv4 / IPv6 Firewall and VPN.
21.	Support for IPv4 to/from IPv6 translations or tunneling.
22.	Should support Virtualization (Virtual Firewall, Security zones and VLAN).
	Firewall Management
23.	Firewall should support Web based (HTTP and HTTPS) configuration and management.
24.	Firewall should support Command Line Interface using console and SSH.
25.	Firewall should support management via VPN tunnel on any interface.
	Logging.
26.	Should support Syslog server logging.
27.	Should have support for SNMP V1 to V3.
28.	Support for voice protocols: H.323, SIP, and NAT/ ALG for H.323/ SIP.
29.	Firewall should have Automated certificate enrolment (SCEP). PKI Support.
	Administration.
30.	Firewall should support multilevel administration privilege.
31.	Firewall should support software upgrades using secure web Interface
32.	Firewall should support Command Line Interface using console SSH.

10.40. Integrated Building management system

Sr #	
1.	<p>A. The MSI shall supply, install and commission BAS, Access control and Physical security system for NRDA Office, North block at Paryavaas Bhawan). <i>The HVAC drawing of Paryavas Bhawan is provided in Annexure XII of this RFP.</i></p> <p>B. MSI has to also provide all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification</p> <p>C. The MSI shall Supply, install and commission a complete Building Automation System (BAS) including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification. All components of the system –, application controllers, unitary controllers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2007, or EIA standard 709.1, the LonTalk™ protocol, or Modbus protocol. At a minimum, provide controls for the following:</p> <ol style="list-style-type: none"> 1. Air handling units 2. Return air fans 3. Exhaust and supply fans 4. Chilled water system including pumps, chillers, and cooling towers 5. Boilers including hot water pumps 6. Computer room air handling units 7. Refrigerant leak detection system 8. Smoke evacuation sequence of AHUs and return fans including smoke control dampers and fire command override panel. 9. Finned tube radiation control 10. Variable volume and constant volume box control including interlocks with finned tube radiation. 11. Cabinet unit heater controls 12. Monitoring points for packaged equipment such as emergency generators, 13. Power wiring to DDC devices, smoke control dampers and BAS panels except as otherwise specified. <p>D. Except as otherwise noted, the control system shall consist of all necessary Ethernet Network Controllers, Standalone Digital Control Units, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, control panels, and other accessory equipment, along with a complete system of electrical interlocking wiring to fill the intent of the specification and provide for a complete and operable system. Except as otherwise specified, provide operators for equipment such as dampers if the equipment manufacturer does not provide these. Coordinate requirements with the various Contractors.</p> <p>E. The MSI shall review and study all HVAC drawings and the entire specification to familiarize themselves with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.</p> <p>F. All interlocking wiring, wiring and installation of control devices associated with the equipment listed below shall be provided. When the BAS system is fully installed and operational, the MSI and representatives of the Owner will review and check out the system. At that time, the MSI shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications.</p>

	<p>G. Provide services and manpower necessary for commissioning of the system in coordination with the existing HVAC Contractor, Balancing Contractor and Owner's representative.</p> <p>H.</p>
2.	<p>BAS -System Description</p> <p>A. In accordance to the scope of work, the system shall also provide a graphical, web-based, operator interface that allows for instant access to any system through a standard browser. The contractor must provide PC-based programming workstations, operator workstations and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions. The system shall consist of the following components:</p> <ul style="list-style-type: none"> • Administration and Programming Workstation(s) • Ethernet-based Network Router and/or Network Server Controller(s) These controllers will connect directly to the Operator Workstation over Ethernet at a minimum of 100mbps, and provide communication to the Standalone Digital Control Units and/or other Input/Output Modules. Network Server Controllers shall conform to BACnet device profile B-BC. Network controllers that utilize RS232 serial communications or ARCNET to communicate with the workstations will not be accepted. • Network Controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as Network Server Controllers (B-BC). • Standalone Digital Control Units (SDCUs): Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment. Each BACnet protocol SDCU shall conform to the BACnet device profile B-AAC. • BACnet SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL) as Advanced Application Controllers (B-AAC). <p>B. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Modbus, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Server Controllers (NSCs), user workstations and a local host computer system.</p> <p>C. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.</p> <p>D. The system shall enable an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol and/or ANSI / ASHRAE™ Standard 135-2007, BACnet functionality to assure interoperability between all system components. Native support for the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2007, BACnet protocol are required to assure that the project is fully supported by the HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.</p> <p>E. The system shall enable an architecture that utilizes a MS/TP selectable 9.6-76.8 Kbaud protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-2008, BACnet functionality to assure interoperability between all system components. The AAC shall be capable of communicating as a MS/TP device or as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The ANSI /</p>

	<p>ASHRAE™ Standard 135-2008, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.</p> <p>F. LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth where necessary or desired.</p> <ul style="list-style-type: none"> • Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide functionality lines for such encapsulation and shall be based on industry standard protocols. • The products used in constructing the BMS shall be LonMark™ compliant. • In those instances in which Lon-Mark™ devices are not available, the BMS contractor shall provide device resource files and external interface definitions for LonMark devices. <p>G. The software tools required for network management of the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2008, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans and are required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 4; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet IP or MS/TP. Physical connection of LonWorks devices shall be via Ethernet IP or FTT-10A.</p> <p>H. The system shall support Modbus TCP and RTU protocols natively, and not require the use of gateways.</p> <p>I. The field bus shall support the use of wireless communications.</p> <p>J. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BAS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.</p> <ul style="list-style-type: none"> • The supplied system must incorporate the ability to access all data using Java and HTML5 enabled browsers without requiring proprietary operator interface and configuration programs. • A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. <p>K. Provide the Commissioning, configuration and diagnostic tool (CCDT), color display personnel computer, software, and interfaces to provide uploading/downloading of High Point Count Controllers (AAC), Unitary Equipment Controllers (UEC) and VAV controllers (VAVDDC) monitoring all BACnet objects, monitoring overrides of all controller physical input/output points, and editing of controller resident time schedules.</p> <p>L. Provide a Portable Operator's Terminal (POT) color display personnel computer, software, and interfaces to provide uploading/downloading of Custom Application Controller and Application Specific Controllers databases, monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and overrides of all controller physical input/output points, and editing of controller resident time schedules. POT connectivity shall be via digital wall sensor connected to controller.</p> <p>M. Deployed system must satisfy system requirements to NBC, ASHRE Latest Compliant..</p> <p>N. The system shall have the capability to provide a web-based AFDD (automated fault detection</p>
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	<p>and diagnostic) system. The AFDD system shall be able to interface directly with the project BAS and energy/performance metering system to provide information on HVAC systems that are being controlled. Pricing is to be a separate line item from the BAS proposal. See specification section 25 08 01 for exact requirements.</p> <p>O. The system shall have the capability to provide a web-based APEO (automated predictive energy optimization) system and enable effective participation in local utility Demand Response (DR) programs. The vendor shall provide software and ongoing services that will identify actionable energy saving and peak reduction opportunities to assist the facility in achieving its energy and sustainability objectives, and automatically and continuously operate the systems necessary to achieve the targeted savings and reductions.</p> <p>P. The system shall have the capability to provide a web-enabled PEMS (power and energy management system) monitoring system intended to monitor an entire electrical distribution infrastructure, from incoming utility feeds down to low voltage distribution points. It shall be designed to monitor and manage energy consumption throughout an enterprise, whether within a single facility or across a network of facilities, to improve energy availability and reliability, and to measure and manage energy efficiency. It shall be a standard product offering with no custom programming required. It shall provide a seamless user experience (“Single pane of glass”) for managing the mechanical systems (HVAC and lighting) and monitoring the power distribution system (transformers, breakers, relays, switches, capacitors, UPS, invertors, etc.)</p>
	<p>BAS -System Architecture</p> <p>A.General</p> <ol style="list-style-type: none"> 1. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable. 2. An Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks. 3. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it. 4. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows based computer. The Reports Server can be installed on the same computer as the Enterprise Server. 5. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, LonWorks IP, and/or Modbus TCP protocol. 6. Modbus RTU/ASCII (and J-bus), Modbus TCP, BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported. A sub-network of SDCUs using the BACnet MS/TP, LonTalk FTT-10A, and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers. <p>B.TCP/IP Level</p>

	<p>1. The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the campus firewall. Fixed IP addresses for connections to the campus WAN shall be used for each device that connects to the WAN.</p> <p>C.Fieldbus Level with Standalone Digital Control Units (SDCUs)</p> <p>1. The fieldbus layer shall support all of the following types of SDCUs:</p> <p>a. BACnet SDCU requirements: The system shall consist of one or more BACnet MS/TP field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer consists of an RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) for operation of HVAC and lighting equipment. These devices shall conform to BACnet standard 135-2007. The NSCs shall be capable of at least two BACnet MS/TP field buses for a total capability of 254 SDCUs per NSC.</p> <p>b. LonWorks SDCU requirements: The system shall consist of one or more LonWorks FTT-10A field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer shall consist of up to 64 Lonworks SDCUs using peer-to-peer, event-driven communication for operation of HVAC and lighting equipment.</p> <p>c. Modbus SDCU requirements: The system shall consist of one or more Modbus RTU (RS-485 or RS-232) field buses managed by the Network Server Controller. The field bus layer shall consist of up to 31 SDCUs for operation of HVAC, power metering, and lighting equipment. If utilizing Modbus TCP, the field bus layer shall consist of up to 100 SDCUs for operation of HVAC, power metering, and lighting equipment. The NSCs shall be capable of at least two Modbus RTU field buses for a total capability of 62 SDCUs per NSC.</p> <p>d. NETWORK 8000 SDCU requirements: The system shall consist of one or more ASD or LCM field buses managed by the Network Server Controller. The field bus layer shall consist of up to 128 ASD SDCUs or 31 LCM SDCUs for operation of HVAC, power metering, and lighting equipment.</p> <p>e. I/NET SDCU requirements: The system shall consist of one or more controller LANs and subLANs managed by the Network Server Controller. The network shall consist of up to 100,000 I/NET points capable through numerous links and devices for operation of HVAC, power metering, and lighting equipment.</p> <p>D.BAS LAN Segmentation</p> <p>1. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.</p> <p>E. Standard Network Support</p> <p>1. All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of</p>
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using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.

F. System Expansion

1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
2. Web-based operation shall be supported directly by the NSCs and require no additional software.
3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.

G. Support For Open Systems Protocols

1. All Network Server Controllers must natively support the BACnet IP, BACnet MS/TP, LonWorks FTT-10, Modbus TCP, Modbus RTU (RS-485 and RS-232), and Modbus ASCII protocols.

Operator Workstation Requirements

H. General

1. The operator workstation portion of the BAS shall consist of one or more full-powered configuration and programming workstations, and one or more web-based operator workstations. For this project provide a minimum of 10 concurrent operator users and/or 2 concurrent engineering users within the enterprise server.
2. The programming and configuration workstation software shall allow any user with adequate permission to create and/or modify any or all parts of the NSC and/or Enterprise Server database.

I. General Administration and Programming Workstation Software

1. System architecture shall be truly client server in that the Workstation shall operate as the client while the NSCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the server is responsible for data gathering and delivery.
2. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and set point adjustments.
3. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information will be available in graphic or text displays stored at the NSC. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

	<p>J. User Interface:</p> <ol style="list-style-type: none"> 1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of “hot-spots” that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user’s “PC Desktop” – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC. 2. System shall be able to automatically switch between displayed metric vs. imperial units based on the workstation/web stations localization. 3. Web stations shall have the capability to automatically re-direct to an HTTPS connection to ensure more secure communications. 4. Personalized layouts and panels within workstations shall be extended to web stations to ensure consistent user experiences between the two user interfaces. 5. Servers and clients shall have the ability to be located in different time zones, which are then synchronized via the NTP server. 6. Workstation shall indicate at all times the communication status between it and the server. <p>K. User Security</p> <ol style="list-style-type: none"> 1. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. Additionally, the software shall enable the ability to add/remove users. 2. Additional requirements include mandatory change of passwords: <ol style="list-style-type: none"> a) At first logon with default credentials b) Of admin passwords before deploying via Project Configuration Servers <p>L. Automatic monitoring</p> <ol style="list-style-type: none"> 1. The software shall allow for the automatic collection of data and reporting from any controller or NSC. The frequency of data collection shall be user-configurable. <p>M. Alarm Management</p>
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	<ol style="list-style-type: none">1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.2. Alarm management features shall include:<ol style="list-style-type: none">a. A minimum of 1000 alarm notification levels at the NSC, workstation, and web station levels. At the Enterprise level the minimum number of active and viewable alarms shall be 10,000. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.b. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).c. Playing an audible sound on alarm initiation or return to normal.d. Sending an email page to anyone specifically listed on the initial occurrence of an alarm. The ability to utilize email paging of alarms shall be a standard feature of the software integrated with the operating system's mail application interface (MAPI). No special software interfaces shall be required and no email client software must be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.e. Individual alarms shall be able to be re-routed to a user at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.f. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.g. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.h. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.i. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.j. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.k. An operator shall have the capability to assign an alarm to another user
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	<p>of the system.</p> <p>l. Time schedules shall be able to be used to set control notifications to users.</p> <p>m. An operator shall have the capability to save and apply alarm favorites.</p> <p>N.Report Generation</p> <ol style="list-style-type: none"> 1. The Reports Server shall be able to process large amounts of data and produce meaningful reports to facilitate analysis and optimization of each installation. 2. Reports shall be possible to generate and view from the operator Workstation, and/or Webstation, and/or directly from a reports-only web interface. 3. A library of predefined automatically generated reports that prompt users for input prior to generation shall be available. The properties and configurations made to these reports shall be possible to save as Dashboard reports, so that the configurations are saved for future used. 4. It shall be possible to create reports standard tools, such as Microsoft Report Builder 2.0 or Visual Studio, shall be used for customized reports. 5. Additional reports or sets of reports shall be downloadable, transferrable, and importable 6. All reports shall be able to be set up to automatically run or be generated on demand. 7. Each report shall be capable of being automatically emailed to a recipient in Microsoft Word, Excel, and/or Adobe .pdf format. 8. Reports can be of any length and contain any point attributes from any controller on the network. 9. Image management functionality shall be possible to enable the system administrators to easily upload new logos or images to the system. 10. It shall be possible to run other executable programs whenever a report is initiated. 11. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition. 12. Minimum supplied reports shall include: <ol style="list-style-type: none"> a. Activities Per Server Report b. Activities Per User Report c. Alarm Amount by Category Report d. Alarm Amount by Type Report e. Alarms Per Sever Report f. Current Alarm Report g. Most Active Alarm Report h. System Errors Per Server Report i. Top Activities Report j. Top Alarms Report k. Top System Errors Report l. Trend Log Comparison Report m. User Logins Report n. Users and Groups Reports
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	<p>13. Minimum Energy Reports shall include:</p> <ol style="list-style-type: none"> a. Energy Monitoring Calendar Consumption Report: Shall provide an interactive report that shows the energy usage on one or multiple selected days. b. Energy Monitoring Consumption Breakdown Report: Shall provide a report on energy consumption broken down using sub-metering. c. Energy Monitoring Consumption Report: Shall show the energy consumption against a specified target value. <p>O. Scheduling</p> <ol style="list-style-type: none"> 1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network. 2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view. 3. Schedules shall be programmable for a minimum of one year in advance. 4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications. 5. Additionally, from the operator web stations, each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times. 6. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller. 7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead. 8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule. 9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen. 10. It should accommodate a minimum of 16 priority levels. 11. Values should be able to be controlled directly from a schedule, without the need for special program logic. <p>P. Saving/Reloading</p> <ol style="list-style-type: none"> 1. The workstation software shall have an application to save and restore NSC and field controller memory files. 2. For the NSC, this application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information. <p>Q. Audit Trail</p> <ol style="list-style-type: none"> 1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc. 2. It shall be possible to view a history of alarms, user actions, and commands
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	<p>for any system object individually or at least the last 5000 records of all events for the entire system from Workstation.</p> <ol style="list-style-type: none"> 3. The Enterprise server shall be able to store up to 5 million events. 4. It shall be possible to save custom filtered views of event information that are viewable and configurable in Workstation. 5. It shall be capable to search and view all forced values within the system. <p>R. Fault Tolerant Enterprise Server Operation (Top level NSC)</p> <ol style="list-style-type: none"> 1. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover. <p>S. Web-based Operator Software</p> <ol style="list-style-type: none"> 1. General: <ol style="list-style-type: none"> a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network. b. The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values. 2. Graphic Displays <ol style="list-style-type: none"> a. The browser-based interface must share the same graphical displays as the Administration and Programming Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall support commands to change set points, enable/disable equipment and start/stop equipment. b. Through the browser interface, operators must be able to navigate through the entire system, and change the value or status of any point in any controller. Changes are effective immediately to the controller, with a record of the change stored in the system database. 3. Alarm Management <ol style="list-style-type: none"> a. Systems requiring additional client software to be installed on a PC for viewing the web station from that PC will not be considered. b. Through the browser interface, a live alarm viewer identical to the alarm viewer on the Administration and Programming workstation shall be presented, if the user's password allows it. Users must be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text must be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available. <p>T. Groups and Schedules</p> <ol style="list-style-type: none"> 1. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically. 2. Through the browser interface, operators must be able to change schedules – change start and stop times, add new times to a schedule, and modify calendars. <p>U. User Accounts and Audit Trail</p> <ol style="list-style-type: none"> 1. The same user accounts shall be used for the browser interface and for the
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	<p>operator workstations. Operators must not be forced to memorize multiple passwords.</p> <ol style="list-style-type: none"> 2. All commands and user activity through the browser interface shall be recorded in the system's activity log, which can be later searched and retrieved by user, date, or both. <p>V. Web Services</p> <ol style="list-style-type: none"> 1. The installed system shall be able to use web services to "consume" Information within the Network Server/Controllers (NSCs) with other products and systems. Inability to perform web services within the NSCs will be unacceptable. 2. Shall be able to "consume" data into the system via SOAP and REST web services.
	<p>Network Server Controllers (NSCs)-DDC Panel</p> <ol style="list-style-type: none"> A. Network Router Controllers shall combine both network routing functions, control functions, and server functions into a single unit. B. The BACnet NSC shall be classified as a "native" BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC). C. The Network Server Controller shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS. D. The NSCs shall be capable of whitelisting IPs to restrict access to a pre-defined list of hosts or devices. E. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU or boiler. F. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list. G. It shall be capable of executing application control programs to provide: <ol style="list-style-type: none"> 1. Calendar functions 2. Scheduling 3. Trending 4. Alarm monitoring and routing 5. Time synchronization by means of an Internet site including automatic synchronization 6. Native integration of LonWorks controller data and Modbus controller data or BACnet controller data and Modbus controller data 7. Network Management functions for all LonWorks based devices H. Hardware Specifications <ol style="list-style-type: none"> 1. Memory: <ol style="list-style-type: none"> a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-

	<p>volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.</p> <ol style="list-style-type: none"> 2. Each NRC shall provide the following on-board hardware for communication: <ol style="list-style-type: none"> a. One 10/100bT Ethernet for communication to Workstations, other NRCs and onto the Internet b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable) c. One TP/FT port for communication to LonWorks devices. d. One device USB port e. One host USB port 3. The NSC shall conform to a small footprint no larger than 100W x 125H x 75D mm (3.94W x 4.92H x 2.95D in). <p>I. Modular Expandability:</p> <ol style="list-style-type: none"> 1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications. 2. One shall be able to “hot-change” (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic. 3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses will be protected. <p>J. Hardware Override Switches:</p> <ol style="list-style-type: none"> 1. All digital outputs shall, optionally, include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position. <p>K. Universal Input Temperatures</p> <ol style="list-style-type: none"> 1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed. <ol style="list-style-type: none"> 1) 10 kohm Type I (Continuum) 2) 10 kohm Type II (I/NET) 3) 10 kohm Type III (Satchwell) 4) 10 kohm Type IV (FD) 5) Linearized 10 kohm Type V (FD w/11k shunt) 6) Linearized 10 kohm (Satchwell) 7) 1.8 kohm (Xenta) 8) 1 kohm (Balco) 9) 20 kohm (Honeywell) 10) 2.2 kohm (Johnson)
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	<p>2. In addition to the above, the system shall be capable of using the below RTD sensors, however it is not required that all universal inputs be compatible with them.</p> <ol style="list-style-type: none"> 1) PT100 (Siemens) 2) PT1000 (Sauter) 3) Ni1000 (Danfoss) <p>L. Local Status Indicator Lamps:</p> <ol style="list-style-type: none"> 1. The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green. <p>M. Real Time Clock (RTC):</p> <ol style="list-style-type: none"> 1. Each NSC shall include a real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time. 2. The RTC date and time shall also be accurate, up to 30 days, when the NSC is powerless. 3. No batteries may be used to for the backup of the RTC. <p>N. Power Supply:</p> <ol style="list-style-type: none"> 1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required. 2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring. <p>O. Automatic Restart After Power Failure:</p> <ol style="list-style-type: none"> 1. Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required. <p>P. Data Retention:</p> <ol style="list-style-type: none"> 1. During a power failure, the NSC shall retain all programs, configuration data, historical data, and all other data that is configured to be retained. There shall be no time restriction for this retention and it must not use batteries to achieve it. <p>Q. Software Specifications</p> <ol style="list-style-type: none"> 1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There will be no restrictions placed on the type of application programs in the system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any
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	<p>other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.</p> <ol style="list-style-type: none"> 2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage. <p>R. User Programming Language:</p> <ol style="list-style-type: none"> 1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and set points. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs. 2. Network Server Controllers that use a “canned” program method will not be accepted. <p>S. Control Software:</p> <ol style="list-style-type: none"> 1. The NSC shall have the ability to perform the following pre-tested control algorithms: <ol style="list-style-type: none"> a. Proportional, Integral plus Derivative Control (PID) b. Two Position Control c. Digital Filter d. Ratio Calculator e. Equipment Cycling Protection <p>T. Mathematical Functions:</p> <ol style="list-style-type: none"> 1. Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep. <p>U. NSCs shall have the ability to perform any or all of the following energy management routines:</p> <ol style="list-style-type: none"> 1. Time of Day Scheduling 2. Calendar Based Scheduling 3. Holiday Scheduling 4. Temporary Schedule Overrides 5. Optimal Start 6. Optimal Stop 7. Night Setback Control 8. Enthalpy Switchover (Economizer) 9. Peak Demand Limiting 10. Temperature Compensated Duty Cycling 11. CFM Tracking
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	<ol style="list-style-type: none"> 12. Heating/Cooling Interlock 13. Hot/Cold Deck Reset 14. Hot Water Reset 15. Chilled Water Reset 16. Condenser Water Reset 17. Chiller Sequencing <p>V. History Logging:</p> <ol style="list-style-type: none"> 1. Each NSC controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1440 minutes or based upon a user configurable change of value. A minimum of 1000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command. 2. For extended trend logging a minimum of 1500 trends shall be capable, with a minimum number of 600,000 records within. 3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC. 4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data. 5. The presentation of logged data shall be built into the server capabilities of the NSC. Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales and time spans. 6. Tooltips shall be present, magnetic, and visible based on users preference. 7. Comments shall be visible whenever viewing the trend log list. <p>W. Alarm Management:</p> <ol style="list-style-type: none"> 1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms will be tested each scan of the NSC and can result in the display of one or more alarm messages or reports. 2. There is no limit to the number of alarms that can be created for any point 3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions. 4. Alarms will be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views will be presented to a user upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation. 5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
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6. Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.
- X. Embedded Web Server
1. Each NSC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.

BACnet Fieldbus and BACnet SDCUs –DDC panel

A. Networking

1. IP Network: All devices that connect to the WAN shall be capable of operating at 10 megabits per second or 100 megabits per second.
2. IP To Field Bus Routing Devices
 - a. A Network Server Controller shall be used to provide this functionality.
 - b. These devices shall be configurable locally with IP crossover cable and configurable via the IP network.
 - c. The routing configuration shall be such that only data packets from the field bus devices that need to travel over the IP level of the architecture are forwarded.

B. Field Bus Wiring and Termination

1. The wiring of components shall use a bus or daisy chain concept with no tees, stubs, or free topology.
2. Each field bus shall have a termination resistor at both ends of each segment.
3. The field bus shall support the use of wireless communications.

C. Repeaters

1. Repeaters are required to connect two segments.
2. Repeaters shall be installed in an enclosure. The enclosure may be in an interstitial space.

D. Field Bus Devices

1. General Requirements
 - a. Devices shall have a light indicating that they are powered.
 - b. Devices shall be locally powered. Link powered devices (power is furnished from a central source over the field bus cable) are not acceptable.
 - c. Application programs shall be stored in a manner such that a loss of power does not result in a loss of the application program or configuration parameter settings. (Battery backup, flash memory, etc.)

E. Network Server Controllers (NSCs)

- a. If NSCs have embedded I/O, all of the requirements for I/O that are described under Advance Application Controllers shall apply.
- b. Shall support the export of data to NSCs from other vendors that support the data sharing, read property service.

	<ul style="list-style-type: none"> c. Shall support the export of data using Change of Value (COV) initiation to NSCs from other vendors that support the subscription to data using the COV concept. d. Shall support the export of data to any BACnet OWS that supports the data sharing, read property service. e. Shall support the export of data using Change of Value (COV) initiation to any BACnet OWS that supports the subscription to data using the COV concept. f. Shall provide trend log support for all of the devices on the field bus. They shall provide sufficient memory to store up to 300 samples for each variable required to be trended by the sequence of control. g. Shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending. h. Shall provide time schedule support for all of the devices on the field bus. i. Shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters. j. Shall provide alarm message initiation for all alarms conditions from any of the field bus devices. k. Shall deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient of the notification. l. Shall support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement. m. Shall support the control of the out of service property and assignment of value or state to analog and binary objects from any BACnet OWS that supports writing to the out of service property and the value property of analog and binary objects. n. Shall support the receipt and response to Time Synchronization commands from any device that supports the BACnet service for initiating time synchronization commands. o. Shall support the "Who is?" and "I am." BACnet service. p. Shall support the "Who has?" and "I have." BACnet service. q. Shall support Backup and Restore commands from any BACnet OWS that supports the initiation of Backup and Restore commands. r. Shall be BTL certified. <p>F. Advance Application Controllers (B-AAC)</p> <ul style="list-style-type: none"> 1. The key characteristics of a B-AAC are: <ul style="list-style-type: none"> a. They have physical input and output circuits for the connection of analog input devices, binary input devices, pulse input devices, analog output devices, and binary output devices. The number and type of input and output devices supported will vary by model. b. They may or may not provide support for additional input and output devices beyond the number of circuits that are provided on the basic circuit board. Support for additional I/O shall be provided by
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	<p>additional circuit boards that physically connect to the basic controller.</p> <ul style="list-style-type: none"> c. The application to be executed by a B-AAC is created by an application engineer using the vendor's application programming tool. d. If local time schedules are embedded, the B-AAC shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters. e. If local trend logging is embedded, the B-AAC shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending. f. If local alarm message initiation is embedded, the B-AAC shall: <ul style="list-style-type: none"> 1) Deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient of the alarm message. 2) Support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement, g. Shall support the reading of analog and binary data from any BACnet OWS or Building Controller that supports the BACnet service for the reading of data. h. Shall support the control of the out of service property and assignment of value or state to analog and binary objects from any BACnet OWS that supports writing to the out of service property and the value property of analog and binary objects. i. Shall support the receipt and response to Time Synchronization commands from a BACnet Building Controller. j. Shall support the "Who is" and "I am." BACnet services. k. Shall support the "Who has" and "I have." BACnet services. <p>2. Analog Input Circuits</p> <ul style="list-style-type: none"> a. The resolution of the A/D chip shall not be greater than 0.01 Volts per increment. For an A/D converter that has a measurement range of 0 to 10 VDC and is 10 bit, the resolution is 10/1024 or 0.00976 Volts per increment. b. For non-flow sensors, the control logic shall provide support for the use of a calibration offset such that the raw measured value is added to the (+/-) offset to create a calibration value to be used by the control logic and reported to the Operator Workstation (OWS). c. For flow sensors, the control logic shall provide support for the use of an adjustable gain and an adjustable offset such that a two point calibration concept can be executed (both a low range value and a high range value are adjusted to match values determined by a calibration instrument). d. For non-linear sensors such as thermistors and flow sensors the B-AAC shall provide software support for the linearization of the input signal. <p>3. Binary Input Circuits</p>
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	<ul style="list-style-type: none"> a. Dry contact sensors shall wire to the controller with two wires. b. An external power supply in the sensor circuit shall not be required. <p>4. Pulse Input Circuits</p> <ul style="list-style-type: none"> a. Pulse input sensors shall wire to the controller with two wires. b. An external power supply in the sensor circuit shall not be required. c. The pulse input circuit shall be able to process up to 20 pulses per second. <p>5. True Analog Output Circuits</p> <ul style="list-style-type: none"> a. The logical commands shall be processed by a digital to analog (D/A) converter chip. The 0% to 100% control signal shall be scalable to the full output range which shall be either 0 to 10 VDC, 4 to 20 milliamps or 0 to 20 milliamps or to ranges within the full output range (Example: 0 to 100% creates 3 to 6 VDC where the full output range is 0 to 10 VDC). b. The resolution of the D/A chip shall not be greater than 0.04 Volts per increment or 0.08 milliamps per increment. <p>6. Binary Output Circuits</p> <ul style="list-style-type: none"> a. Single pole, single throw or single pole, double throw relays with support for up to 230 VAC and a maximum current of 2 amps. b. Voltage sourcing or externally powered triacs with support for up to 30 VAC and 0.5 amps at 24 VAC. <p>7. Program Execution</p> <ul style="list-style-type: none"> a. Process control loops shall operate in parallel and not in sequence unless specifically required to operate in sequence by the sequence of control. b. The sample rate for a process control loop shall be adjustable and shall support a minimum sample rate of 1 second. c. The sample rate for process variables shall be adjustable and shall support a minimum sample rate of 1 second. d. The sample rate for algorithm updates shall be adjustable and shall support a minimum sample rate of 1 second. e. The application shall have the ability to determine if a power cycle to the controller has occurred and the application programmer shall be able to use the indication of a power cycle to modify the sequence of controller immediately following a power cycle. <p>8. Local Interface</p> <ul style="list-style-type: none"> a. The controller shall support the connection of a portable interface device such as a laptop computer or vendor unique hand-held device. The ability to execute any tasks other than viewing data shall be password protected. Via this local interface, an operator shall be able to: <ul style="list-style-type: none"> 1) Adjust application parameters. 2) Execute manual control of input and output points. 3) View dynamic data. <p>G.Application Specific Devices</p> <ul style="list-style-type: none"> 1. Application specific devices shall have fixed function configurable applications.
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	<ol style="list-style-type: none"> 2. If the application can be altered by the vendor's application programmable tool, the device is an advanced application controller and not an application specific device. 3. Application specific devices shall be BTL certified.
	<p>DDC Sensors and Point Hardware</p> <p>H. Temperature Sensors</p> <ol style="list-style-type: none"> 1. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F. 2. Room Sensor: Standard space sensors shall be available in an [off white] [black] enclosure made of high impact ABS plastic for mounting on a standard electrical box. <ol style="list-style-type: none"> 1) Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature set point, as well as a push button for selecting after hours operation. 2) Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, set point and other operator selectable parameters. Using built in buttons, operators shall be able to adjust set points directly from the sensor. 3. Duct Probe Sensor: Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet. 4. Duct Averaging Sensor: Averaging sensors shall be employed in ducts which are larger than 14 square feet. The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing. 5. Pipe Immersion Sensor: Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Provide sensor probe length suitable for application. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications. 6. Outside Air Sensor: Provide the sensing element on the building's north side. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure. Operating range -40 to 122 F, 7. A pneumatic signal shall not be allowed for sensing temperature. <p>I. Humidity Wall Transmitter</p> <ol style="list-style-type: none"> 1. Transmitters shall be accurate to +/- [1] [2] % at full scale. 2. Transmitter shall have replaceable sensing element. 3. Sensor type shall be thin-film capacitive. 4. Sensor element shall contain multipoint calibration on-board in nonvolatile memory 5. Operating range shall be 0 - 100% RH noncondensing, 50 to 95 F

6. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
7. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
8. Transmitter shall be available in an [off white] [black] enclosure made of high impact ABS plastic for mounting on a standard electrical box.
9. Transmitter shall have LCD display
10. Transmitter shall be available with a certification of NIST calibration
11. Transmitter shall have integrated temperature sensor

J. Humidity Duct Transmitter

1. Transmitters shall be accurate to +/- [1] [2] % at full scale.
2. Transmitter shall be fully encapsulated in potting material within a stainless steel probe.
3. Transmitter shall have replaceable sensing element.
4. Sensor type shall be thin-film capacitive.
5. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
6. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
7. Output shall be 4-20 mA or 0-5/0-10 VDC.
8. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
9. Transmitter shall be available with a certification of NIST calibration
10. Transmitter shall have integrated temperature sensor

K. Humidity Outdoor Transmitter

1. Transmitters shall be accurate to +/- 2% at full scale.
2. Transmitter shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.
3. Transmitter shall have replaceable sensing element.
4. Sensor type shall be thin-film capacitive.
5. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
6. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
7. Output shall be 4-20 mA or 0-5/0-10 VDC.
8. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
9. Transmitter shall be available with a certification of NIST calibration
10. Transmitter shall have integrated temperature sensor

L. Carbon Dioxide Wall Transmitter:

1. Sensor type shall be Non-dispersive infrared (NDIR).
2. Accuracy shall be ± 30 ppm $\pm 2\%$ of measured value with annual drift of ± 10 ppm. Minimum five year recommended calibration interval.
3. Repeatability shall be ± 20 ppm $\pm 1\%$ of measured value
4. Response Time shall be <60 seconds for 90% step change
5. Outputs shall be field selectable [Analog: 4-20mA or 0-5/0-10VDC] [Protocol: Modbus or BACnet] with [SPDT Relay 1A@30VDC] [temperature setpoint slider]
6. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
7. Temperature Range: [32° to 122°F (CO2 only)] [50° to 95°F (with humidity option)]

	<ol style="list-style-type: none"> 8. Output range shall be programmable 0-2000 or 0-5000 ppm 9. Transmitter shall be available in an [off white] [black] enclosure for mounting on a standard electrical box. 10. Transmitter shall have LCD display for commissioning and provide additional faceplate to conceal LCD display where occupants may misinterpret CO2 readings. 11. Transmitter shall have integrated humidity sensor, temperature sensor <p>M. Carbon Dioxide Duct Transmitter:</p> <ol style="list-style-type: none"> 1. Sensor type shall be Non-dispersive infrared (NDIR). 2. Accuracy shall be ± 30 ppm $\pm 2\%$ of measured value with annual drift of ± 10 ppm. Minimum five year recommended calibration interval. 3. Repeatability shall be ± 20 ppm $\pm 1\%$ of measured value 4. Response Time shall be < 60 seconds for 90% step change 5. Outputs shall be field selectable Analog: 4-20mA or 0-5/0-10VDC with SPDT Relay 1A@30VDC 6. Transmitter shall accept 12-30 VDC or 24 VAC supply power. 7. Temperature Range: 32° to 122°F 8. Output range shall be programmable 0-2000 or 0-5000 ppm 9. Enclosure shall not require remote pickup tubes and make use of integrated H-beam probe to channel air flow to sensor. 10. Enclosure lid shall require no screws and make use of snap on features for attachment 11. Enclosure shall be made of high impact ABS plastic 12. Transmitter shall have LCD display 13. Transmitter shall have integrated humidity sensor, temperature sensor <p>N. Air Pressure Transmitters.</p> <ol style="list-style-type: none"> 1. Sensor shall be microprocessor profiled ceramic capacitive sensing element 2. Transmitter shall have 14 selectable ranges from 0.1 – 10” WC 3. Transmitter shall be $\pm 1\%$ accurate in each selected range including linearity, repeatability, hysteresis, stability, and temperature compensation. 4. Transmitter shall be field configurable to mount on wall or duct with static probe 5. Transmitter shall be field selectable for Unidirectional or Bidirectional 6. Maximum operating pressure shall be 200% of design pressure. 7. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC linear. 8. Transmitter shall accept 12-30 VDC or 24 VAC supply power 9. Response time shall be field selectable T95 in 20 sec or T95 in 2 sec 10. Transmitter shall have an LCD display 11. Units shall be field selectable for WC or PA 12. Transmitter shall have provision for zeroing by pushbutton or digital input. 13. Transmitter shall be available with a certification of NIST calibration <p>O. Liquid Differential Pressure Transmitters:</p> <ol style="list-style-type: none"> 1. Transmitter shall be microprocessor based 2. Transmitter shall use two independent gauge pressure sensors to measure and calculate differential pressure 3. Transmitter shall have 4 switch selectable ranges
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4. Transmitter shall have test mode to produce full-scale output automatically.
5. Transmitter shall have provision for zeroing by pushbutton or digital input.
6. Transmitter shall have field selectable outputs of 0-5V, 0-10V, and 4-20mA.
7. Transmitter shall have field selectable electronic surge damping
8. Transmitter shall have an electronic port swap feature
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power
10. Sensor shall be 17-4 PH stainless steel where it contacts the working fluid.
11. Performance:
 - a. Accuracy shall be $\pm 1\%$ F.S. and $\pm 2\%$ F.S. for lowest selectable range
 - b. Long term stability shall be $\pm 0.25\%$
 - c. Sensor temperature operating range shall be -4° to 185°F
 - d. Operating environment shall be 14° to 131°F ; 10-90% RH noncondensing
 - e. Proof pressure shall be 2x max. F.S. range
 - f. Burst pressure shall be 5x max. F.S. range
12. Transmitter shall be encased in a NEMA 4 enclosure
13. Enclosure shall be white powder-coated aluminum
14. Transmitter shall be available with a certification of NIST calibration
15. [Transmitter shall be preinstalled on a bypass valve manifold]

P. Current Sensors

1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in split core models, and offer either a digital or an analog signal to the automation system.

Q. Current Status Switches for Constant Load Devices

1. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
2. Visual LED indicator for status.
3. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 0.5 A to 175 A.
4. Normally open current sensor output. 0.1A at 30 VAC/DC.
5. Basis of Design: Veris Model H608.

R. Current Status Switches for Constant Load Devices (Auto Calibration)

1. General: Microprocessor based, self-learning, self-calibrating current switch. Calibration-free status for both under and overcurrent, LCD display, and slide-switch selectable trip point limits. At initial power-up automatically learns average current on the line with no action required by the installer
2. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 200 A.
3. Display: Backlit LCD; illuminates when monitored current exceeds 4.5A
4. Nominal Trip Point: $\pm 40\%$, $\pm 60\%$, or on/off (user selectable)
5. Normally open current sensor output. 0.1A at 30 VAC/DC.

S. Current Status Switches for Variable Frequency Drive Application

1. General: Microprocessor controlled, self-learning, self-calibrating current sensor to detect motor undercurrent and overcurrent situations such as belt loss, coupling shear, and mechanical failure on variable loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory and relearn.
2. Visual LED indicator for status.
3. Alarm Limits: $\pm 20\%$ of learned current in every 5 Hz freq. band
4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 1.5 A to 150 A and from 12 to 115 Hz.
5. Normally open current sensor output. 0.1A at 30 VAC/DC.

T. Liquid Flow, Insertion Type Turbine Flowmeter:

1. General: Turbine-type insertion flow meter designed for use in pipe sizes 1 1/2" and greater. Available in hot tap configuration with isolation valves and mounting hardware to install or remove the sensor from pipeline that is difficult to shut down or drain
2. Performance:
 - 1) Accuracy $\pm 1\%$ of rate over optimum flow range; ≥ 10 upstream and ≥ 5 downstream straight pipe diameters, uninterrupted flow
 - 2) Repeatability $\pm 0.5\%$
 - 3) Velocity Range: 0.3 to 20 FPS
 - 4) Pressure Drop 0.5 psi or less @ 10 ft/sec for all pipe sizes 1.5" dia and up
 - 5) Pressure Rating: 1000 psi @ 70°F
3. Maximum Temperature Rating: 300°F
4. Materials: Stainless Steel or Brass body; Stainless steel impeller
5. Transmitter:
 - 1) Power Supply: 12 - 30VAC or 8 - 35VDC.
 - a) Output: [Frequency] [4-20 mA] [Scaled Pulse]
 - 2) Temperature Range: 14° to 150°F
 - 3) Display: 8 character 3/8" LCD (Optional)
 - 4) Enclosure: NEMA 4, Polypropylene with Viton® sealed acrylic cover

U. Liquid Flow/Energy Transmitter, Non-invasive Ultrasonic (Clamp-on):

1. General: Clamp-on digital correlation transit-time ultrasonic flow meter designed for clean liquids or liquids containing small amounts of suspended solids or aeration. Optional temperature sensors for BTU calculations.
2. Liquid: water, brine, raw sewage, ethylene, glycol, glycerin, others. Contact manufacturer for other fluid compatibility
3. Pipe Surface Temperature: Pipe dia 1/2" to 2": -40-185°F; Pipe dia > 2": -

	<p>40-250°F</p> <ol style="list-style-type: none"> 4. Performance: <ol style="list-style-type: none"> 1) Flow Accuracy: <ol style="list-style-type: none"> a) Pipe dia 1/2" to 3/4" 1% of full scale b) Pipe dia 1" to 2" 1% of reading from 4-40 FPS c) Pipe dia 2" to 100" 1% of reading from 1-40 FPS 2) Flow Repeatability $\pm 0.01\%$ of reading 3) Velocity Range: (Bidirectional flow) <ol style="list-style-type: none"> a) Pipe dia 1/2" to 2" 2 to 40 FPS b) Pipe dia 2" to 100" 1 to 40 FPS 4) Flow Sensitivity 0.001 FPS 5) Temperature Accuracy (energy): 32-212°F; Absolute 0.45°F; Difference 0.18°F 6) Temperature Sensitivity: 0.05°F 7) Temperature Repeatability: $\pm 0.05\%$ of reading 5. Transmitter: <ol style="list-style-type: none"> 1) Power Supply: 95 to 264 VAC, 47 to 63 Hz or 10 to 28 VDC. 2) Output: [RJ45] [Modbus TCP/IP] [Ethernet/IP] [BACnet/IP] [Pulse] [4-20 mA] [RS-485 Modbus RTU] 3) Temperature Range: -40 to +185°F 4) Display: 2 line backlit LCD with keypad 5) Enclosure: NEMA 4, (IP65), Powder-coated aluminium, polycarbonate 6. Agency Rating: UL 1604, EN 60079-0/15, CSA C22.2, CSA Class 1 (Pipe > 2") <p>V. Analog Electric/Pneumatic Transducer:</p> <ol style="list-style-type: none"> 1. General: Micro-controlled poppet valve for high accuracy and with no air loss in the system. Field configurable for pressure sensing in multiple applications. 2. Power Supply: 22-30VDC, 20-30VAC 3. Control Input: 4-20mA, 0-10V, 0-5V; jumper selectable 4. Performance: <ol style="list-style-type: none"> 1) Accuracy: 1% full scale; combined linearity, hysteresis, repeatability 2) Compensated Temperature Range: 25° to 140°F 3) Temp Coefficient: $\pm 0.05\%$°C 4) Operating Environment: 10-90% RH, non-condensing; 25° to 140°F 5. Supply Pressure: 45 psig max. 6. Manual Override: Jumper selectable mode, digital pushbutton adjust 7. Alarm Contact: 100mA@30VAC/DC (Optional) 8. Control Range 0-20 psig or 3-15 psig; jumper selectable 9. Pressure Differential 0.1 psig (supply to branch) 10. Pressure Indication Electronic, 3-1/2 digit LCD 11. Housing: Mounted on standard SnapTrack; Optional clear dust cover <p>W. Control Valves</p> <ol style="list-style-type: none"> 1. Provide automatic control valves suitable for the specified controlled media
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	<p>(steam, water or glycol). Provide valves which mate and match the material of the connected piping. Equip control valves with the actuators of required input power type and control signal type to accurately position the flow control element and provide sufficient force to achieve required leakage specification.</p> <ol style="list-style-type: none"> 2. Control valves shall meet the heating and cooling loads specified, and close off against the differential pressure conditions within the application. Valves should be sized to operate accurately and with stability from 10 to 100% of the maximum design flow. 3. Trim material shall be stainless steel for steam and high differential pressure applications. 4. Electric actuation should be provided on all terminal unit reheat applications unless electric heat is provided. <p>X.Dampers</p> <ol style="list-style-type: none"> 1. Automatic dampers, furnished by the Building Automation Contractor shall be single or multiple blade as required. Dampers are to be installed by the HVAC Contractor under the supervision of the MSI. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet Metal Contractor. 2. Damper frames are to be constructed of 13 gauge galvanized sheet steel mechanically joined with linkage concealed in the side channel to eliminate noise as friction. Compressible spring stainless steel side seals and acetyl or bronze bearings shall also be provided. 3. Damper blade width shall not exceed eight inches. Seals and 3/8 inch square steel zinc plated pins are required. Blade rotation is to be parallel or opposed as shown on the schedules. 4. For high performance applications, control dampers will meet or exceed the UL Class I leakage rating. 5. Control and smoke dampers shall be Ruskin, or approved equal. 6. Provide opposed blade dampers for modulating applications and parallel blade for two position control. <p>Y.Damper Actuators</p> <ol style="list-style-type: none"> 1. Damper actuators shall be electronic, and shall be direct coupled over the shaft, without the need for connecting linkage. The actuator shall have electronic overload circuitry to prevent damage. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-spring return actuators shall have an external manual gear release to allow positioning of the damper when the actuator is not powered. <p>Z. Smoke Detectors</p> <ol style="list-style-type: none"> 1. Air duct smoke detectors shall be by Air Products & Controls or approved equal. The detectors shall operate at air velocities from 300 feet per minute to 4000 feet per minute. 2. The smoke detector shall utilize a photoelectric detector head. 3. The housing shall permit mechanical installation without removal of the detector cover. 4. The detectors shall be listed by Underwriters Laboratories and meet the
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	<p>requirements of UL 268A.</p> <p>AA. Airflow Measuring Stations</p> <ol style="list-style-type: none"> 1. Provide a thermal anemometer using instrument grade self heated thermistor sensors with thermistor temperature sensors. 2. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.
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10.40.1. DDC Sensors and Point Hardware

- Temperature Sensors
 - All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
 - Room Sensor: Standard space sensors shall be available in an [off white] [black] enclosure made of high impact ABS plastic for mounting on a standard electrical box.
 - Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
 - Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
 - Duct Probe Sensor: Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet.
 - Duct Averaging Sensor: Averaging sensors shall be employed in ducts which are larger than 14 square feet. The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing.
 - Pipe Immersion Sensor: Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Provide sensor probe length suitable for application. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications.
 - Outside Air Sensor: Provide the sensing element on the building's north side. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure. Operating range -40 to 122 F,
 - A pneumatic signal shall not be allowed for sensing temperature.
- Humidity Wall Transmitter
 - Transmitters shall be accurate to +/- [1] [2] % at full scale.
 - Transmitter shall have replaceable sensing element.
 - Sensor type shall be thin-film capacitive.
 - Sensor element shall contain multipoint calibration on-board in nonvolatile memory
 - Operating range shall be 0 - 100% RH noncondensing, 50 to 95 F

- Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
 - Transmitter shall accept 12-30 VDC or 24 VAC supply power.
 - Transmitter shall be available in an [off white] [black] enclosure made of high impact ABS plastic for mounting on a standard electrical box.
 - Transmitter shall have LCD display
 - Transmitter shall be available with a certification of NIST calibration
 - [Transmitter shall have integrated temperature sensor]
- Humidity Duct Transmitter
 - Transmitters shall be accurate to +/- [1] [2] % at full scale.
 - Transmitter shall be fully encapsulated in potting material within a stainless steel probe.
 - Transmitter shall have replaceable sensing element.
 - Sensor type shall be thin-film capacitive.
 - Sensor element shall contain multipoint calibration on-board in nonvolatile memory
 - Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
 - Output shall be 4-20 mA or 0-5/0-10 VDC.
 - Transmitter shall accept 12-30 VDC or 24 VAC supply power.
 - Transmitter shall be available with a certification of NIST calibration
 - [Transmitter shall have integrated temperature sensor]
- Humidity Outdoor Transmitter
 - Transmitters shall be accurate to +/- 2% at full scale.
 - Transmitter shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.
 - Transmitter shall have replaceable sensing element.
 - Sensor type shall be thin-film capacitive.
 - Sensor element shall contain multipoint calibration on-board in nonvolatile memory
 - Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
 - Output shall be 4-20 mA or 0-5/0-10 VDC.
 - Transmitter shall accept 12-30 VDC or 24 VAC supply power.
 - Transmitter shall be available with a certification of NIST calibration
 - [Transmitter shall have integrated temperature sensor]
- Carbon Dioxide Wall Transmitter:
 - Sensor type shall be Non-dispersive infrared (NDIR).
 - Accuracy shall be ± 30 ppm $\pm 2\%$ of measured value with annual drift of ± 10 ppm. Minimum five year recommended calibration interval.
 - Repeatability shall be ± 20 ppm $\pm 1\%$ of measured value
 - Response Time shall be <60 seconds for 90% step change
 - Outputs shall be field selectable [Analog: 4-20mA or 0-5/0-10VDC] [Protocol: Modbus or BACnet] with [SPDT Relay 1A@30VDC] [temperature setpoint slider]
 - Transmitter shall accept 12-30 VDC or 24 VAC supply power.
 - Temperature Range: [32° to 122°F (CO2 only)] [50° to 95°F (with humidity option)]
 - Output range shall be programmable 0-2000 or 0-5000 ppm
 - Transmitter shall be available in an [off white] [black] enclosure for mounting on a standard electrical box.

- Transmitter shall have LCD display for commissioning and provide additional faceplate to conceal LCD display where occupants may misinterpret CO2 readings.
- [Transmitter shall have integrated [humidity sensor] [temperature sensor]]
- Carbon Dioxide Duct Transmitter:
 - Sensor type shall be Non-dispersive infrared (NDIR).
 - Accuracy shall be ± 30 ppm $\pm 2\%$ of measured value with annual drift of ± 10 ppm. Minimum five year recommended calibration interval.
 - Repeatability shall be ± 20 ppm $\pm 1\%$ of measured value
 - Response Time shall be < 60 seconds for 90% step change
 - Outputs shall be field selectable Analog: 4-20mA or 0-5/0-10VDC with SPDT Relay 1A@30VDC
 - Transmitter shall accept 12-30 VDC or 24 VAC supply power.
 - Temperature Range: 32° to 122°F
 - Output range shall be programmable 0-2000 or 0-5000 ppm
 - Enclosure shall not require remote pickup tubes and make use of integrated H-beam probe to channel air flow to sensor.
 - Enclosure lid shall require no screws and make use of snap on features for attachment
 - Enclosure shall be made of high impact ABS plastic
 - Transmitter shall have LCD display
 - [Transmitter shall have integrated [humidity sensor] [temperature sensor]]
- Air Pressure Transmitters.
 - Sensor shall be microprocessor profiled ceramic capacitive sensing element
 - Transmitter shall have 14 selectable ranges from 0.1 – 10” WC
 - Transmitter shall be +/- 1% accurate in each selected range including linearity, repeatability, hysteresis, stability, and temperature compensation.
 - Transmitter shall be field configurable to mount on wall or duct with static probe
 - Transmitter shall be field selectable for Unidirectional or Bidirectional
 - Maximum operating pressure shall be 200% of design pressure.
 - Output shall be field selectable 4-20 mA or 0-5/0-10 VDC linear.
 - Transmitter shall accept 12-30 VDC or 24 VAC supply power
 - Response time shall be field selectable T95 in 20 sec or T95 in 2 sec
 - Transmitter shall have an LCD display
 - Units shall be field selectable for WC or PA
 - Transmitter shall have provision for zeroing by pushbutton or digital input.
 - Transmitter shall be available with a certification of NIST calibration
- Liquid Differential Pressure Transmitters:
 - Transmitter shall be microprocessor based
 - Transmitter shall use two independent gauge pressure sensors to measure and calculate differential pressure
 - Transmitter shall have 4 switch selectable ranges
 - Transmitter shall have test mode to produce full-scale output automatically.
 - Transmitter shall have provision for zeroing by pushbutton or digital input.
 - Transmitter shall have field selectable outputs of 0-5V, 0-10V, and 4-20mA.
 - Transmitter shall have field selectable electronic surge damping

- Transmitter shall have an electronic port swap feature
- Transmitter shall accept 12-30 VDC or 24 VAC supply power
- Sensor shall be 17-4 PH stainless steel where it contacts the working fluid.
- Performance:
- Accuracy shall be $\pm 1\%$ F.S. and $\pm 2\%$ F.S. for lowest selectable range
- Long term stability shall be $\pm 0.25\%$
- Sensor temperature operating range shall be -4° to 185°F
- Operating environment shall be 14° to 131°F ; 10-90% RH noncondensing
- Proof pressure shall be 2x max. F.S. range
- Burst pressure shall be 5x max. F.S. range
- Transmitter shall be encased in a NEMA 4 enclosure
- Enclosure shall be white powder-coated aluminum
- Transmitter shall be available with a certification of NIST calibration
- [Transmitter shall be preinstalled on a bypass valve manifold]

- Current Sensors
 - Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in split core models, and offer either a digital or an analog signal to the automation system.
- Current Status Switches for Constant Load Devices
 - General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
 - Visual LED indicator for status.
 - Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 0.5 A to 175 A.
 - Normally open current sensor output. 0.1A at 30 VAC/DC.
 - Basis of Design: Veris Model H608.
- Current Status Switches for Constant Load Devices (Auto Calibration)
 - General: Microprocessor based, self-learning, self-calibrating current switch. Calibration-free status for both under and overcurrent, LCD display, and slide-switch selectable trip point limits. At initial power-up automatically learns average current on the line with no action required by the installer
 - Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 200 A.
 - Display: Backlit LCD; illuminates when monitored current exceeds 4.5A
 - Nominal Trip Point: $\pm 40\%$, $\pm 60\%$, or on/off (user selectable)
 - Normally open current sensor output. 0.1A at 30 VAC/DC.
- Current Status Switches for Variable Frequency Drive Application
 - General: Microprocessor controlled, self-learning, self-calibrating current sensor to detect motor undercurrent and overcurrent situations such as belt loss, coupling shear, and mechanical failure on variable loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory and relearn.
 - Visual LED indicator for status.
 - Alarm Limits: $\pm 20\%$ of learned current in every 5 Hz freq. band

- Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 1.5 A to 150 A and from 12 to 115 Hz.
- Normally open current sensor output. 0.1A at 30 VAC/DC.
- Liquid Flow, Insertion Type Turbine Flowmeter:
 - General: Turbine-type insertion flow meter designed for use in pipe sizes 1 1/2" and greater. Available in hot tap configuration with isolation valves and mounting hardware to install or remove the sensor from pipeline that is difficult to shut down or drain
 - Performance:
 - Accuracy $\pm 1\%$ of rate over optimum flow range; ≥ 10 upstream and ≥ 5 downstream straight pipe diameters, uninterrupted flow
 - Repeatability $\pm 0.5\%$
 - Velocity Range: 0.3 to 20 FPS
 - Pressure Drop 0.5 psi or less @ 10 ft/sec for all pipe sizes 1.5" dia and up
 - Pressure Rating: 1000 psi @ 70°F
 - Maximum Temperature Rating: 300°F
 - Materials: Stainless Steel or Brass body; Stainless steel impeller
 - Transmitter:
 - Power Supply: 12 - 30VAC or 8 - 35VDC.
 - Output: [Frequency] [4-20 mA] [Scaled Pulse]
 - Temperature Range: 14° to 150°F
 - Display: 8 character 3/8" LCD (Optional)
 - Enclosure: NEMA 4, Polypropylene with Viton® sealed acrylic cover
- Liquid Flow/Energy Transmitter, Non-invasive Ultrasonic (Clamp-on):
 - General: Clamp-on digital correlation transit-time ultrasonic flow meter designed for clean liquids or liquids containing small amounts of suspended solids or aeration. Optional temperature sensors for BTU calculations.
 - Liquid: water, brine, raw sewage, ethylene, glycol, glycerin, others. Contact manufacturer for other fluid compatibility
 - Pipe Surface Temperature: Pipe dia 1/2" to 2": -40-185°F; Pipe dia > 2": -40-250°F
 - Performance:
 - Flow Accuracy:
 - Pipe dia 1/2" to 3/4" 1% of full scale
 - Pipe dia 1" to 2" 1% of reading from 4-40 FPS
 - Pipe dia 2" to 100" 1% of reading from 1-40 FPS
 - Flow Repeatability $\pm 0.01\%$ of reading
 - Velocity Range: (Bidirectional flow)
 - Pipe dia 1/2" to 2" 2 to 40 FPS
 - Pipe dia 2" to 100" 1 to 40 FPS
 - Flow Sensitivity 0.001 FPS
 - Temperature Accuracy (energy): 32-212°F; Absolute 0.45°F; Difference 0.18°F
 - Temperature Sensitivity: 0.05°F
 - Temperature Repeatability: $\pm 0.05\%$ of reading
 - Transmitter:
 - Power Supply: 95 to 264 VAC, 47 to 63 Hz or 10 to 28 VDC.

- Output: [RJ45] [Modbus TCP/IP] [Ethernet/IP] [BACnet/IP] [Pulse] [4-20 mA] [RS-485 Modbus RTU}
- Temperature Range: -40 to +185°F
- Display: 2 line backlit LCD with keypad
- Enclosure: NEMA 4, (IP65), Powder-coated aluminum, polycarbonate
- Agency Rating: UL 1604, EN 60079-0/15, CSA C22.2, CSA Class 1 (Pipe > 2")
- Analog Electric/Pneumatic Transducer:
 - General: Micro-controlled poppet valve for high accuracy and with no air loss in the system. Field configurable for pressure sensing in multiple applications.
 - Power Supply: 22-30VDC, 20-30VAC
 - Control Input: 4-20mA, 0-10V, 0-5V; jumper selectable
 - Performance:
 - Accuracy: 1% full scale; combined linearity, hysteresis, repeatability
 - Compensated Temperature Range: 25° to 140°F
 - Temp Coefficient: ±0.05%°C
 - Operating Environment: 10-90% RH, non-condensing; 25° to 140°F
 - Supply Pressure: 45 psig max.
 - Manual Override: Jumper selectable mode, digital pushbutton adjust
 - Alarm Contact: 100mA@30VAC/DC (Optional)
 - Control Range 0-20 psig or 3-15 psig; jumper selectable
 - Pressure Differential 0.1 psig (supply to branch)
 - Pressure Indication Electronic, 3-1/2 digit LCD
 - Housing: Mounted on standard SnapTrack; Optional clear dust cover
- Control Valves
 - Provide automatic control valves suitable for the specified controlled media (steam, water or glycol). Provide valves which mate and match the material of the connected piping. Equip control valves with the actuators of required input power type and control signal type to accurately position the flow control element and provide sufficient force to achieve required leakage specification.
 - Control valves shall meet the heating and cooling loads specified, and close off against the differential pressure conditions within the application. Valves should be sized to operate accurately and with stability from 10 to 100% of the maximum design flow.
 - Trim material shall be stainless steel for steam and high differential pressure applications.
 - Electric actuation should be provided on all terminal unit reheat applications unless electric heat is provided.
- Dampers
 - Automatic dampers, furnished by the Building Automation Contractor shall be single or multiple blade as required. Dampers are to be installed by the HVAC Contractor under the supervision of the BAS Contractor. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet Metal Contractor.
 - Damper frames are to be constructed of 13 gauge galvanized sheet steel mechanically joined with linkage concealed in the side channel to eliminate noise as friction.

Compressible spring stainless steel side seals and acetyl or bronze bearings shall also be provided.

- Damper blade width shall not exceed eight inches. Seals and 3/8 inch square steel zinc plated pins are required. Blade rotation is to be parallel or opposed as shown on the schedules.
 - For high performance applications, control dampers will meet or exceed the UL Class I leakage rating.
 - Control and smoke dampers shall be Ruskin, or approved equal.
 - Provide opposed blade dampers for modulating applications and parallel blade for two position control.
- Damper Actuators
Damper actuators shall be electronic, and shall be direct coupled over the shaft, without the need for connecting linkage. The actuator shall have electronic overload circuitry to prevent damage. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-spring return actuators shall have an external manual gear release to allow positioning of the damper when the actuator is not powered.
- Smoke Detectors
 - Air duct smoke detectors shall be by Air Products & Controls or approved equal. The detectors shall operate at air velocities from 300 feet per minute to 4000 feet per minute.
 - The smoke detector shall utilize a photoelectric detector head.
 - The housing shall permit mechanical installation without removal of the detector cover.
 - The detectors shall be listed by Underwriters Laboratories and meet the requirements of UL 268A.
- Airflow Measuring Stations
 - Provide a thermal anemometer using instrument grade self heated thermistor sensors with thermistor temperature sensors.
 - The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.

10.40.2. Access Control System:

- Access Controller Ethernet Based
 - The Access Controller's should be designed for both critical government & private sector security applications.
 - Below input & output modules should be onboard with the Controllers.
 - Universal Inputs : 12
 - Reader Inputs : 8
 - Tamper Input : 1
 - Digital Lock Output : 4
 - The Access Controller's should be designed to support both entry & egress readers while supplying +5 or +12 VDC to each reader.
 - The controller should support the data transfer rates upto 100 Mbps and should have IPSec/IKE encryption and authentication. Encryption (up to 192-bit) and authentication may be enabled for communication to and from workstations and controllers. Controller

should utilize Internet Protocol Security (IPSec) and Internet Key Exchange (IKE) for its encryption to assure tamperproof communications over the Ethernet.

- The Controller should be perfect for large systems. A controller servicing up to 8 areas can hold 480,000 personnel records. With such a large local storage capacity, access decisions can be made swiftly without waiting for validation by a remote server.
- Controller should have inbuilt 32 MB of flash memory and 128 MB of DDR SDRAM. The flash memory is used to preserve 12 MB of application and run-time data. The dynamic RAM is partitioned for dedicated functions: a full 12 MB for applications, 48 MB for personnel records and 8 MB for the operating system. The unused memory should be available for future enhancements. Personnel record data should be preserved using onboard batteries that can hold the data for at least 7 days without the use of an external UPS. If the controller has its application stored in flash and power loss lasts longer than what the battery can supply for RAM, the controller will send a message to Cyber Station and request that the personnel records automatically be reloaded when the power returns.
- The reader inputs should be powered by a dedicated processor allowing the controllers to support current and future devices for advanced applications. The hardware should be ready to support 260-bit encrypted data messages from the reader.
- It is important for controller to be able to contain potential threats when they are detected. The Controller should respond to Area Lockdown commands set from Access control software providing a quick method of sealing off areas. A simple click of a graphic or an automatic program response is all that is needed to disable card readers and exit requests in any given area. First responder personnel can still gain access to the area if their record is marked with “executive privilege”.
- The Controller should be able to adapt access rights to a change in condition or “threat” levels. Each personnel record should be assigned a clearance level for each area to which they have access. When the condition is more severe than the person’s clearance level then access is automatically denied. The Condition Level may be set manually through workstation or automatically through a program. A program can even be used to monitor national threat levels and adjust Condition Levels accordingly.
- Each controller should support the use of two expansion modules plus an Display unit. The expansion module is used for expanding the controller for special or access to doors. Modules can also be used to provide a cost effective entry reader only solution.
- The Access controller should support up to 32 Infinet nodes. The RS-485 programmable port can be set to support a wired or wireless Infinet field bus.
- The Controllers should be ready to support a wide range of card formats. Ideal for retrofits, The Controller lets you preserve existing cards by accepting standard formats (Weigand, ABA, HID Corporate-1000, CardKey) as well as custom formats (Custom Weigand, Custom ABA). The Controller should support formats up to 260-bits making the controllers ready for government installations that must meet HSPD-12 and FIPS 201 standards.
- SNMP (Simple Network Messaging Protocol) messages may be sent to network monitoring software to inform IT managers as to the health and presence of the access controller on the corporate network. The Access Controller should also support the SNMP alarming option.

Parameters	Specifications
Controller	Microprocessor Based with 8 Readers 12 Inputs, 4 DO , 10/100 bT
Memory	DDR SDRAM: 128 MB Flash: 32 MB
Power	24 VAC , 50/60 Hz 12-28 VDC auto-sensing , 50/60 Hz
Power Consumption	90 VA (AC) 50 W (DC)
Real time Clock	Battery backed by an Internal Battery
Operation Environment	0-50 * C 10-90% RH (Non-Condensing)
Enclosure	UL open class, flammability rating of UL94-5V, IP 10
Mounting	Wall mount using fasteners.
Internal Battery	NiMH , 3.6 VDC, 800 mAh
Battery Backup	Minimum 7 days DDR SDRAM and real-time clock
Ethernet LAN Interface	10/100 Ethernet; ethernet cable with RJ-45 connector.
Serial Comm. Inteface	One RS-485 programmable port, software configurable for Infinet, wireless adapter, RoamIO2 or third-party system.
Input Voltage Range	0-5.115 volts DC
Input Impedance	10K ohm to 5.120V or 5M ohm with pull-up resistor disabled
Input Resolution	5.0 mV
Input Accuracy	±15mV (±0.56°C from -23°C to +66°C or ±1°F from -10°F to +150°F)
Alarm Inputs	12
Card Reader/Keypad Inputs	8, Each input can be connected to a card reader, dedicated keypad, or reader/keypad combination.
Card Reader Type	Wiegand, ABA, or CardKey (jumper selectable)
Max Number of Bits/Card	Up to 260 bits/card
Card Reader Power	+5 VDC @ 120 mA or +12 VDC @ 180 mA (jumper selectable)
Door Outputs	4 Nos. Form C relays with a manual override switch

Output Rating	24 VAC/30 VDC @ 3 A
Overrides	3-position manual override switch on each output for manual control of relay. LED override status indicator.
Status Indicator LEDs	CPU Active, Transmit & Receive Data , Status of Ethernet activity & link etc.
Dip Switches	Universal inputs, 10 K ohm pull-up disable/enable
Listing & Certifications	FCC , ICES, CE, C-Tick, WEEE, UL/CUL , UL.

- **Input/output Expansion Module:** Up to two I/O modules and an xP-Display may be connected to a controller.

Parameters	Specifications
Operating Environment	32°–120°F (0–49°C), 10–95% RH (non-condensing)
Communications Interface	Through built-in Expansion Port on controller
Status Indicator LEDs	CPU Module is Active
Switches	RESET
Listing	CE,UL & FCC

10.40.3. Smart card/Biometric fingerprint reader

Parameters	Specifications
Read Range	Card Up to 4” (10.2 cm) Key/Tag Up to 1.25” (3.2 cm)
Mounting	Mounting plate attaches to US/EU/ Asian back box, 52-60 mm Screw hole spacing (vertical or horizontal). LCD/Keypad reader Housing latches onto mounting plate; fingerprint module secured to reader with a screw.
Power Supply	9-12 VDC, Linear supply
Operating Temperature	32° F to 113° F (0° C to 45° C)
Operating Humidity	5% to 95% relative humidity non-condensing

Transmit Frequency	13.56 Mhz
Cable Distance	Wiegand/Clock-and-Data Interface: 500 ft (150 m) (22AWG), RS232: 50 ft (15 m), RS485: 4000 ft (1220 m), USB: 16 ft (4 m), UART: 1 ft (0.30 m).
Card Compatibility	iCLASS 15693 & 14443B - read-only on 16k bit (2k Byte), 32k bit (4k Byte); HID Application iCLASS 15693 & 14443B - read/write (RWKLB575 only) on 16k bit (2k Byte), 32k bit (4k Byte); Application Space
Certifications	UL,CE,FCC, C-Tick.
Housing Material	UL94 Polycarbonate
Resolution	500 dpi, 256-bit gray scale, 18 x 22 mm sensor area
Timing	Card read < 0.5 sec Fingerprint capture < 2 sec, typical 1 sec Verification of captured finger < 1 sec
False Accept/Reject Rate	FAR < 0.01%, FRR < 0.01%

10.40.4. Electromagnetic Lock (LED with Lamp Indicator):

Parameters	Specifications
Magnet Size	250 x 42 x 26 mm
Armature Size	180 x 38 x 11 mm
Holding Force	Up to 600 lbs
Current Drain	480 mA+/- 10% / 12 VDC
Temperature	(-10 to 55) * C (14 to 131) * F
Weight	2.0 Kg

10.40.5. Fixed Dome Cameras for Indoor Surveillance

#	Parameter	Minimum Specifications
1.	Video Compression	H.264
2.	Video Resolution	1920x1080
3.	Frame rate	25 fps in all resolutions
4.	Image Sensor	1/4" / 1/3" Progressive Scan CMOS

#	Parameter	Minimum Specifications
5.	Lens Type	Varifocal, C/CS Mount, IR Correction
6.	Lens	Fixed IRIS 2.8-10mm, F1.7, 10x digital zoom
7.	Minimum Illumination	0.9 lux
8.	Image settings	Compression, colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, rotation
9.	Protocol	HTTP, HTTPS, FTP, SMTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, UPnP, QoS, IPV4, IPV6
10.	Security	Password Protection, IP Address filtering, User Access Log
11.	Operating conditions	0 to 50°C
12.	Casing	Tamper Resistant casing for Indoor Environment

10.40.6. DFMD

S.No.	Parameter	Minimum Specifications
1.	Technology	Microprocessor based
2.	No. of Zones	Minimum 6 Zones or Better
3.	Operation Frequency	User Selectable
4.	Sensitivity	100 sensitivity steps per program or better
5.	Metal Detection	Should detect: <ul style="list-style-type: none"> • Ferrous, Non-Ferrous, Ferrite Alloys • Uniformly in entire frame • In all orientation and • In all possible speed of interception Detection at correct zone levels without interference/false identification of adjacent zones.
6.	Alarm Signal	<ul style="list-style-type: none"> • Audible Alarm • Alphanumeric display & zone display • Remote alarm relay. • Option for remote zonal display unit. • Metering signals proportional to the mass of the detected target
7.	Reset Time	Minimum 0.3 seconds
8.	Traffic Light Status indicator	An LED indicating Green/Red status of the traffic light should be installed on the <ul style="list-style-type: none"> • Control unit display panel

		<ul style="list-style-type: none"> • Top and bottom of both side panels on the exit side of the metal
9.	Interference Suppression	<ul style="list-style-type: none"> • Should not interfere with adjacent installed DFMD's • Total immunity to environmental/ Radio Signals • Optimum compensation for external stationary metal
10.	Power Supply	<ul style="list-style-type: none"> • 220V AC 50 Hz. Mains • Battery Operated from and provided with 12V SMF battery of suitable capacity for 4 hours backup.
11.	Calibration	<ul style="list-style-type: none"> • Automatic & Manual • Built in Keypad • Provision for Remote control unit for parameter settings • Reset time adjustable
12.	Counter	Intelligent traffic counter for transit
13.	Safety	<ul style="list-style-type: none"> • Should conform to international standards of safety/radiations • Should be safe for heart pace makers • Should be data safe
14.	Self-Diagnostics	User friendly self-testing diagnostics to identify faulty condition
15.	Ambient temperature	From 0°C to 60°C
16.	Humidity	Up to 90% No Condensation
17.	Control Panel	Easily accessible, modular design with Standard plugs and connectors.
18.	Network Connectivity	<ul style="list-style-type: none"> • Compatibility to integrated physical security system via TCP IP • Adaptability to remote monitoring systems.
19.	Integration	<ul style="list-style-type: none"> • Integration with Other Access Control Devices like Turnstiles, Flap gates etc • Integration capability with cameras
20.	Construction	Light Weight, rigid, laminated side panels and cross piece, all plastic boots for panel protection base wheels for easy mobility.
21.	Standards	<ul style="list-style-type: none"> • Meets Electrical Safety and Compatibility Requirements • International Standards (IS) Command • CE/FCC/IEC/IEEE certified.

10.40.7. HHMD

#	Parameter	Minimum Specifications
1.	Display	<p>The HHMD may be of LED display type or of LCD display type (type offered shall be clearly indicated in the offer). The following minimum LED indications should be available in the HHMD:-</p> <ul style="list-style-type: none"> • ON indication,

		<ul style="list-style-type: none"> • Metal detection indication, • Low battery Indication
2.	Dimension	Area of search coil: Minimum 125 Sq. cm
3.	Sensitivity	<p>There will not be any sensitivity control switch and calibration shall be automatic. The number of beeps will indicate the size of metal. Sensitivity should be very high so as to easily detect the following. It shall detect objects concealed in ferrite.</p> <ul style="list-style-type: none"> • Ferrous Coins, Paper Pin, Paper clip, Knife/Blade, Stainless steel blade • Non Ferrous Aluminium tube, Copper plate, Brass plate
4.	Audio Alarm	<p>Audio Alarm should:</p> <ul style="list-style-type: none"> • be loud enough on detection of any metal • give an idea about the size of the objects by the number of beeps Detection of objects • detect ferrous and non-ferrous metals alloys in any possible orientation • Give distinct and different audio output in case of Ferrite detection
5.	Power Source	<ul style="list-style-type: none"> • Rechargeable - NiCD/NiMH pack each sufficient 50 hour operation without audio and 25 hours with audio on one charge • The HHMD should have inbuilt charging capacity
6.	Construction	Light Weight, Rugged, High Impact ABS case with reinforced coil compartment
7.	Tuning	Automatic
8.	Safety	Magnetic field generated by the HHMD should be harmless to magnetic media, electronic devices and heart pace makers.
9.	Temperature	From 0°C to 50°C
10.	Standards	Should conform IS:12126:1987/CE certified
11.	Miscellaneous	<ul style="list-style-type: none"> • Cleaning Kit • Technical manual • User handbook

10.40.8. Boom Barriers

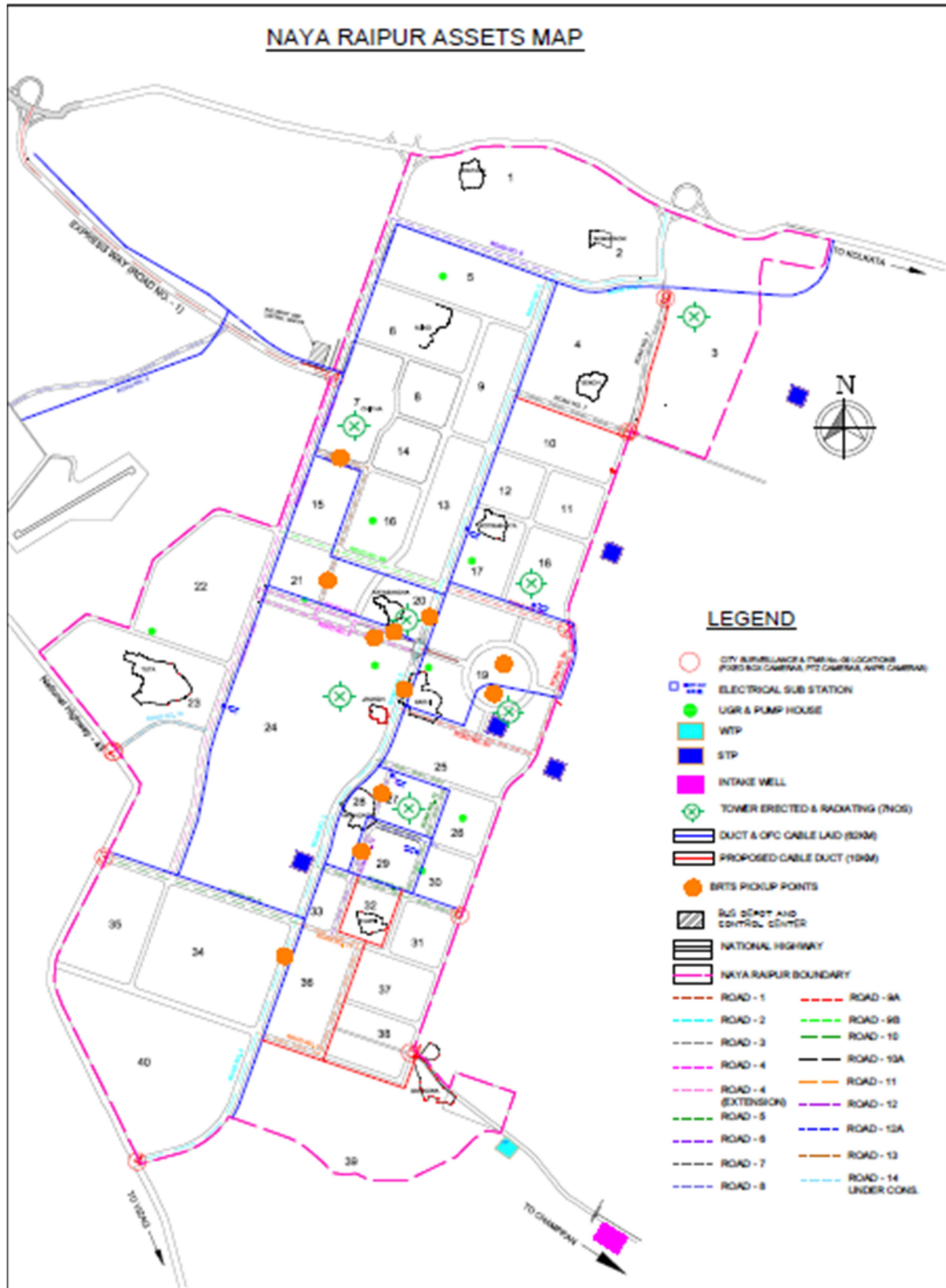
#	Parameter	Minimum Specifications
1.	Barrier Length	3 to 6 Meters (Depending upon Site requirement)
2.	Opening/ Closing Time	Maximum 2 secs
3.	Maximum Torque	600NM
4.	Duty Cycle	100%
5.	MCBF	Minimum 5000000 Cycles
6.	Power	230VAC
7.	Motor Power Supply	230VAC or 24VDC
8.	Operating Temperature	0 Deg C to 60 Deg C
9.	Operating Humidity	More than 95%
10.	IP Rating	IP 65 or better

10.40.9. Cable

1. Signal Cable : 2x1.5sq.mm Cu. Conductor, PVC insulated, sheathed FRLS armoured cable signal cabling
2. Communication Cable : 2x1.5sq.mm Cu. Conductor, PVC insulated, sheathed shielded twisted FRLS armoured cable communication cabling

11. Annexure IV- List of Proposed Locations of Camera, Asset Map and estimated requirement IBMS I/O

Point on Map	Type of location	Type of Camera			Total Cameras
		Fixed	PTZ	ANPR	
1	Entry Exit Point Road No. 1 and Road No. 4	3	1	6	10
2	Entry Exit Point Tuta Road and NH43- T Junction (Rajvotsava)	2	1	6	9
3	Entry Point Junction between NH43 and Rd No. 5- T Point	2	1	6	9
4	Entry and Exit NH43 and Road No.2- T Point	2	1	6	9
5	Entry and Exit Point on Road to Champaran	2	1	6	9
6	Intersection Road No. 10 and Naya Raipur Border	2	1	0	3
7	Intersection Road No. 9A and Naya Raipur Border	2	1	0	3
8	Intersection Road No. 7 and Naya Raipur Border	3	1	6	10
9	Intersection Road No. 2 and Road No. 7	2	1	6	9
	Total	20	9	42	71



Note: 4 BRTS Shelter/Stops are under construction and their location is not mentioned in above map

BUILDING MANAGEMENT SYSTEM							
DATA POINTS SUMMARY							
(AI- Analog Input, DI- Digital Input, AO- Analog output, DO- Digital Output, SI- Software Integration)							
Sr. No.	Function	Qty	AI	DI	AO	DO	SI
	Chilled Water Plant						
1	CHILLERS	3					
	Chiller Enable / Disable					3	
	Chiller Status			3			
	Chiller Manual Operation Status			3			
	Expansion Tank - Pressure Monitoring		1				
	Pressure Drop Across Pot Strainer for CHW		1				
2	CHILLER EVAPORATOR	3					
	CHW Flow Status - Individual Chillers			3			
	CHW Flow Monitoring - Individual Chillers		3				
	Isolation Valve Open / Close Command					3	
	Isolation Valve - Limit Switch Status			3			
	Individual Header Supply/Retun Temperature		6				
3	CHILLER CONDENSER	3					
	Isolation Valve Open / Close Command					3	
	Isolation Valve - Limit Switch Status			3			
	Individual Header Supply/Retun Temperature		6				
4	PRIMARY CHILLED WATER PUMPS (3W+1S)	4					
	Primary Chilled Water Pump on / off command					4	
	Primary Chilled water Pump run Status			4			
	Primary Chilled water Pump trip Status			4			
	Auto Manual Switch			4			
5	SECONDARY CHILLED WATER PUMPS	4					
	Secondary Chilled Water Pump on / off command(VFD)					4	
	Secondary Pumps Run Status			4			
	Secondary Pumps Trip Status			4			
	CHW Return Temperature of each CHW Zone			4			
	CHW Pressure Monitoring of each CHW Zone		4				
	VFD Integration						
6	CONDENSER WATER PUMPS	4					
	Condenser Water Pump on / off command					4	
	Condenser water Pump run Status			4			
	Condenser Chilled water Pump trip Status			4			
	Auto Manual Switch			4			
7	COOLING TOWER	3					
	Cooling Tower fans On/Off Command					3	
	Cooling Tower fans Run Status			3			
	CT Fan Auto/Manual Status			3			
	CT Hi/Lo Water Alarm			3			
	CT Fan Motor Trip Status			3			

BUILDING MANAGEMENT SYSTEM							
DATA POINTS SUMMARY							
(AI- Analog Input, DI- Digital Input, AO- Analog output, DO- Digital Output, SI- Software Integration)							
Sr. No.	Function	Qty	AI	DI	AO	DO	SI
	Outside Air Temp & RH		1				
	Hardness Monitoring for Condenser Water		1				
	TDS Monitoring for Condenser Water		1				
	CT Tower Outlet Temperature		1				
	Pressure Drop Across Pot Strainer for CDW		1				
	SUB TOTAL - AC PLANT		26	63	0	24	
1	FLOOR MOUNTED AIR HANDLING UNIT (WITHOUT VFD)	1					
	AHU ON/OFF Command					1	
	AHU Run Status			1			
	AHU Auto/Manual Operation Status			1			
	AHU Trip Status			1			
	AHU Filter Status			1			
	AHU Return Air Temperature Monitoring		1				
	AHU CHW Supply and Return Temperature		2				
	CHW Valve Modulation				1		
	CHW Valve Position Feedback		1				
	Static Pressure Monitoring		1				
	SUBTOTAL FOR AHU WITHOUT VFD		5	4	1	1	
2	FLOOR MOUNTED AHU (WITH VFD)	31					
	AHU VFD Enable / Disable					31	
	AHU VFD Speed Control				31		
	AHU Blower Status			31			
	AHU Manual Operation Status			31			
	AHU Trip Status			31			
	AHU Filter Status			31			
	AHU Supply and Return Air Temperature		62				
	AHU CHW Supply and Return Temperature		62				
	CHW Valve Modulation				31		
	CHW Valve Position Feedback		31				
	AHU VFD						
	Static Pressure Monitoring		31				
	SUBTOTAL FOR AIR HANDLING UNIT WITH VFD		186	124	62	31	
3	CEILING SUSPENDED UNIT	2					
	CSU ON/OFF Command					2	

BUILDING MANAGEMENT SYSTEM							
DATA POINTS SUMMARY							
(AI- Analog Input, DI- Digital Input, AO- Analog output, DO- Digital Output, SI- Software Integration)							
Sr. No.	Function	Qty	AI	DI	AO	DO	SI
	CSU Run Status			2			
	CSU Auto/Manual Operation Status			2			
	CSU Trip Status			2			
	CSU Filter Status			2			
	CSU Return Air Temperature Monitoring		2				
	CSU Valve Modulation				2		
	CSU Valve Position Feedback		2				
	Static Pressure Monitoring		2				
	SUBTOTAL FOR CEILING SUSPENDED UNITS		6	8	2	2	
4	VENTILATION AND EXHAUST FANS (INCL. SMOKE EXTRACTION, STAIRCASE, LIFTWELL, INLINE, PROPELLOR, AXIAL FANS)	106					
	Fan Start/Stop					106	
	Fan run status			106			
	Fan Manual Operation Status			106			
	Fan Trip Status			106			
	Sub total for FANS		0	318	0	106	
5	FIRE DAMPERS & VOLUME CONTROL DAMPERS	40					
	Fire Damper Open/Close Command					40	
	Fire Damper Open/Close Status			40			
	Air Volume Damper - Control				40		
	Air Volume Damper - Feedback		40				
	Sub total for Ventilation System		40	40	40	40	
6	PRESSURE INDEPENDENT VAV BOXES	40					
	VAV BOXES Damper Control				40		
	VAV BOXES Damper Position Feedback		40				
	VAV BOXES - Air Differential Pressure Sensor		40				
	VAV Boxes Air Velocity		40				
	Sub total for VAV BOXES		120	0	40	0	0
5	ELECTRICAL DG SET	2					
	DG Run Status			2			
	DG Oil Tank Low Level Indicator			2			
	Sub total for DG System		0	4	0	0	0

BUILDING MANAGEMENT SYSTEM							
DATA POINTS SUMMARY							
(AI- Analog Input, DI- Digital Input, AO- Analog output, DO- Digital Output, SI- Software Integration)							
Sr. No.	Function	Qty	AI	DI	AO	DO	SI
8	ELECTRICAL						
	HT Breaker On/Off Status	1		1			
	HT Breaker Trip Status Status	1		1			
	LT Breaker On/Off Status	8		8			
	LT Breaker Trip Status Status	8		8			
	DG Breaker On/Off Status	1		1			
	DG Breaker Trip Status Status	1		1			
	BUS COUPLER On/Off Status	1		1			
	BUS COUPLER Trip Status Status	1		1			
	UPS Breaker On/Off Status	1		1			
	UPS Breaker Trip Status Status	1		1			
	APFC Panel Status	4		4			
	MCC Panel Breaker On/Off Status	1		1			
	MCC Panel Breaker Trip Status	1		1			
	Sub Total for Electrical System		0	30	0	0	0
9	PLUMBING & FIRE FIGHTING						
	Sewage Treatment Plant (STP)	3					
	Sump Pump Run Status			3			
	Air Blowers Run Status			3			
	Supply to MBR Pumps - Run Status			3			
	Screw Pumps - Run Status			3			
	Soft Water Make up Pumps - Run Status			3			
	Flushing Water Transfer Pumps - Run Status			3			
	Irrigation Water Tank Pumps Run Status			3			
	Suction Pumps Run Status			3			
	Return Sludge Pump Run Status			3			
	Chemical Cleaning Pump Run Status			3			
	Softener Feed Pump Run Status			3			
	STP Control Panel Integration						
	WTP						
	Domestic Water Pumps (1 W + 1 S) - Run and Trip Status	2		2			
	Soft Water Pumps (1 W + 1 S)	2		2			
	Water Treatment Pumps (1 W + 1 S)	2		2			
	Recycled Water Pumps (1 W + 1 S)	2		2			
	Fire Protection System						
	Sprinklers / Hydrant Pump Run Status	1		1			
	Jockey Pump Run Status	1		1			
	Diesel operated FF & Sprinkler Pump - Run Status	1		1			

BUILDING MANAGEMENT SYSTEM							
DATA POINTS SUMMARY							
(AI- Analog Input, DI- Digital Input, AO- Analog output, DO- Digital Output, SI- Software Integration)							
Sr. No.	Function	Qty	AI	DI	AO	DO	SI
	Pumps Pressure Switch Status	1	1				
	FF System Line Pressure	1		1			
	TANKS / SUMPS LEVEL MONITORING						
	Underground tanks						
	(a) Fire Static Tanks	1		2			
	(b) Raw Water Tanks	1		2			
	(c) Domestic Water Tanks	1		2			
	(d) Soft Water Tanks	1		2			
	Overhead tanks						
	(a) Domestic Flushing & soft Water Tanks	3		6			
	Sub Total for PLUMBING AND FIRE FIGHTING SYSTEM		1	59	0	0	0
	Elevators/Lifts	3					
	Elevator - Alarm Monitoring Status			3			
	Emergency Switch Status			3			
	Sub Total for Lifts		0	6	0	0	0
10	SOFTWARE INTEGRATIONS						
	FIRE ALARM SYSTEM -- MODBUS RS485 / BACNET MSTP	1					800
	UPS -- MODBUS RS485 / BACNET MSTP	2					80
	DG -- -- MODBUS RS485	2					40
	VFD'S -- MODBUS RS485 / BACNET MSTP / LON	35					350
	CHILLERS -- MODBUS RS485 / BACNET MSTP	3					120
	ENERGY METERS - MODBUS RS485						150
	Sub Total for SOFTWARE INTEGRATIONS		0	0	0	0	1540
	GRAND TOTAL		384	656	145	204	1540

12. Annexure V: Common guidelines/ comments regarding the compliance of equipment/ systems

1. The specifications mentioned for various IT / Non-IT components are indicative requirements and should be treated for benchmarking purpose only. Bidders are required to undertake their own requirement analysis and may propose higher specifications that are better suited to the requirements.
2. Any manufacturer and product name mentioned in the Tender should not be treated as a recommendation of the manufacturer / product.
3. None of the IT / Non-IT equipment's proposed by the Bidder should be End of Life product. It is essential that the technical proposal is accompanied by the OEM certificate in the format given in Section 5.11 (Form 10) of Volume I of this Tender, where-in the OEM will certify that the product is not end of life & shall support for at least 7 years from the date of Bid Submission.
4. Technical Bid should be accompanied by OEM's product brochure / datasheet. Bidders should provide complete make, model, part numbers and sub-part numbers for all equipment/software quoted, in the Technical Bid.
5. Bidder should ensure that only one make and model is proposed for one component in Technical Bid for example all PTZ cameras must belong to a single OEM and must be of the same model etc.
6. Bidders should ensure complete warranty and support for all equipment from OEMs. All the back-to-back service agreements should be submitted along with the Technical Bid.
7. All equipment, parts should be original and new.
8. The user interface of the system should be a user friendly Graphical User Interface (GUI).
9. Critical core components of the system should not have any requirements to have proprietary platforms and should conform to open standards.
10. For custom made modules, industry standards and norms should be adhered to for coding during application development to make debugging and maintenance easier. Object oriented programming methodology must be followed to facilitate sharing, componentizing and multiple-use of standard code. Before hosting the application, it shall be subjected to application security audit (by any of the CERTIN empanelled vendors) to ensure that the application is free from any vulnerability; and approved by the NRDA.
11. All the Clients Machines / Servers shall support static assigned IP addresses or shall obtain IP addresses from a DNS/DHCP server.
12. The Successful Bidder should also propose the specifications of any additional hardware/Non IT infrastructure, if required for the system.

13. The design consideration of the system is given in this volume. The Successful Bidder must provide the architecture of the solution it is proposing.
14. MSI is required to ensure that there is no choking point / bottleneck anywhere in the system (end-to-end) and enforce performance and adherence to SLAs. SLA reports must be submitted as specified in the Bid without fail.
15. All the hardware and software supplied should be from the reputed Original Equipment Manufacturers (OEMs).
16. All licenses should be in the name of the NRDA and should be Perpetual.
17. The proposed solution of MSI should meet the minimum specification requirements for respective component, bidder need to size the solution components to meet the project requirement. In case any of the system / appliance could not meet the performance requirement during the implementation testing or operations phase, MSI will be responsible to change the same with equivalent/better product without any additional cost to NRDA.
18. All components to be maintained in redundancy with Active - Active / Active- Passive Clustering based on the SLA requirements, architecture and performance. Bidder need to provide the compliance with respect to each clause and clear reference-able document, highlighting how the stated requirement is being met. All components should be sized to meet the required performance and SLA level when one of the redundant devices is down.
19. The proposed solution should be optimized for power, rack space, bandwidth while ensuring high availability and no single point of failure across the architecture.
20. The proposed systems and IT Infrastructure components like servers, storage, network etc. should be of enterprise class and must be current as per OEMs latest offering, in line with advancements of technology in these domains. Bidder need to provide the published benchmarks for the stated systems along with the sizing assessment sheet being certified by the OEM for the stated systems. All the components should be able to handle expected loads and provision the desired transaction times and throughputs.
21. Servers should be based on x86 platform in high density form factor to ensure optimal power and space usage. However, bidder may suggest rack form factor for any specific server usage, stating clearly the benefits being derived without compromising on the power and cooling factors.
22. The database layer should utilize the database servers for consolidating the database requirements. The architecture should have horizontal scalability. Benefits/additional security, reliability, availability features at the server level architecture would be given due consideration during evaluation
23. Redundancies/teaming should be maintained at different interconnecting fabrics so as to avoid any single point of failure / performance bottleneck
24. Networking equipment should be capable of processing IPV4 & IPV6 traffic. Security features that are delivered shall be IP v 6 ready.
25. All devices should be IPv4 and IPv6 ready from day-1. MSI shall deploy IPv4 and IPV6 dual stack supported network from day-1. The proposed solution and all appliances should meet this requirement. The MSI shall also be responsible for security adherence on both IPv4 and IPv6.

26. Bidder should utilize virtualization technology to optimise the solution and provide benefits for the overall Cost of ownership and ease of maintenance.
27. Proposed environment at DC should support set up and operations of multiple OEMs / brands of servers and storage without having any compatibility issue.
28. The IT infrastructure proposed for NRDA system should comply with the below :

S. No.	Item	To be provided of the OEM listed in latest Gartner report (2015-2016)	Quadrant
1.	Servers (x86)	Magic Quadrant for Servers	Leaders/Challengers
2.	Storage	Magic Quadrant for Storage & Disk Arrays	Leaders/Challengers
3.	Network Equipment: Switches & Routers	Magic Quadrant for Data Centre Network Infrastructure	Leaders/Challengers
4.	Firewall	Magic Quadrant for Enterprise Network Firewalls,	Leaders/Challengers
5.	Endpoint Protection (Anti-Virus)	Magic Quadrant for Endpoint Protection	Leaders/Challengers
6.	Database (RDBMS)	Magic Quadrant for Operational Database Management Systems	Leaders/Challengers
7.	Document Management System	Magic Quadrant for Enterprise Content Management	Leaders/Challengers

- Bidder need to submit a copy of relevant section of the Gartner report along with technical proposal.

* During the Demonstration at technical evaluation stage, the Technical Committee will give special attention to verify the quality, robustness and appropriateness of the proposed cameras for field scenario/conditions. If any brand / product are found un-suitable, Bidder may get dis-qualified or may be asked to replace the product with better brands meeting the tender requirements, without any change in commercial bid.

13. Annexure VI: GIS Layers

NRDA has also prepared an indicative list of GIS layers that will be developed for NRDA under the GIS platform.

S. No.	Group	Layer	Layer Type	Attribute
1	Land Purchase	Khasra	Polygon	Ownership
				Cumulative details in ERP
				Ownership (Before and after allotment)
				With Land use Information
				Number (Unique with 4 fields) primary key
		Assets (Well, Trees etc.)	Points	Type, number, age, size
		Topography	Points	Trees, electric poles etc.
Line	Contour, electrical transmission lines etc.			
Polygon	Plantation area, area under water etc.			
2	Development Plan	Development Plan Approved	Polygon	Layer, Landuse, Sectors, Etc.
		Development Plan Modifications	Polygon	Layer, Landuse, Sectors, Etc.
3	Sector Plan/Layout	Sector Plan/Layout	polygon	Plots, Roads, Use / Activity, ownership (status of Building permission)
				status of layout approval
				lease premium
				lease rent dues
		Points	plot location, connection points etc.	
4	Buildings	Individual Residential Units	Polygon	Area, No of Floors, status of Permission, construction and completion, Architect, Structural Consultant, Other Consultant, Construction Agency Etc.
		Group Housing	Polygon	Area, No of Floors, status of Permission, construction and completion, Architect, Structural Consultant, Other Consultant, Construction Agency Etc.
		Commercial	Polygon	Area, No of Floors, status of Permission, construction

S. No.	Group	Layer	Layer Type	Attribute
				and completion, Architect, Structural Consultant, Other Consultant, Construction Agency Etc.
		PSP	Polygon	Use, Area, No of Floors, status of Permission, construction and completion, Architect, Structural Consultant, Other Consultant, Construction Agency Etc.
		Industrial	Polygon	Type, Area, No of Floors, status of Permission, construction and completion, Architect, Structural Consultant, Other Consultant, Construction Agency Etc.
		Recreational	Polygon	Type, Area, No of Floors, status of Permission, construction and completion, Architect, Structural Consultant, Other Consultant, Construction Agency Etc.
		Utility	polygon	Type, Area, No of Floors, status of Permission, construction and completion, Architect, Structural Consultant, Other Consultant, Construction Agency Etc.
5	Road	Center Line	Line	Road Nos, Type (City, Sector, VDP, Village Etc.), Width, Handed Over to NRDA or Not Etc.
		Right of Way	polygon	Nos, Area, Pavement Type, Type of Road, Width of Median, Width of Carriage Way, Width of hedging, width of Cycle Track and pathway, Utility Corridor
		Pathway	Line	Nos, Type(both Side, One Side), Width of one Side, Width of Other Side, Payment Type
		Cycle Track	Line	Nos, Type(both Side, One Side), Width of one Side, Width of Other Side, Payment Type
		Cross Duct Work - Bridge / pipe culvert / utility crossings and no. of pipes/	polygon	Nos, Chain age, Type, Size, Purpose
		Facility Centers	polygon	Nos, Area, No of shops, Etc.
		Parking Lots	polygon	Nos, Area, Type (Car, Cycle, Truck/Bus Etc.), Numbers, Pavement Type, Paid or Free, Managed or unmanaged

S. No.	Group	Layer	Layer Type	Attribute
		Rotaries, islands	polygon	Nos, Area, Type, Cover / Pavement Type, Maintained By, Etc.
		Street Furniture	Points	Nos, Type, Material, Photo/Design
		Signage	Points	Nos, Type, Material, Photo/Design
		Signals	Points	Nos. Type, Powered By, Next to, and Before
		Construction Update	Line	Phase, Consultants, Contractor, Excavation / Embankment work / Subgrade work / granular sub base work/ Curb laying /wet mix macadam work / Dense bitumen macadam work / semi dense bituminous concrete/ bituminous concrete /seal coat/ road signage works
		Maintenance	Line	Maintenance Contractor, Quality Checks, top layer etc.
			points	Pot Holes, Animal Causality, other maintenance
6	BRTS	Center Line	Line	Route Nos, Type (Naya Raipur, Raipur),Center Median / Road Side Boarding,
		Stops	polygon	Nos, Name, Location, Width, Area
7	Railways	Center Line	Line	Type(broad-gauge), etc.
		services	point	railway station entry gates, ticket counters, eatery counters, kiosks, parking
		Parking	polygons	parking areas, right of way
8	Light Rail Transit (LRT)	Center Line	Line	Type(broad-gauge), etc.
		services	point	railway station entry gates, ticket counters, eatery counters, kiosks, parking
		Parking	polygons	parking areas, right of way
10	Water Supply	pipeline network	Line	Nos, Type of material, Diameter, level (City, Sector, Village or layer 2/3),
		Pumping Stations	polygon	Nos, Types of Pumps, Nos of Pumps, Date of Commissioning, Feeding to Sectors, Feeding to areas, No of Bulk or retail consumer etc.
		UGR / OHT	polygon	Nos, Type, Capacity
		WTP	polygon	Inlet chamber/Clariflocculator /Filter beds and no. of filter beds/ clear water sump capacity/ pump house/ MBR capacity/
		Valves	points	Nos, Type, Material, Direction

S. No.	Group	Layer	Layer Type	Attribute
		Construction Update	Line	Phase, Level, Consultant, Contractor, Date of LoA, Targeted Date of Completion, Excavation/Laying of pipeline/Pipe dia./pipe material/class of pipe (pressure rating)/Sluice valves/ scour valve/ butterfly valve/Air valve/Electromechanical water meter/house water meters/ fittings/ Thrust Blocks/ Testing commissioning/Back filling.
		Maintenance	Line	Maintenance Contractor, Quality Checks, network and equipment replacement etc.
			points	leakage reporting and identification, Etc.
11	Sewerage	pipeline network	Line	Nos, Type of material, Diameter, level (City, Sector, Village or layer 2/3), Invert Levels
		Intermediate Pumping Stations	polygon	Nos, Types of Pumps, Nos of Pumps, Date of Commissioning, Catering to Sectors, Capacity Head Height Etc.
		STP	polygon	wet well/Installation of SBR / UGR/Pump house/Testing commissioning of STP/ Disposal point
		Manholes	points	Nos, Type, Material, Direction
		Construction Update	Line	Phase, Level, Consultant, Contractor, Date of LoA, Targeted Date of Completion, Excavation/Laying of pipeline/ Manholes type of material/ Manhole Invert level/ Pipe dia./pipe material/Testing commissioning/flow data/velocity/house disposal manhole no.s, wet well/Installation of SBR / UGR/Pump house/Testing commissioning of STP/ Disposal point, Back filling.
		Maintenance	Line	Maintenance Contractor, Quality Checks, network and equipment replacement etc.
			points	leakage / blockage reporting and identification, Etc.
12	Recycled Water Supply	Pipeline network	Line	Nos, Type of material, Diameter, level (City, Sector, Village or layer 2/3),
		Pumping Stations	polygon	Nos, Types of Pumps, Nos of Pumps, Date of Commissioning, Feeding to Sectors, Feeding to areas, No of Bulk or retail consumer etc.
		UGR / OHT	polygon	Nos, Type, Capacity
		Valves	points	Nos, Type, Material, Direction
		Construction Update	Line	Phase, Level, Consultant, Contractor, Date of LoA, Targeted Date of Completion, Excavation/Laying of

S. No.	Group	Layer	Layer Type	Attribute
				pipeline/Pipe dia. /pipe material/class of pipe (pressure rating)/Sluice valves/ scour valve/ butterfly valve/Air valve/Electromechanically water meter/house water meters/ fittings/ Thrust Blocks/ Testing commissioning/Back filling.
		Maintenance	Line	Maintenance Contractor, Quality Checks, network and equipment replacement etc.
			Points	leakage reporting and identification, Etc.
13	Drainage	Network	polygon	Type(Natural / Man made), On ground, or underground, Size, Area, Invert Level, Catchment area, Capacity Type of Construction, Etc.
		Structures	Polygon	Type of Structure, Etc.
14	Electrification	Duct	Polygon	
		Network	Lines	
		Sub-Station	Polygons	
		RMU's	Polygons	
		Street Lights	points	
		Construction Update	Line	
			Points	
		Maintenance	Line	
points				
15	Surveillance	Cameras	points	Nos, type, Location, Angle Etc.
		Network	Line	Nos, Type of Duct, Level of Duct, Capacity available, Capacity utilized/ consumed
		Access Points	points	Nos, Device Type, No of Access available, Type of Access available
16	Telecom	Network		Nos, Type of Duct, Level of Duct, Capacity available, Capacity utilized/ consumed
		Exchange/ Tower Locations		Nos, Type of Exchange, GBT / BTS, No of connection / sharing available and consumed, Type of connection / sharing available
17	Plantation/ landscaping	Road Side	polygon	Nos, Location, Area, Type, Type of Plantation, Level(City, Sector, Neighborhood), Maintained By, Contract Starting / Ending Date Etc.
		Median	polygon	Nos, Location, Area, Type, Type of Plantation, Level(City, Sector, Neighborhood), Maintained By,

S. No.	Group	Layer	Layer Type	Attribute
				Contract Starting / Ending Date Etc.
		Islands	polygon	Nos, Location, Area, Type, Type of Plantation, Level(City, Sector, Neighborhood), Maintained By, Contract Starting / Ending Date Etc.
		Block plantation	polygon	Nos, Location, Area, Type, Type of Plantation, Level(City, Sector, Neighborhood), Maintained By, Contract Starting / Ending Date Etc.
		Parks and playgrounds	polygon	Nos, Location, Area, Type, Type of Plantation, Level(City, Sector, Neighborhood), Maintained By, Contract Starting / Ending Date Etc.
		Ceremonial Landscape	polygon	Nos, Location, Area, Type, Type of Plantation, Level(City, Sector, Neighborhood), Maintained By, Contract Starting / Ending Date Etc.
		Ceremonial Grounds	polygon	Nos, Location, Area, Type, Type of Plantation, Level(City, Sector, Neighborhood), Maintained By, Contract Starting / Ending Date Etc.
18	Public Utility	Parking Lots	points	
		Toilets / drinking water taps	points	
		Auto Repair and maintenance	points	
		Medical Store	points	
		Fire Station	points	
		Emergency Care / Hospitals	points	
		police booths	points	
		Police Stations	points	
		Police Station Jurisdictions	Polygon	
		Schools / colleges	Points	
		Vegetable /	Points	

S. No.	Group	Layer	Layer Type	Attribute
		Fish Markets		
		Restaurants	Points	
		Food Joints / Kiosks	Points	
		mobile Food Joints	Points	
		Mobile Vendors	Points	
		ATM	Points	
		Banks	Points	
		Government Offices	Points	
		Milk booths	Points	
		Daily Needs	Points	
		Post office	Points	
		Gardens, Parks, Play Grounds	Points	
		Tourist destinations	Points	
		Bus Stops	Points	
		cremation/ burial ground	point	

14. Annexure VII- Smart City-Design Consideration

14.1. Key Design Considerations

Key design considerations taken into account are as follows –

- System is Designed for Projected Population of 5.6 Lakhs by 2031
- Designed for 24x7 online availability of application.
- Scalable solution on open protocols
- No propriety devices/ applications
- API based architecture for Integration with other web applications and Mobile applications

The key guiding principles considered for building the integrated Smart Governance solution are the following:

- **Transformational nature of Smart City applications** - Instead of imitating paper process in electronic form, applications should look to fully embrace mobile adoption, digital signature, online authentication, etc. to transform the processes completely and offer wider choice and no/low touch point for residents to interact directly. It is critical that project design are aligned to larger trends and designed for next decade rather than past.
- **Continuous adoption of rapidly evolving Technology** - Technology evolves too fast and Government projects similar to Smart City with its long procurement cycles do not align naturally to adapt to this trend. Also, any changes to existing implementations require contract changes, new RFP (Request for Proposal), etc. Hence the entire system would be built to be open (standards, open API, plug-n-play capabilities), components coupled loosely to allow changes in sub-system level without affecting other parts, architected to work completely within a heterogeneous compute, storage, and multi-vendor environment.
- **Selection of best solution at best rate as and when required** - Large integrated systems of Smart City operations should be designed to get best cost and performance advantages of natural technology curve (constant increase of speed and decrease of cost) and still aligned to open procurement practices of the Government. For this to happen, architecture should be open and vendor neutral, use commodity hardware, and designed for horizontal scale. This allows buying of commodity compute, storage, etc. only when needed at best price.
- **Distributed Access and Multi-channel service delivery** -With high penetration of mobile devices and very large percentage of internet usage using mobile devices, it is imperative that the Smart City applications provide multiple channels of service delivery to its stakeholders. An important consideration is that the access devices and their screen capabilities (including browser variations) are numerous and constantly evolve. Hence, it is imperative to design the system such that the ecosystem of Smart City-integrated mobile apps also evolves.
- **Security and privacy of data** - Security and privacy of data within the integrated Smart City system will be foundational keeping in view of the sensitivity of data and critical nature of the infrastructure envisioned to be built for Smart City operations. Security and privacy of data should be fundamental

in design of the system without sacrificing utility of the system. When creating a system of this scale, it is imperative that handling of the sensitivity and criticality of data are not afterthoughts, but designed into the strategy of the system from day one.

- **Provision of a Sustainable, Scalable Solution-** The motive of the technological enhancements to provide a system that would be sustainable for the next few years. The expectation is that the system should sustain at least 7 years from GO-Live. The solution would be done keeping in mind the scalability of the system. The simplified procurement processes and ease of compliance is expected to lead to huge growth in contract's base. Every component of NRDA system needs to scale horizontally to very large volume of data.

The Application Software will have the capability to scale up to tomorrow's requirements like given below:

- Managing the entire Property Life Cycle (Data Collaboration between various govt. departmental systems)
- Maintaining Information on Citizen Life Cycle (Right from Birth to Marriage, Health, Education, Driving License, Interactions with NRDA)
- **API Approach-** NRDA has decided to adopt Open API as the guiding paradigm to achieve the above goals. Though NRDA system would develop a portal but that would not be the only way for interacting with the NRDA system as the stakeholders via his choice of third party applications, which will provide all user interfaces and convenience via desktop, mobile, other interfaces, will be able to interact with the NRDA system. These applications will connect with the NRDA system via secure NRDA system APIs. This architectural approach has been taken as the UI based integration through a ubiquitous web portal requires manual interaction and does not fit most consumption scenarios. The following benefits are envisaged from API based integration,
 - Consumption across technologies and platforms(mobile, tablets, desktops, etc.) based on the individual requirements
 - Automated upload and download of data
 - Ability to adapt to changing taxation and other business rules and end user usage models
 - Integration with customer software (GIS, Accounting systems).
- **Business Rule Driven Approach-**All configurations including policy decisions, business parameters, rules, etc. shall be captured in a central place within the system. The system shall provide facility to the decision makers to add new or edit/delete existing policies or make changes with appropriate permission control and audit trace. Managing these in a central repository ensures only once source of truth is used across many application servers and reduces issues of inconsistent application behaviour. Decoupling of the business parameters/rules/master data from the rest of the solution architecture and making them configurable allows for a great deal of flexibility.
- **Data Distribution Service-**As a future roadmap it is envisaged that the functionalities provided by the NRDA Smart City system should be available as services that could be offered to other stakeholders on request. Keeping this in mind the system shall be able to provide data on subscription-publication basis. The organization of the information exchange between modules is fundamental to publish-subscribe (PS) systems. The PS model connects anonymous information producers (publishers) with information consumers (subscribers). The overall distributed application (the PS system) is composed of processes. The goal of the DDS architecture is to facilitate efficient distribution of data in a distributed system. Participant using DDS can 'read' or 'write' data

efficiently and naturally with a typed interface. Underneath, the DDS middleware will distribute the data so that each reading participant can access the ‘most current’ values.

14.2. Guiding Architecture Principle

The IT architecture principles defined in this section are the underlying general rules and guidelines that will drive the subsequent development, use and maintenance of architectural standards, frameworks and future state target architecture.

NRDA system will be built on the following core principles:

14.2.1 Platform Approach

It is critical that a platform based approach is taken for any large scale application development, to ensure adequate focus and resources on issues related to scalability, security and data management. Building an application platform with reusable components or frameworks across the application suite provides a mechanism to abstract all necessary common features into a single layer. Hence the NRDA system is envisaged as a faceless system with 100% API driven architecture at the core of it. NRDA portal will be one such application on top of these APIs, rather than being fused into the platform as a monolithic system.

Open APIs designed to be used form the core design mechanism to ensure openness, multi-user ecosystem, specific vendor/system independence, and most importantly providing tax payers and other ecosystem players with choice of using innovative applications on various devices (mobile, tablet, etc.) that are built on top of these APIs.

14.2.2 Openness

Adoption of open API, open standards and wherever prudent open source products are of paramount importance for the system. This will ensure the system to be lightweight, scalable and secure. Openness comes from use of open standards and creating vendor neutral APIs and interfaces for all components. All the APIs will be stateless. Data access must be always through APIs, no application will access data directly from the storage layer or data access layer. For every internal data access also (access between various modules) there will be APIs and no direct access will be there.

14.2.3 Data as an enterprise asset

Information is a high value asset to be leveraged across the organization to improve performance and decision making. Accurate information would ensure effective decision making and improved performance

Effective and careful data management is of high importance and top priority should be placed on ensuring where data resides, that its accuracy can be relied upon, and it can be obtained when and where needed.

14.2.4 Performance

A best of breed solution using the leading technologies of the domain should be proposed in the solution ensuring the highest levels of performance. It will also ensure that the performance of various modules should be independent of each other to enhance the overall performance and also in case of disaster, performance of one module should not impact the performance other modules.

The solution should be designed in a manner that the following can be achieved:

- Modular design to distribute the appropriate system functions on web and app server
- Increase in-memory Operations (use static operations)
- Reduce number of I/O operations and N/w calls using selective caching
- Dedicated schemas for each function making them independent and avoiding delays due to other function accessing the same schema.
- Solution should provide measurable and acceptable performance requirements for users, for different connectivity bandwidths.
- The solution should provide optimal and high performance Portal Solution satisfying response time for slow Internet connections and different browsers.

14.2.5 Scalability

The component in the architecture will be capable of being scaled up to more user requests or handling more no. of input resources in various modules. Even inclusion of additional application functionalities can be catered to by upgrading the software editions with minimal effort.

The design of the system to consider future proofing the systems for volume handling requirements

- The application functions to be divided logically and developed as Modular solution.
- The system should be able to scale horizontally & vertically.
- **User Base** - Must support Ten Thousand users (knowledge workers) with projected growth of 10 %/year. Concurrent users at peak time may be assumed to be at 20 Internal and 2000 external concurrent users. The design of the Solution should be scalable to handle increasing number of users.
- **Data Volume**- Ability to support 20 % projected volume growth in content post system implementation & content migration.
- **Functionality** – Ability to extend functionality of the solution without significant impact to the existing functional components and infrastructure.
- **Loose coupling through layered modular design and messaging** - The architecture would promote modular design and layered approach with clear division of responsibility and separation of concerns at the data storage, service and integration layer in order to achieve desired interoperability without any affinity to platforms, programming languages and network technologies. The architecture has to be scalable, maintainable and flexible for modular expansion as more citizen and business services are provided through the Smart City system. Each of the logical layers would be loosely coupled with its adjacent layers
- **Data partitioning and parallel processing** - Smart City system functionality naturally lends itself for massive parallel and distributed system. For linear scaling, it is essential that entire system is architected to work in parallel within and across machines with appropriate data and system partitioning. Choice of appropriate data sources such as RDBMS, Hadoop, NoSQL data stores, distributed file systems; etc. must be made to ensure there is absolutely no “single point of bottleneck” in the entire system including at the database and system level to scale linearly using commodity hardware.
- **Horizontal scale for compute, Network and storage** – Smart City system architecture must be such that all components including compute, network and storage must scale horizontally to ensure that

additional resources (compute, storage, network etc.) can be added as and when needed to achieve required scale.

14.2.6 No Vendor lock-in and Replace-ability

Specific OEM products may only be used when necessary to achieve scale, performance and reliability. Every such OEM component/service/product/framework/MSI pre-existing product or work must be wrapped in a vendor neutral API so that at any time the OEM product can be replaced without affecting rest of the system. In addition, there must be at least 2 independent OEM products available using same standard before it can be used to ensure system is not locked in to single vendor implementation.

14.2.7 Security

The security services will cover the user profile management, authentication and authorization aspects of security control. This service run across all the layers since service components from different layers will interact with the security components. All public contents should be made available to all users without authentication. The service will authenticate users and allows access to other features of the envisaged application for which the user is entitled to.

The system should be designed to provide the appropriate security levels commiserate with the domain of operation. Also the system will ensure data confidentiality and data integrity.

The application system should have the following

- A secure solution should be provided at the hardware infrastructure level, software level, and access level.
- Authentication, Authorization & Access Control: 3 factors (User ID & Password, Biometric, and Digital Signature) security mechanisms should be implemented to enable secure login and authorized access to portal information and services.
- Encryption Confidentiality of sensitive information and data of users and portal information should be ensured.
- Appropriate mechanisms, protocols, and algorithms necessary to protect sensitive and confirmation data and information both during communication and storage should be implemented.
- Data security policies and standards to be developed and adopted across the Smart City departments and systems
- In order to adequately provide access to secured information, security needs must be identified and developed at the data level. Database design must consider and incorporate data integrity requirements.
- Role based access for all the stake holders envisaged to access and use the system
- Appropriate authentication mechanism adhering to industry good practice of Password Policies etc.
- Ability to adopt other authentication mechanism such as Electronic Signature Certificates
- Authorization validity to be ensured for the users providing the Data to the system. Data should be accepted only from the entity authorized
- Data should be visible only to the authorized entity

- Audit trails and Audit logging mechanism to be built in the system to ensure that user action can be established and can be investigated if any can be aided (e.g. Logging of IP Address etc.)
- Data alterations etc. through unauthorized channel should be prevented.
- Industry good practice for coding of application so as to ensure sustenance to the Application Vulnerability Assessment

System must implement various measures to achieve this including mechanisms to ensure security of procurement data, spanning from strong end-to-end encryption of sensitive data, use of strong PKI national standards encryption, use of HSM (Hardware Security Module) appliances, physical security, access control, network security, stringent audit mechanism, 24x7 monitoring, and measures such as data partitioning and data encryption.

Activities such as anti-spoofing (no one should be able to masquerade for inappropriate access), anti-sniffing (no one should be able to get data and interpret it), anti-tampering (no one should be able to put/change data which was not meant to be put/changed) should be taken care for data in transit, as well as data at rest, from internal and external threats.

14.2.8 User Interface

The architecture and application solutions to be designed should promote simplicity and ease of use to the end users while still meeting business requirements. It should provide a simpler and more cost-effective solution. Reduces development time and makes the solution easier to maintain when changes in requirements occur.

This will be accomplished by the implementation of rich User Interfaces along with its integration with the DMS, Relational Data Store, Messaging and other external applications.

- Efficient and layout design are the key considerations that enhance usability which should be factored in while designing the application. Standard and consistent usability criteria must be defined. An intuitive, user friendly, well-articulated navigation method for the applications greatly enhances the usability of the application.
- Effective information dissemination
- Enhanced functionalities including personalized delivery of content, collaboration and enriching GUI features
- The load time for all web page user interfaces must satisfy both the following response time targets on 1 mbps connection:
 - 3 sec for welcome page
 - 5 sec for static pages
 - 10 sec for dynamic pages
- Ability to perform a simple search within 10 seconds on 1 mbps connectivity and a complex search (combining four terms) within 15 seconds regardless of the storage capacity or number of files and records on the system.
- Mobile Application Platform
 - Applications and services including all appropriate channels such as SMS/USSD/IVRS and development of corresponding mobile applications to the applications and services leveraging the Mobile Service Delivery Gateway (MSDG) and Mobile App Store.

- Application platform should support the following smart phone mobile OS (Android 4.0 and above, iOS 4, 5 and above, Windows Phone OS 8.0 and above, Mobile Web App)
- Support the target packaging components like (Mobile Website, Hybrid App, Native App, Web App and Application Development, Eclipse tooling platforms)
- Support the ability to write code once and deploy on multiple mobile operating systems
- Support integration with native device API
- Support utilization of all native device features
- Support development of applications in a common programming language
- Support integration with mobile vendor SDKs for app development and testing
- Support HTML5, CSS3, JS features for smartphone devices
- Support common protocol adapters for connection to back office systems (i.e. HTTP, HTTPS, SOAP, XML for format)
- Support JSON to XML or provide XHTML message transformations
- Support multi-lingual and language internalization
- Support encrypted messaging between server and client components

14.2.9 Reliability

This is a very crucial system and data are of high sensitivity, the data transfer and data management should be reliable to keep the confidence of the stakeholders. The system should have appropriate measures to ensure processing reliability for the data received or accessed through the application.

It may be necessary to mainly ensure the following

- Prevent processing of duplicate incoming files/data
- Unauthorized alteration to the Data uploaded in the NRDA system should be prevented
- Ensure minimum data loss(expected zero data loss)

14.2.10 Manageability

It is essential that the application architecture handles different failures properly; be it a hardware failure, network outage, or software crashes. The system must be resilient to failures and have the ability to restart, and make human intervention minimal.

All layers of the system such as application, infrastructure must be managed through automation and proactive alerting rather than using 100's of people manually managing.

The entire application must be architected in such a way that every component of the system is monitored in a non-intrusive fashion (without affecting the performance or functionality of that component) and business metrics are published in a near real-time fashion. This allows data centre operators to be alerted proactively in the event of system issues and highlight these issues on a Network Operations Centre (NoC) at a granular level. The solution should be envisaged to utilize various tools and technologies for management and monitoring services. There should be management and monitoring tools to maintain the SLAs.

14.2.11 Availability

The solution design and deployment architecture will ensure that the application can be deployed in a centralized environment offering system High Availability and failover.

The solution should meet the following availability requirements

- Load Balanced across two or more Web Server avoiding single point of failure
- Deployment of multiple application instances should be possible
- Distributed or load balanced implementation of application to ensure that availability of services is not compromised at any failure instance.
- Network, DC, DR should be available 99.99 % time.

14.2.12 SLA driven solution

Data from connected smart devices to be readily available (real-time), aggregated, classified and stored, so as not to delay the business processes of monitoring and decision making, and will enable appropriate timely sharing across the Smart City organization.

Readily available and consumed device data will facilitate timely access of analytics reports at every level and department of the Smart City and provide timely analysis of data as well as monitoring of KPIs through SLAs resulting in effective service delivery and improved decision making.

14.2.13 Reconstruction of truth

System should not allow database/system administrators to make any changes to data. It should ensure that the data and file (data at rest) that is kept in the systems has tamper resistance capacity and source of truth (original data of invoices and final returns) could be used to reconstruct derived data such as ledgers and system generated returns. System should be able to detect any data tampering through matching of hash value and should be able to reconstruct the truth.

- Services/solutions should be flexible and extensible to respond to, accommodate and adapt to changing business needs and unanticipated requirements easily. Consolidate and simplify technology applications wherever possible to minimize complexity. Ongoing application, database and server consolidation may be required.
- Software should use meta-data to configure itself (using declarations rather than coding).
- Avoid proprietary solutions and technologies if possible. Consider adhering to latest industry best practices and technical standards.
- The infrastructure should support an environment that allows applications to start small, grow quickly, and operate inexpensively. An adaptable infrastructure provides the capability to add to the current infrastructure with minimum inconvenience to the user.
- The IT architecture should be designed to support the overall SLA requirements around scalability, availability and performance.
- Each application should be performance tested to identify performance issues. The potential performance bottlenecks need to be identified and cost-effective paths for performance improvements should be provided for these identified problem areas.

- The system infrastructure should be architected considering failover requirements and should ensure that a single server or network link failure does not bring down the entire system.
- The system should be reliable handling every request and yield a response. It should handle error and exception conditions effectively

14.3. Integration Architecture

This section recommends the proposed integration architecture aligning with the overarching architectural principles.

The following are the integration specifications for the various integration scenarios -

Real-time integration

All the Smart City applications will be deployed in the Data Center while any external application of the Smart City ecosystem will reside in outside premises.

The need for a Service Oriented Architecture (SOA) is felt that will facilitate NRDA in defining an enterprise integration platform. An SOA platform will help in data exchange across applications in real-time mode (both synchronous and asynchronous), promote loose coupling with ease of maintenance and change, facilitate rapid composition of complex services, achieve scalability through modularity, and improved business visibility.

SOA is an architectural style that allows the integration of heterogeneous applications & users into flexible service delivery architecture. Discrete business functions contained in enterprise applications could be organized as layers of interoperable, standards-based shared "services" that can be combined, reused, discovered and leveraged by other applications and processes.

The proposed middleware based Service Oriented Architecture (SOA) is depicted below. All real-time data integration across the enterprise applications will be through middleware based enterprise integration platform.

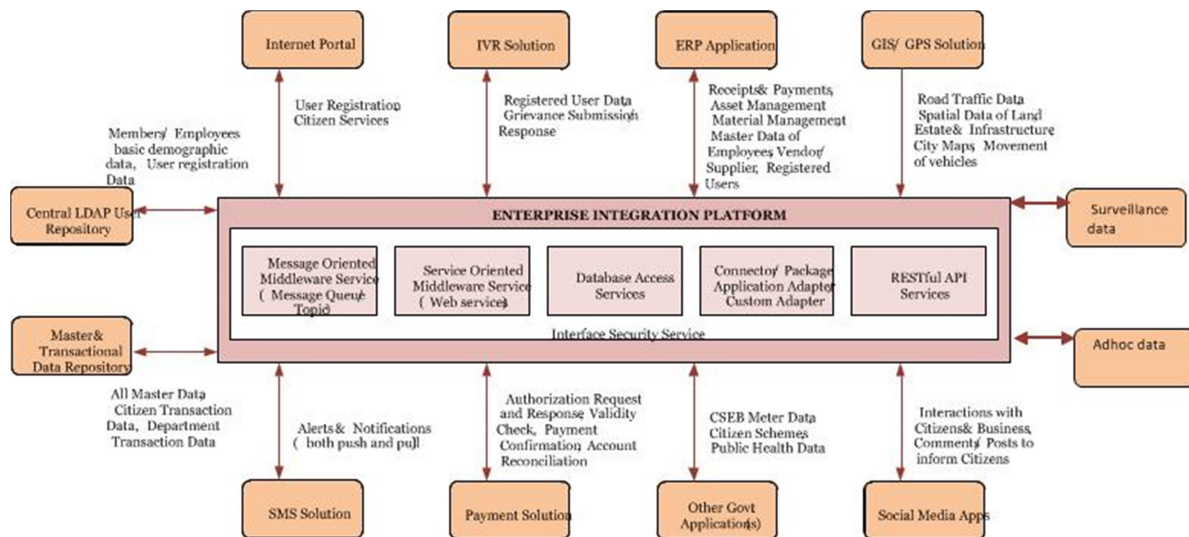


Figure 1: Integration Framework

The following are the various integration modes and techniques that could be leveraged -

- SOAP web service based interfacing technique will be leveraged as the real-time point to point synchronous integration mode with external or third party systems. The following integration points could be considered for SOAP web service based interfacing -
 - Payment gateway of the authorized banks to enable authorized users make financial transactions for the Smart City services availed by them. This should support a unified interface to integrate with all Payment Service Providers using web services over secured protocols.
 - SMS application, acting as the SMS Gateway, will make use of Java Communication APIs for SMS communication to GSM network using the GSM modem, which can be both event-driven as well as time-driven. The API will be exposed to initiate the broadcasting or alert notification.
 - Social Media Apps and NoSQL data stores to exchange photos, videos and message feeds, based on interactions with Citizens and Business as well as comments/posts to inform stakeholders
 - IVR/Customer Support solution with ERP and Transactional Data Repository to exchange citizen and business demographic, registration and payment data as well as transactional data related to citizen services and municipal operations.
 - GIS/GPS solution with traffic management, surveillance and land & estate management applications to capture the data pertaining to location traces left by GPS-enabled smartphones and Wi-Fi network logins, road traffic condition, movement of vehicles and spatial data of land, estate and Smart City infrastructure.
- Message based interfacing technique will be leveraged for real-time asynchronous integration mode. The following integration points could be considered for message based interfacing -
 - Central LDAP with ERP to synchronize member and employee user registration data
 - Payment solution and ERP to exchange payment data for tracking of beneficiary's payment transactions against different services (citizen, workers, transporter, vendor), master data (employee, vendor/supplier, location, facilities, price table)
 - Employee attendance data with ERP (HR Module) to capture data pertaining to employee location and attendance
 - Departmental applications with ERP (Asset Management module) to exchange data for procurement and maintenance of any assets or infrastructure items for each department.
 - Municipal operations application with ERP (Material Management module) to capture materials related transaction and inventory data for public works
 - Other government applications with Smart City application to exchange data for government procurement, public health schemes, welfare schemes, citizen health and CSEB meters.
- RESTful API service based interfacing technique will be leveraged for the following integration areas-
 - Access and use of various services provided by the different departments for citizens and business community will be done through a RESTful, stateless API layer.
 - Access and use of various internal functions related to operations and administration of Smart City for departmental and NRDA employees will be done through a RESTful, stateless API layer
- Data integration in batch mode will be through ETL. The following integration points could be considered for ETL based data integration -

- Initial data migration to cleanse, validate and load the data extracted from source systems into target tables
- Data load from all the individual transactional systems like ERP, Grievance Redressal to central enterprise data warehouse solution for aggregation, mining, dashboard reporting and analytics.

Process Integration layer of the NRDA solution will automate complex business processes or provide unified access to information that is scattered across many systems. Process Integration will provide a clean separation between the definition of the process in the process model, the execution of the process in the process manager, and the implementation of the individual functions in the applications. This separation will allow the application functions to be reused in many different processes.

An enterprise service bus (ESB) is a software architecture model used for designing and implementing the interaction and communication between mutually interacting software applications in Service Oriented Architecture. As software architecture model for distributed computing it is a variant of the more general client server software architecture model and promotes strictly asynchronous message oriented design for communication and interaction between applications. Its primary use is in Enterprise Application Integration of heterogeneous and complex landscapes. Following are the requirement for an ESB system:

- The solution should support static/deterministic routing, content-based routing, rules-based routing, and policy-based routing, as applicable in various business cases.
- The solution should have capabilities to receive input message in heterogeneous formats from various different systems, interpret those messages, process and transform those messages to generate output and feed them to various different clients as per formats applicable.
 - The solution should have features to communicate across different services, process them and expose as single aggregate service to facilitate business functionality
 - ESB should support SOA standards such as XML, XSLT, BPEL, web services standards and messaging standards.
 - ESB should support all industry standards interfaces for interoperability between different systems
 - ESB should support the following integration security standards:
 - Authentication
 - Authorization
 - Encryption
 - Secure Conversation
 - Non-repudiation
 - XML Firewalls
 - Security standards support
 - WS-Security 1.1
 - WS-Trust 1.3
 - WS-Secure Conversations 1.3
 - WS-Basic Security Profile
 - The solution should support routing to all internal & external systems.
 - The solution should have comprehensive auditing capabilities to support any internal or external audits.

- The solution should provide configurable logging feature for supporting error handling.
- The solution should include feature of service registry for managing all services.
- The solution should support Business Activity Monitoring. One should be able to do a real time analysis of the data flowing within the ESB. One should be also able to monitor Key Performance Indicators.
- The solution should be able to interoperate and connect with applications deployed on a number of platforms including, AIX, HP-UX, Sun Solaris, Windows, Linux etc.
- The solution should support a whole suite of adapters such as Data Handler for XML, Exchange, Lotus Domino, industry standard packaged solutions etc.
- The solution should support various messaging patterns e.g. synchronous, asynchronous, pub/sub, multicast, etc.
- The solution should support SQL access to relational databases. Integration capabilities with NoSQL databases would be also advised.
- The proposed ESB should support Time Control and Notification for messaging
- The ESB should have an capabilities of Routing, Enrichment, Update, Transformation Processing
- The ESB should support for Message Expiry configuration

There are four integration gateways envisaged as part of the solution design. The key requirements with respect to each of these are mentioned below:

SMS Gateway: SMS services are envisaged to be made available as part of the solution design. The service provider may integrate the solution with MSDG, and use the services available through it, or deploy its own SMS Gateway services at no extra charge to NRDA, but it is a mandatory requirement that all the SMS based services (alerts and notifications) should be available as part of the solution. Following are some of the key requirements for the SMS services through the solution:

- Should contain required details/information and targeted to the applicant or designated officers of tax departments and other stakeholders and users as per prevailing TRAI norms
- Facilitate access through access codes for different types of services
- Support automated alerts that allows to set up triggers that will automatically send out reminders
- Provide provision for International SMS
- Provide provision to receive messages directly from users
- Provide provision for personalized priority messages
- Resend the SMS in case of failure of the message
- Provide messaging templates

Email Services: Email services are envisaged to be made available as part of the solution design to send alerts/intimations/automated messages to registered email ids, based on preferences set up/opted by individual users. An authenticated SMTP mail service (also known as a SMTP relay or smart host) is envisaged to be integrated with the solution for sending mail from the solution, and delivered to intended inbox. Support antispam features.

Payment Gateway: The solution is envisaged to have integration with payment gateways, to enable authorized Users make financial transactions, as per rights and privileges provided to him/her. The service provider is

required to make the provisions for integration with such third party gateways and provide payment services, as per requirement of the NRDA. Some of the key features of payment gateway are mentioned below:

- Should support secure integration with Payment Service Providers
- Should support a unified interface to integrate with all Payment Service Providers
- Should support integration with Payment Service Providers using web services and over HTTP/S protocol
- Should manage messages exchange between UI and payment service providers
- Should support beneficiary's payment transactions tracking against various services
- Should support bank accounts reconciliation
- Should provide logs for all transactions performed through the Payment Gateway for future financial dispute resolution that might arise between entities and either beneficiaries or Payment Service Providers
- Should maintain and keep transactions logs for time period required and specified by the financial regulations followed in country
- Should support redundant Payment Discovery
- Should submit Periodic Reconciliation Report to government entities
- Should support transaction reports to monitor and track payments
- Should support real-time online credit card authorization for merchants
- Should support compliance with emerging trends and multiple payment options such debit card, credit card, cash cards and other payment gateways
- Should provide fraud screening features
- Should support browser based remote administration
- Should support multicurrency processing and settlement directly to merchant account
- Should support processing of one-time or recurring transactions using tokenization
- Should support real time integration with SMS and emails

IVR Services: IVR services are envisaged as part of Call Centre facility, which will be integrated with the solution, to provide information and services to the people who would contact the Call Centre: Some of the key features of the IVR services are mentioned below:

- Should provide multi-lingual content support
- Should facilitate access through access codes for different types of services
- Should support Web Service Integration
- Should support Dual Tone Multi Frequency (DTMF) using telephone touchpad - in-band and out-of-band
- Should support for Voice Extensible Markup Language (VoiceXML)
- Should support speech recognition that interprets spoken words as texts (Advanced Speech Recognition).
- Should support playing of pre-recorded sounds
- Should support redirection to human assistance, as per defined rules
- Should be able to generate Data Records – (CDRs) and have exporting capabilities to other systems
- Should provide provision for voice mailbox and voice recognition

There are multiple ways of integration of the solution with other systems is envisaged. These may be through Web Services, Message Queuing, File based or API based. The integration and data sharing mechanism may be either in Batch Mode or Needs basis (synchronous or asynchronous). Some of the key requirements of the interface/integration are mentioned below:

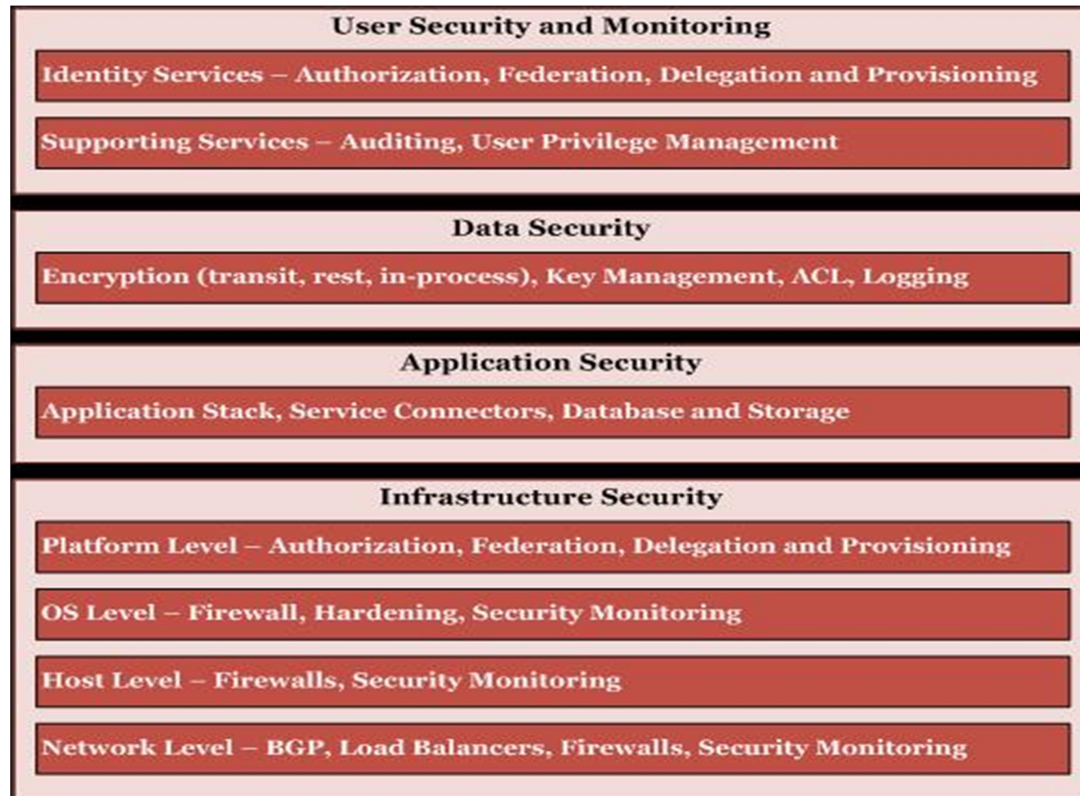
- Interface Definition
- Interface Owner

- Interface Type
 - Interface Format
 - Frequency
 - Source System
 - API/Service/Store Procedure
 - Entitlement Service
 - Consuming System
 - Interface Layout (or) Schema
- Should have provision for exceptional scenarios
 - Should have syntax details such as data type, length, mandatory/option, default values, range values etc.
 - Error code should be defined for every validation or business rule
 - Inputs and outputs should be defined
 - Should be backward compatible to earlier datasets
 - Data exchange should provide transactional assurance
 - Response time and performance characteristics should be defined for data exchange
 - The failover scenarios should be identified
 - Data exchange should be auditable

14.4. Security

Data exchange should abide by all laws on privacy and data protection Security Architecture

This section recommends the proposed security architecture aligning with the overarching architectural principles. The basic tenets of Smart City security architecture are the design controls that protect confidentiality, integrity and availability of information and services for all the stakeholders. A diagrammatic representation of the security framework for the envisaged Smart City system is provided below.



Some of the key security principles are explained below.

14.2.1 User Security and Monitoring

Authentication & Authorization

A strong authentication mechanism should be considered to protect unauthorized access to the Smart City applications. Consider use of at least two of the following forms of authentication mechanism:

- Something you know, such as a password, PIN etc
- Something you have, such as a smart card, hardware security token etc
- Something you are, such as a fingerprint, a retinal scan, or other biometric methods

Levels of Authentication

Based on the security requirements the following levels of authentication should be evaluated.

- For applications handling sensitive data it is recommended that in the least one factor authentication key in the form of a password is essential. Strong password complexity rules should be enforced to ensure confidentiality and integrity of the data
- For applications handling highly sensitive data it is recommended that two factor authentication mechanisms should be considered. The first line of defence is the password conforming to the password complexity rules'. Along with the password next user has to provide a one-time password which varies for each session. One time passwords are valid for each session and it is not vulnerable to dictionary,

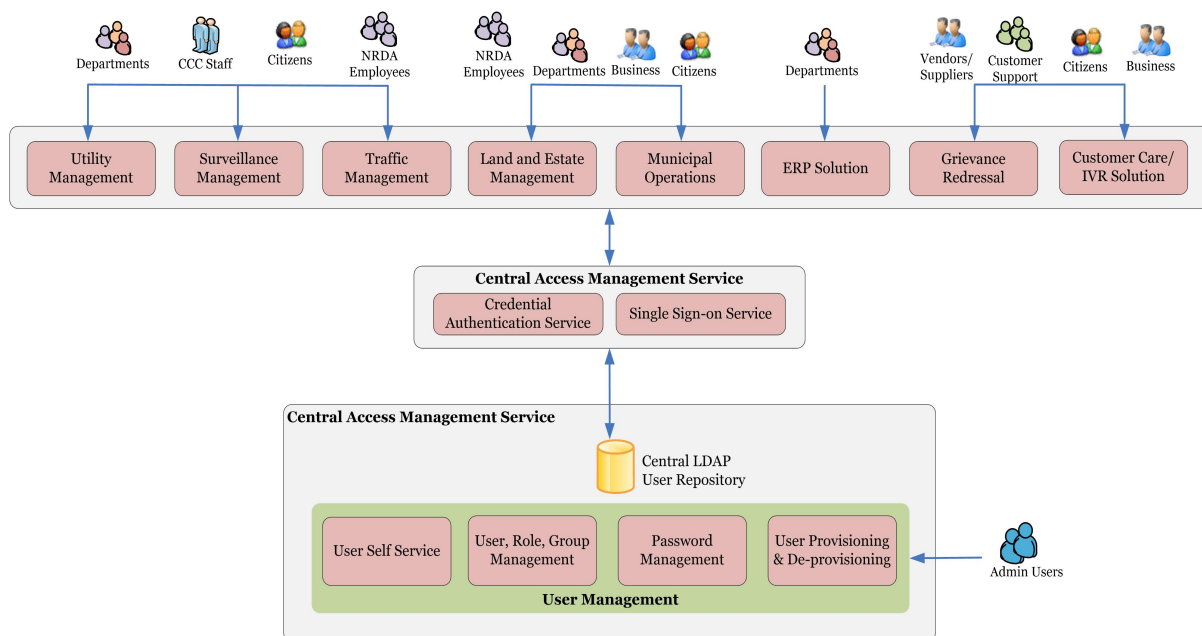
phishing, interception and lots of other attacks. A counter synchronized One-Time Password (OTP) solution could be used for this purpose.

Centralized Identity and Access Management Model

It is recommended to adopt an enterprise level centralized authentication model that is secured and ensures that user has a single credential to access the all the services.

In this model there will a centralized authentication services with provision for centralized user registration and user credential store. A centralized user repository (directory services) for the storage of user credentials will also store the authorization information for the user which will be used in different application.

The proposed centralized Identity and Access Management solution is depicted below –



Central Access Management Service

This service will provide the central authentication service for the users/groups created by verification of the user credentials against the central LDAP user repository. When a user tries to login to any centralized application e.g. single window portal, departmental sub-systems or ERP solution, the user credentials will be validated through the central authentication service.

Single Sign-On service will centrally maintain user session thus preventing user from multiple login when trying to access multiple applications.

Central Identity Management Service

This service will handle user life cycle management that will enable NRDA to manage the lifespan of the user account from its initial stage of provisioning to the end stage of de-provisioning. Typically user provisioning and de-provisioning is workflow driven that will require approval.

User management service will cover user administrative functionalities like creation, propagation and maintenance of user identity and privileges.

Self Service feature will allow end users (e.g. members) to maintain their user identity account including self-password reset which will significantly reduce helpdesk/admin effort to handle password reset requests.

The central user repository will store the user identity data and deliver it to other services (e.g. central authentication service) for credential verification. Adherence to LDAP v3 standard has been the dominant standard for central user repository

Enforce a robust and strong password policies that will allow users to change/reset password with password expiry and account lockout features, define and implement complex password rules and session timeout policies.

Authorization

Authorization of system users should be enforced by access controls. It is recommended to develop access control lists. Consider the following approach for developing access control list -

- Establish groups of users based on similar functions and similar access privilege.
- Identify the owner of each group
- Establish the degree of access to be provided to each group

14.2.2 Data Security

Traditional Structured Enterprise Data

NRDA should protect Integrated Smart City System information against unauthorized access, denial of service, and both intentional and accidental modification. Data security, audit controls and integrity must be ensured across the data life cycle management from creation, accessed, viewed, updated and when deleted (or inactivated). This provides a proactive way to build defences against possible security vulnerabilities and threats, allowing errors to be corrected and system misuse to be minimized.

The implications for adhering to an effective data security and integrity guideline related to the Smart City System are the following –

- Data security policies and standards to be developed and adopted across NRDA Smart City applications and stakeholders
- Data security controls to be put in place to restrict access to enterprise data based on roles and access privileges. Data audit logs should be maintained for audit trail purposes. Security controls will be able to be reviewed or audited through some qualitative or quantitative means for traceability and to ensure that risk is being maintained at acceptable levels.

- In order to adequately provide access to secured information, security needs must be identified and developed at the data level, not the application level. Database design must consider and incorporate data integrity requirements.
- Procedures for data sharing need to be established. Data integrity during data synchronization needs to be ensured across the enterprise.
- *Audit Capabilities*: The system provides for a system-wide audit control mechanism that works in conjunction with the RDBMS.
- *Maintaining Date/Time Stamp and User Id*: Every transaction, with a date and time and User ID, is captured. The system allows generating various audit reports for verification.
- *Access Log*: The NRDA Smart City System should have extensive inbuilt security and access control mechanisms. Based on this, the system keeps track of the various functions accessed by any users.

Secure Big Data Environment

As the Integrated Smart City System will be capturing observation, interaction and monitoring data from various devices (like sensors, scanners, detectors, meters and cameras) and systems (like GIS, social media) on a real-time basis and processing them, it is imperative that the data repository will have the following characteristics - ability to handle large amounts of data, distributed redundant data storage, parallel task processing, extremely fast data insertion, extensible, centralized management and orchestration. This would necessitate considering the corresponding security concerns and countermeasures from a big data perspective.

It is essential to adhere to the following requirements for designing the big data security controls of Smart City system:

- No compromise with the basic functionality of the cluster
- Provision for scalability in line with the cluster
- No compromise with the essential big data characteristics
- Dealing with the security threat to big data environments or data stored within the cluster (refer the table below)

The key security concerns that must be addressed during design process are provided in the table below:

Technical Area	Security Concern	Description
Architecture	Distributed nodes to enable massive parallel computation	Difficulty in verifying security consistency across a highly distributed cluster of possibly heterogeneous platforms
Architecture	Replication into multiple copies and movement of big data to ensure redundancy and resiliency	Missing the centralized data security model where a single copy of data is wrapped in various protections until it is used for processing
Architecture	No built in security within big data stacks except service-level authorization and web proxy capabilities	Big data systems are built on the web services model with very few facilities to counter common web threats and hence vulnerable to well-known attacks
Operation	No built in encryption method to protect data, copied from the cluster and at rest	Provision for encryption of data at rest to guard against attempts to access data outside established application interfaces is not present with most NoSQL variants. Moreover any external encryption tool selected needs to have adequate horizontal scalability and transparency to work with big data.

Technical Area	Security Concern	Description
Operation	Lack of built-in facility to provide separation of duties between different administrators across the nodes	Each node in a big data system has at least one administrator with full access to its data. So any direct unwanted access to data files or data node processes can be addressed through a combination of access controls, separation of duties and encryption technologies, which are not available out-of-the-box for big data system.
Operation	Introduction of a corrupted node or service into a big data cluster through cloning of a node or exact replica of a client app or service	Big data system like Hadoop uses Kerberos to authenticate users and add-on services to the cluster. But a corrupt client can be inserted onto the network using credentials extracted from virtual image files or snapshots.
Operation	No built-in monitoring to detect misuse or block malicious queries	All the available external monitoring tools review data and user requests only at the API layer of the big data system

The implications for taking into consideration the above security concerns for a big data environment and the related requirements of security controls for the Smart City System are the following -

- Kerberos, already built in the Hadoop infrastructure, has to be set up for validating inter-service communication, helping to keep corrupt nodes and application out of the big data cluster, protecting web control access and making administrative functions harder to compromise.
- File layer encryption needs to be established for consistent protection from credentialed user access and multi-key support across different platforms regardless of OS/platform/storage type, while ensuring that this encryption is transparent to both Hadoop and calling applications and scales out as the cluster grows.
- Key management service needs to be leveraged to distribute keys and certificates, and manage different keys for each group, application and user in order to prevent access of encryption keys to an attacker.
- Validation process for patches, application configuration, machine images, certificates and Hadoop stack must be in place prior to deployment in a multi-node environment.
- Audit Capabilities: The system provides for a system-wide audit control mechanism that works in conjunction with the big data environment.
- Secure Communication: SSL/TLS implementation technique needs to be used for secure communication between two nodes or between a node and an application.
- Logging: Collection and management of event data through logging within the big data cluster has to be ensured in order to keep the records of activity for detecting attacks, diagnosing failures or investigating unusual behavior.

Additionally for any service based on cloud environment, there are three main security challenges namely multi-tenancy, divided responsibility and dynamic environment. In this context, one of the key concerns for the customers would be protection of sensitive/confidential/personal data through access control, encryption, integrity and origin verification.

In cloud environments, the amount of data at rest, in transit and in use is considerably larger than in traditional networks. So the following technologies should be considered to discover and remedy security vulnerabilities related to integrity protection of data to be used by the IT systems of NRDA Smart City. They can be used separately or can complement each other in achieving desired outcome.

- Symmetric cryptography: It utilizes the same shared key to encrypt plain text message from the sender and decrypt cipher text for the recipient, and thus is relatively faster in processing large volume of data.
- Public key infrastructure (PKI): It utilizes public-private key pairs to verify the integrity of data.

- Keyless Signing Infrastructure (KSI): It utilizes data hashes and hash trees for generating and publishing a root hash for the data to be integrity protected. It then verifies the data integrity using signature tokens that enable data verification using the previously published root.

KSI technology does not rely on a single key that could be breached and no key is needed to verify if data matches the root hash. Hence it provides greater efficiency in the context of big data.

Audit Trail & Audit Log

Audit trails or audit logs should be maintained. Log information is critical in identifying and tracking threats and compromises to the environment.

There are a number of devices and software that should be logged which include hardware & software based firewalls, web servers, authentication servers, central/domain controllers, database servers, mail servers, file servers, routers, DHCP servers etc.

It is essential to decide what activities and events should be logged. The events which ideally should be captured include

- Create, read, update and delete of confidential information;
- User authentication and authorization activities in the system, granting, modification or revoking of user access rights;
- Network or service configuration changes;
- Application process start up, shutdown or restart, abort, failure or abnormal terminations, failure of network services;
- Detection of suspicious activities such as from Intrusion Detection and Prevention system, anti-virus, anti-spyware systems etc.

14.2.3 Application Security

- Smart City system must comply with the Application Security Plan and security guidelines of Government of India as applicable
- Secure coding guidelines should be followed. Secure coding guidelines should include controls against SQL injection, command injection, input validation, cross site scripting, directory traversal, buffer overflows, resource exhaustion attacks etc. OWASP Top 10 standard should be mapped in the secure coding guidelines to cover all major vulnerabilities.
- Validation checks should be incorporated into the application to detect any corruption of information through processing errors or deliberate acts.
- Data output from an application should be validated to ensure that the processing of stored information is correct and appropriate to the circumstances
- Should implement secure error handling practices in the application
- Smart City system should have Role based access, encryption of user credentials. Application level security should be provided through leading practices and standards including the following:
 - Prevent SQL Injection Vulnerabilities for attack on database
 - Prevent XSS Vulnerabilities to extract user name password (Escape All Untrusted Data in HTML Contexts and Use Positive Input Validation)
 - Secure Authentication and Session Management control functionality shall be provided through a Centralize Authentication and Session Management Controls and Protect Session IDs from XSS

- Prevent Security Misconfiguration Vulnerabilities (Automated scanners shall be used for detecting missing patches, misconfigurations, use of default accounts, unnecessary services, etc. maintain Audits for updates)
- Prevent Insecure Cryptographic Storage Vulnerabilities (by encrypt off-site backups, ensure proper key storage and management to protect keys and passwords, using a strong algorithm)
- Prevent Failure to Restrict URL Access Vulnerabilities (By providing authentication and authorization for each sensitive page, use role-based authentication and authorization and make authentication and authorization policies configurable)
- Prevent Insufficient Transport Layer Protection Vulnerabilities (enable SSL for all sensitive pages, set the secure flag on all sensitive cookies and secure backend connections)
- Prevent Id Redirects and Forwards Vulnerabilities
- For effective prevention of SQL injection vulnerabilities, MSI should have monitoring feature of database activity on the network and should have reporting mechanism to restrict or allow the traffic based on defined policies.

14.2.4 Infrastructure Security

The following focused initiatives to discover and remedy security vulnerabilities of the IT systems of NRDA Smart City should be considered to proactively prevent percolation of any threat vectors -

- Deploy anti-virus software to all workstations and servers to reduce the likelihood of security threats;
- Deploy perimeter security technologies e.g. enterprise firewalls to reduce the likelihood of any security threat;
- Deploy web content filtering solutions to prevent threats from compromised websites to help identify and block potentially risky web pages;
- Install enterprise-level e-mail anti-security software to reduce vulnerability to phishing and other e-mail security spams. This would check both incoming and outgoing messages to ensure that spam messages are not being transmitted if a system becomes compromised.
- Perform periodic scanning of the network to identify system level vulnerabilities
- Establish processes for viewing logs and alerts which are critical to identify and track threats and compromises to the environment. The granularity and level of logging must be configured to meet the security management requirements.
- Deploy technology to actively monitor and manage perimeter and internal information security.
- Deploy network Intrusion Detection System (IDS) on the perimeter and key points of the network and host IDS to critical systems. Establish process to tune, update, and monitor IDS information.
- In case of cloud deployment, cloud services can be disrupted by DDoS attacks or misconfiguration errors which have the potential to cascade across the cloud and disrupt the network, systems and storage hosting the cloud application.
- Deploy security automation techniques like automatic provisioning of firewall policies, privileged accounts, DNS, application identity etc.

Network Security for Smart Devices

The core principles of security for any smart device network rest on the three most important data security concerns of confidentiality, integrity and authentication. Hence the security for smart device networks should primarily focus on the protection of the data itself and network connections between the nodes. From a network perspective, following are to be considered for designing the smart devices network -

- Protection of fair access to communication channels (i.e. media access control)
- Concealing of physical location of the nodes
- Defence against malicious resource consumption, denial of service, node capturing and node injection
- Provision for secure routing to guard the network from the effects of bad nodes
- Protection of the mobile code

Smart devices have a triple role in most networks - data collectors, processors and traffic forwarders for other devices in the network. The typical attacks for which countermeasures are to be defined and implemented are: Radio Jamming, Nodes Reporting Wrong Data, Data Aggregation Attacks and Battery Attacks.

The following guidelines need to be considered for security enhancement of smart devices and their networks:

- Use of IP-based network for smart devices
- Use of Link Layer Security for password-based access control and encryption
- Protection of smart devices nodes behind a firewall for carrying out SSL-based application data transfer and mechanism to avoid distributed DoS attacks
- Public-key-based authentication of individual devices to the network and provisioning them for secure communications
- Conformance of the security solution to the standards of IETF, IEC and IEEE to ensure maximum security and interoperability, with support for the following commonly used protocols at a minimum - IPSec/IKE, SSH and SSL/TLS

14.5. Software Development Lifecycle

Continuous Build

The Naya Raipur Smart City system should be highly modular and parallel development should be carried out for faster execution using industry's best Software Development Lifecycle practices. All application modules within the same technology platform should follow a standardized build and deployment process.

A dedicated 'development / customization' environment should be proposed and setup. The MSI must provision separate development and testing environment for application development and testing. Any change, modifications in any module must follow industry standard processes like change management, version control and release management in large and complex application development environment.

Application source code could be maintained in source control and could be broken up into a number of projects. Source control projects are created to abstract related set of modules or feature that can be independently included in another application.

It is a mandatory to create, update and maintain all relevant documentation throughout the contract duration. Also it should be ensured that a bug tracking tool is maintained for proper tracking of all bugs fixes as per various tests conducted on the application.

14.6. Quality Assurance

A thorough quality check is proposed for the Naya Raipur Smart City system and its modules, as per standard Software Development Life Cycle (SDLC). MSI is expected to lay down a robust Quality Assurance program for testing of the developed application for its functionality, performance and security before putting in production environment. The program must include an overall plan for testing and acceptance of system, in which specific methods and steps should be clearly indicated and approved by NRDA. MSI is required to

incorporate all suggestions / feedback provided after the elaborate testing of the system, within a pre-defined, mutually agreed timeline. MSI must undertake the following:

- Outline the methodology that will be used for testing the system.
- Define the various levels or types of testing that will be performed for system.
- Provide necessary checklist/documentation that will be required for testing the system.
- Describe any technique that will be used for testing the system.
- Describe how the testing methodology will conform to the requirements of each of the functionalities and expected outcome.
- Indicate / demonstrate to NRDA that all applications installed in the system have been tested.

14.2.1 Automated Testing

MSI is expected to perform automated testing with following features:

- Should support multi-layer test scenarios with a single solution.
- Should support and execute testing on GUI and UI-Less (standard Web Services, non-SOAP Web Services, such as REST, etc.) Components.
- Should allow version control of tests and test assets providing ability to compare versions and identify changes.
- Should allow centralized storage and management of tests and test assets including external resources used by tests.
- Should have an IDE environment for QA engineers which should be configurable.
- Should provide local system monitoring to test and validate performance issues including memory leakage, CPU overload and network overload to determine if specific business scenarios exceed desired performance thresholds.
- Should provide Auto-documentation while creating of automated tests.
- Should generate reports that can diagnose defects and can be exported to (PDF, XML , Html) (mandatory) and doc (optional) formats.
- Report with summary data, pie charts and statistics for both the current and previous runs needs to be provided.
- Should enable thorough validation of applications through a full complement of checkpoints such as GUI object, database, XML, XPath, etc.
- Should provide Unicode support for multilingual application testing.
- Should be able to record the test Execution into a video file for viewing later.
- Should provide facility to parameterize tests to generate/assign test case output values automatically during runtime.

14.2.2 Performance and Load Testing

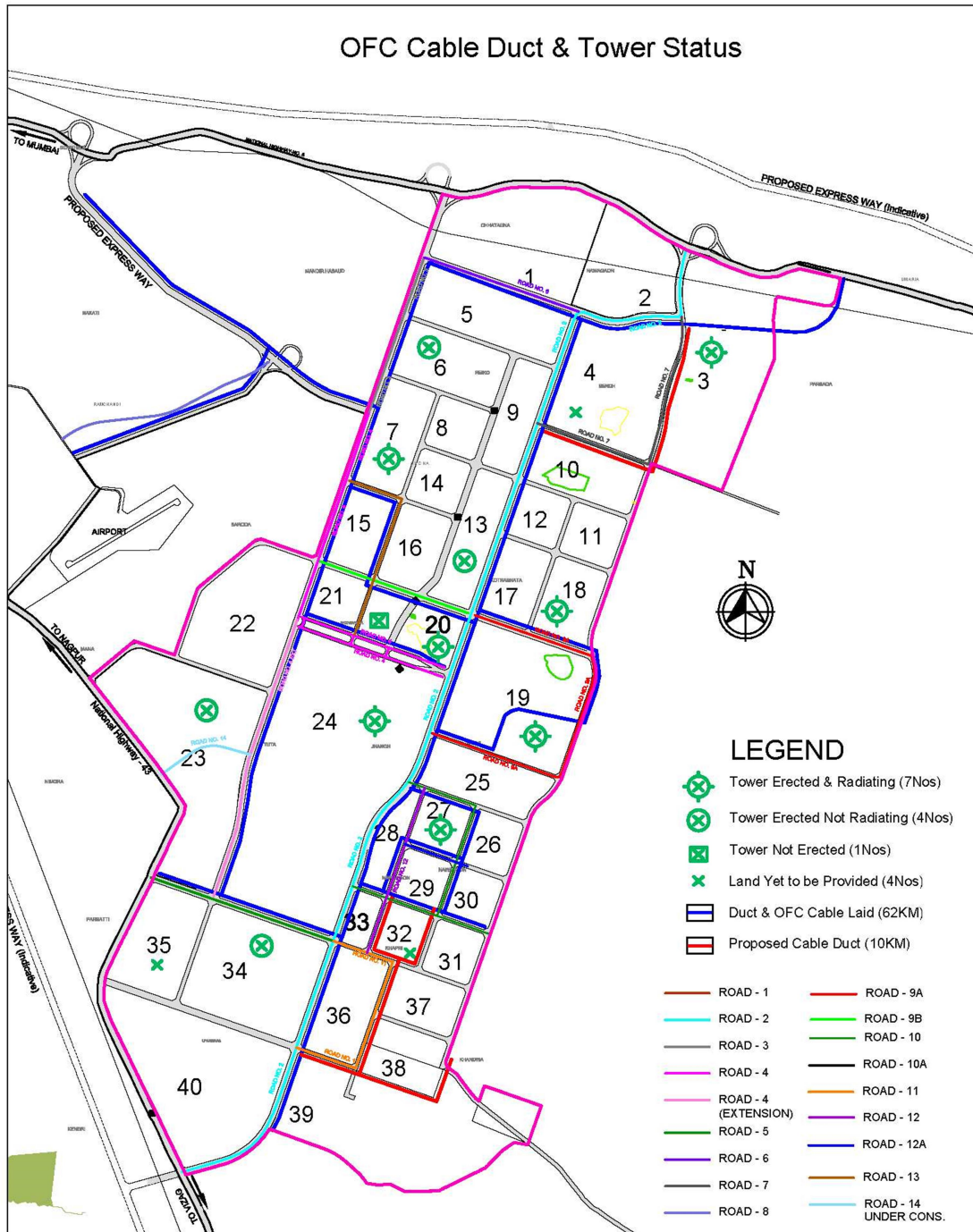
MSI is expected to implement performance and load testing with following features:

- Testing workload profiles and test scenarios based on the various functional requirements should be defined. Application as well as system resource utilization parameters that need to be monitored and captured for each run also needs to be defined.
- Should support application testing and API testing including HTTP(s), web services, mobile applications and different web 2.0 frameworks such as Ajax/Flex/HTML5.

- MSI should perform the load testing of Naya Raipur Smart City system for multiple workload profiles, multiple scenarios, and user loads to handle the envisaged users of the system.
- Different activities before load testing i.e. identification of work load profiles, scenarios, information capturing report formats, creation of testing scripts, infrastructure detailing and workload profile should be prepared before the start of actual load testing exercise.
- Solution parameters needs to be tuned based on the analysis of the load testing reports. The tuning process could be iterative until the issues are closed. Multiple load runs needs to be executed for users to simulate different scenarios, such as peak load (year end, quarter end, etc.), load generation within the LAN, Load generation across WAN or mobile network simulator while introducing configurable latency/jitter/packet loss etc.
- Should eliminate manual data manipulation and enable ease of creating data-driven tests.
- Should provide capability to emulate true concurrent transactions.
- Should identify root cause of performance issues at application or code level. Include code performance analysis to quickly pinpoint component-level bottlenecks: Slowest classes and methods, most frequently called methods, most costly (aggregate time spent for each method), response time variance etc.
- Should allow selection of different network bandwidth such as analog modems, ISDN, DSL, or custom bandwidth.
- Should be able to monitor various system components e.g. Server (OS, Web, Application & Database) Monitoring, Network (between Client & Server) Delay Monitoring, Network Devices (Firewall, Switch & Router) Monitoring during the load test without having to install any data capturing agents on the monitored servers/components
- Should correlate response times and system performance metrics to provide quick insights in to root cause of performance issues.
- Reports on following parameters (but not limited to) such as transaction response time, transaction per second (Passed), user interface rendering time, transaction per second (Failed), web transaction breakdown graphs, hits per second, throughput, HTTP responses per Second, pages downloaded per second, system infrastructure performance metrics etc.
- Should provide End-to-End system performance analysis based on defined SLAs. Should monitor resource utilization including memory leakage, CPU overload and network overload. Should have the ability to split end-to-end response time for Network & Server(s) and provide drill-down capability to identify and isolate bottlenecks.

15. Annexure VIII-Approximate Distance of Naya Raipur Assets, Proposed camera from OFC Duct and Specification of Existing Camera

Approximate Distance of Naya Raipur Asset from OFC Duct which is laid along the road network in Naya Raipur		
UGRs with Pump House (9 nos.)		
Sr no.	UGR - Sector No.	Distances (meters)
1	5	1000
2	16	430
3	17	400
4	19	210
5	21	100
6	22	1400
7	24	950
8	26	570
9	30	270
Electrical Substations (5 nos.)		
Sr. No.	Electrical SS - Sector No.	Distances (meters)
1	17	100
2	18	100
3	24	50
4	27	250
5	29	100
Bus stop/Shelters, DTs, Surveillance Camera, ANPR at city Entry Exit Point and Speed detection System		
Sr. No.	Location	Distances (meters)
1	All Location	Within 100
Note:		
<i>1. The above distances do not incorporate the standard loop lengths of all type of cables which is required for maintenance at periodic intervals.</i>		
<i>2. The above distances depict the distance of the substation/UGR/Camera from the nearby existing optical fiber duct</i>		
<i>3. The distances are approximate and subject to a variation of $\pm 15\%$ as per site condition.</i>		



Road Length in Kms. for Naya Raipur

Sr.No.	Road No.	Length(Km)	OFC Duct Status
1.	Road No. 1	6.69	Duct laid
2.	Road No. 2	16.2	Duct laid
3.	Road No. 3	2.4	Duct laid
4.	Road No. 4	5.74	Duct laid
5.	Road No. 4-Ext	4.3	Duct laid
6.	Road No. 5	2.8	Duct laid
7.	Road No. 6	2.4	Duct laid
8.	Road No. 7	4.05	Duct laid
9.	Road No. 8	3.3	Duct laid
10.	Road No. 9A	5.7	Duct laid
11.	Road No. 9B	2.4	Duct laid
12.	Road No. 10	4.1	Duct laid
13.	Road No. 11	3.5	Duct laid
14.	Road No. 12	2.6	Duct laid
15.	Road No. 13	3.0	Duct laid
16.	Road No. 14	1.4	Duct laid

Existing BRTS Camera specification

HIKVISION

DS-2CC11A2P(N)-IRT(Sample)



Key Features

- Compact design
- new generation CCD with high sensitivity
- 3D-Digital Noise Reduction (3D-DNR)
- Smart IR mode
- Min. illumination: 0.001 Lux @ F1.2 (0 Lux with IR)
- Auto white balance, auto gain control, electronic shutter control and backlight compensation
- Internal Synchronization
- Advanced Engineering Design, High Reliability
- Ingress protection: IP66

Specification

Model	DS-2CC11A2P(N)-IRT
Parameter	700 TVL CCD IR Bullet Camera
Camera	
Image Sensor	1/3" CCD
Signal System	PAL/NTSC
Effective Pixels	PAL: 976 (H) × 582 (V) NTSC: 976 (H) × 484 (V)
Min. Illumination	0.001 Lux @ (F1.2, AGC ON), 0 Lux with IR 0.003 Lux @ (F2.2, AGC ON), 0 Lux with IR
Shutter speed	PAL: 1/30 s to 1/100,000 s NTSC: 1/60 s to 1/100,000 s
Lens	3.6 mm @ F2.2 (2.8mm,6 mm optional)
	Angle of view: 72.8° (3.6 mm)
Lens Mount	M12
Day & Night	Electronic

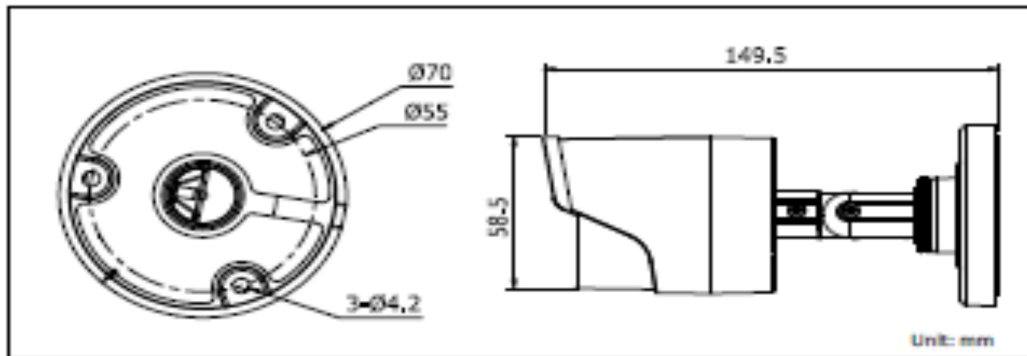
Horizontal Resolution	700 TVL
Synchronization	Internal synchronization
Video Output	1Vp-p composite output (75 Ω/BNC)
S/N Ratio	More than 62 dB
SMART IR	On
3D-DNR	On
General	
Working temperature/humidity	-30 °C - 60 °C (-22 °F - 140 °F) Humidity 90% or less (non-condensing)
Power Supply	12 V DC ± 10%
Power Consumption	Max. 3 W
Ingress protection	IP66
IR Range	Approx. 10 to 20 meters
Dimensions	Φ70×149.5mm(Φ2.76"×5.89")
Weight	360 g (0.79 lbs)

Order Models

3S-2CC11A2P-IRT

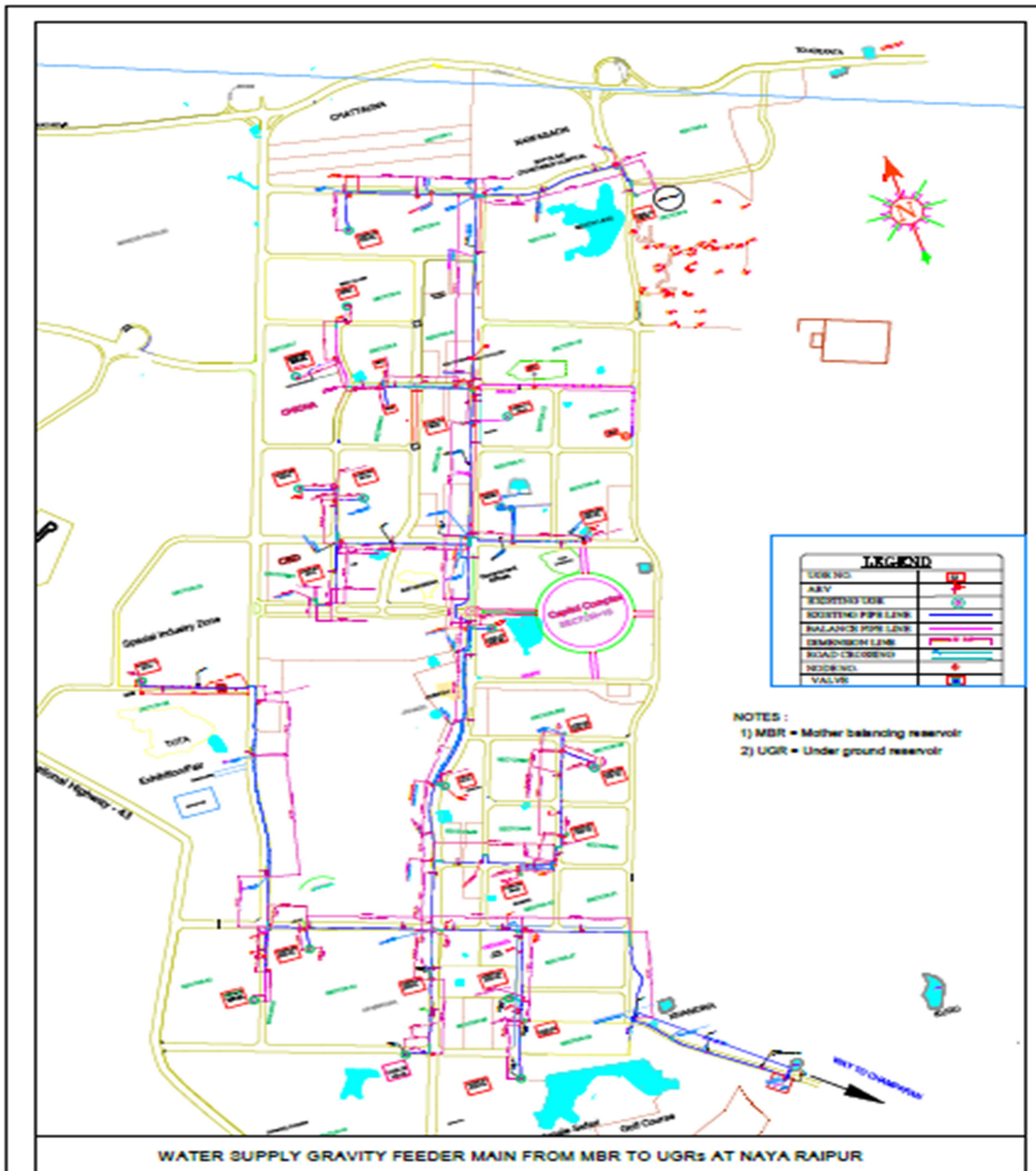
3S-2CC11A2N-IRT

Dimensions



16. Annexure IX: Water Supply, Existing & Proposed Instrumentation detail and Internal Distribution network for sector 19 and 27

16.1 Water Supply gravity feeder main from MBR to UGRs at Naya Raipur Map



16.2 Existing and Proposed Instrumentation

1. Intake Well and Raw water Pumping

1 A. Intake Well Details (EXISTING):

Sno.	Item	Description	Remarks
1	Raw Water Pumping Machinery		
	Vertical turbine pumping Sets Disharge	03 nos. (2W + 1S) Presently working 8-10 hours a day	Incoming power is stepped down to 3.3 KV by 33/3.3 KV by 2 nos. ONAN transformers. Apart from this, there are also two numbers of 3.3/0.415 KV auxiliary transformer for lighting and other relay charging, annunciation purposes. A Diesel Generator of 3.3 KV and capacity 1600 KVA is installed at the premises for backup power.
	Incoming MCC Panel	33 KV	
2	VT Motor		
	No of motors	3 nos	
	Capacity of motors	430 KW	
	Rated voltage of motors	3.3KV	
3	VT Pumps		
	Pump capacity	341 lps @ 87 mtrs	
	Indoor LT Panel	433 V, 400 A with AL Bus, 50 KA	
4	Main transformer		
	No of transformer	2 (1 working + 1 stand by)	
	Rating of transformer	33 / 3.3KV	
	Capacity of transformer	1600 KVA	
5	Auxiliary transformers		
	No of transformer	2	
	Rating of transformer	3.3 / 0.415 KV	
	Capacity of transformer	160 KVA	
6	Soft Starter		
	No of Starters	3	
	Rating of startrs	3.3 KV	

1 B. Raw Water Pumping Main Details -Length 20.875 kms(EXISTING)

Sno.	Item	Number
1	Air Release Valves	34
2	Isolation Valves	4
3	0-velocity valves	2
4	Air Cushion Valves	3

1C. Proposed Instrumentation details at Intake Well and Raw Water Pumping Main Pipeline

Sno.	Location	Description
1	Intake Well At Tila Village	All necessary instrumentation like Pressure Transmitters, motorized butterfly valves, transformer and panel health sensors, motor status indicators, level transmitter etc., communication modules, PLC/RTUs, UPS, cable, control wiring etc. - for remote monitoring and control of Intake Well through Water SCADA and as required to meet the functional requirements and SLAs of this RFP, are to be included by the bidder in his submitted quote.*
2	Raw Water Pumping Main (Length = 21 kms)	All necessary instrumentation like Electrically Actuated Valves, Pressure Transmitters, Flow meters etc., communication modules, PLC/RTUs, UPS, cable, control wiring etc. at an interval of 7 kms for NRW calculation/leak detection, remote monitoring and control through Water SCADA and as required to meet the functional requirements and SLAs of this RFP, are to be included by the bidder in his submitted quote.*
<i>*If need be the bidders are advised to visit the site to satisfy themselves before quoting the bid.</i>		

2. Water Treatment Plant

2 A. Details of Valves At Water Treatment Plant, Pacheda, Naya Raipur (Existing)

Sl no	Location	Type of valve	No of Valves	Size of Gate / Valve (in mm)	Remarks
1	Inlet	MBFV	1	1000	Actuator based
2	Distribution Cahamber	BFV	2	100 & 150	Manual
3		Drain Valve	2	200	Manual
4	Flash Mixture	Sluice Gate	3	750 X 750	Manual
5	Filter Bypass Gate	Sluice Gate	1	1050 X 1050	Manual
6	Filter House	Sluice Gate	8	400 X 400	1 for each bed actuator controlled
		Sluice Gate	8	450 x 450	1 for each bed actuator controlled
		Gate Valve	8	250	3 for each bed with actuator control
		Gate Valve	8	350	
		Gate Valve	8	400	
		Solenoid Valve	8	25	Actuator based
7	Backwash Water Pipe	BFV	1	400	Manual
8	Backwash Water Tank	BFV	1	250	With Actuator
9	CWR	Sluice Gate	4	1050 X 1050	Manual
10	Pump House	BFV	3	600	With Actuator
12	MBR	BFV	1	1000	With Actuator
		BFV	1	1000	With Actuator
		BFV	1	300	Manual

Sl no	Location	Type of valve	No of Valves	Size of Gate / Valve (in mm)	Remarks
		BFV	1	600	Manual
		BFV	1	250	Manual
13	Chemical House	BFV	2	80	Manual
		BFV	2	80	Manual
		BFV	1	100	Manual
		BFV	1	150	With Actuator
14	Backwash Sump	MBFV	2	150	Motorised
15	Chlorine Drum Shed	BFV	3	50	Manual
TOTAL NO OF VALVES			82		

2 B. Details of Flow meters And Level Sensor At Water Treatment Plant, Pacheda, Naya Raipur (Existing)

Sl no	Location	Type of Instrument	No of Flowmeters	Specifications
1	Outlet of MBR	Electromagnetic Flowmeter	1	1000 mm Dia
2	Inlet of WTP	Electromagnetic Flowmeter	1	1000 mm Dia
3	CWR	Ultrasonic Level Transmitter	1	Range - 0-5 meters
4	MBR	Ultrasonic Level Transmitter	1	Range - 0-7 meters

2 C. PROPOSED INSTRUMENTATION AT WTP

All necessary instruments, communication modules, PLC/RTUs, UPS, cable, control wiring etc. required for remote monitoring and control through Water SCADA and as required to meet the functional requirements and SLAs of this RFP, are to be included by the bidder in his submitted quote.*

**If need be the bidders are advised to visit the site to satisfy themselves before quoting the bid.*

3. Clear Water Gravity Main Pipeline

3 A. clear Water Gravity (EXISTING)

The pipe line is laid across Naya Raipur to distribute water @ city level to Underground reservoirs.

The pipe line length is 50 Km, Combining MS pipes from 1000 MM dia to 800 MM dia for length of 11 Km, and DI pipes from 700 MM dia to 100 mm dia for length of 39 Km. It comprise of Air Release Valves , Isolation valves and Branch valves at various locations

3 B. Proposed Instrumentation At Clear Water Gravity Main (Approx 50 Kms)

NO. OF INSTRUMENTATS REQUIRED FOR MONITORING AND CONTROL OF CLEAR WATER GRAVITY MAIN FROM MBR TO UGRs AT VARIOUS LOCATIONS OF NAYA RAIPUR					
Sr. no	Location	Pipe dia.(mm)	Electric Actuator	Electromagnetic flow meter	Pressure Sensors
1	MBR Outlet at WTP site	1000	1	1	1
2	Sector-37 @ East side Road	1000	1	1	1
3	Sector-37 @ near Vedanta hospital	350	1	1	1
4	Sector-34 North East corner at road no. 2	400	1	1	1
5	Sector-34 North East corner at road no. 5	350	1	1	1
6	Sector-24 South west corner	250	1	1	1
7	Sector-24 road no. 4 Ext. near the Ele. sub station	250	1	1	1
8	Sector-28 South west corner	400	1	1	1
9	Sector-30 near the pump house	300	1	1	1
10	Sector-28 near the pump house	800	1	1	1
11	sector-24 North East corner @ Near the capital square	800	1	1	1
12	sector-20 North East corner at road no. 9B	450	1	1	1
13	sector-13 South west corner, near petrol pump	350	1	1	1
14	sector-13 East side road no. 2 @ Near the pump house	700	1	1	1
15	sector-13 North East corner at road no. 2	350	1	1	1
16	sector-13 North East corner at road no. 5WCR	350	1	1	1
17	sector-9 East side road no. 2	250	1	1	1
18	sector-5 North East corner at road no. 6	200	1	1	1
19	sector-4 North West corner at road no. 2	250	1	1	1
Total			19	19	19

Note: The above list is indicative. All necessary instruments, communication modules, PLC/RTUs, UPS, cable, control wiring etc. required for NRW calculation/leak detection, remote monitoring and control through Water SCADA and as required to meet the functional requirements and SLAs of this RFP, are to be included by the bidder in his submitted quote.*

***If need be the bidders are advised to visit the site to satisfy themselves before quoting the bid.**

4. Details of Instruments at each UGR With Pump House (Existing)

4 A. At INLET of UGR- existing valves and meter details (Existing)

Sn o.	Location of UGR with Pump House	From Pump House to Supply Sectors	At INLET of UGR- existing valves and meter details			
			Inlet pipe Dia.(mm)	Electrical Actuator ON/OFF	Electromagnetic Flowmeter	Ultrasonic Level Transmitter
1	Sector-5	Sector-5	100	1*	1*	1**
2	Sector - 16	Sector-16	250	1*	1*	1**
3	Sector - 17	Sector-17	250	1*	1*	1**
4	Sector - 19	Sector-19	150	1*	1*	1**
5	Sector - 21	Sector-20 & 21	250	1*	1*	1**
6	Sector - 22	Sector-22 & 23	200	1*	1*	1**
7	Sector - 24	Sector-24	250	1 (FCV)	1*	1**
8	Sector - 26	Sector-26 & 27	250	1*	1*	1**
9	Sector - 30	Sector-29 & 30	200	1*	1*	1**

Note:- * All valves and meters inlet pipe size

** Ultrasonic Level Transmitter(Range 0-5 meters, remote type transmitter mounting)

*Pump House Campus Dimensions = 30 m * 30 m approx, may vary from site to site.*

4 B. At Pump House OUTLET - existing pumps, valves and meter details

Sn o.	Location of UGR with Pump House	From Pump House to Supply Sectors	At Pump House OUTLET - existing pumps, valves and meter details			
			Hydro Pneumatic Pumping System	Outlet pipe Dia.(mm)	Electrical Actuator (Flow Control Valve)	Electromagnetic Flowmeter
1	Sector-5	Sector-5	3 no. (2Working	250 (Single outlet)		1no. (250mm

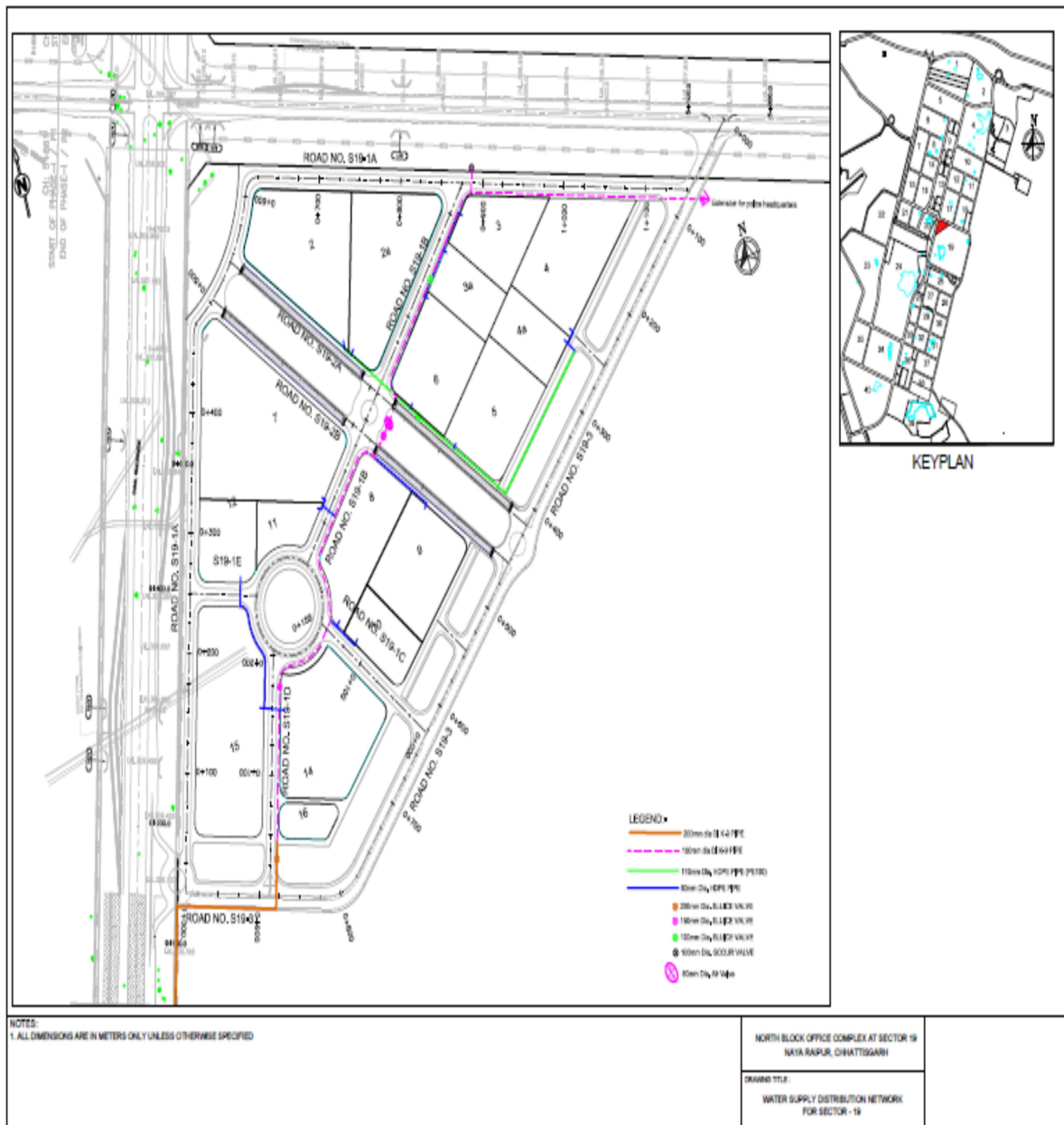
Sn o.	Location of UGR with Pump House	From Pump House to Supply Sectors	At Pump House OUTLET - existing pumps, valves and meter details			
			Hydro Pneumatic Pumping System	Outlet pipe Dia.(mm)	Electrical Actuator (Flow Control Valve)	Electromagnetic Flowmeter
			+1Stand by)			dia.)
2	Sector - 16	Sector-16	3 no. (2Working +1Stand by)	250 (Single outlet)		1no. (250mm dia.)
3	Sector - 17	Sector-17	3 no. (2Working +1Stand by)	250 (Single outlet)		1no. (250mm dia.)
4	Sector - 19	Sector-19	3 no. (2Working +1Stand by)	200 (Two outlets)	2no. (200mm dia.)	2no. (200mm dia.)
5	Sector - 21	Sector-20 & 21	3 no. (2Working +1Stand by)	150 &300 (Two outlets)	1 no. (250 mm dia.)	1no. (150mm dia.)+ 1no. (300mm dia.)
6	Sector - 22	Sector-22 & 23	3 no. (2Working +1Stand by)	250 & 200 (Two outlets)	1no. (250mm dia.)+ 1no. (200mm dia.)	1no. (250mm dia.)+ 1no. (200mm dia.)
7	Sector - 24	Sector-24	3 no. (2Working +1Stand by)	250 (Single outlet)		1no. (250mm dia.)
8	Sector - 26	Sector-26 & 27	3 no. (2Working +1Stand by)	200 & 300 (Two outlets)	1no. (200mm dia.)+ 1no. (300mm dia.)	1no. (200mm dia.)+ 1no. (300mm dia.)
9	Sector - 30	Sector-29 & 30	3 no. (2Working +1Stand by)	300 & 300 (Two outlets)	2no. (300mm dia.)	2no. (300mm dia.)

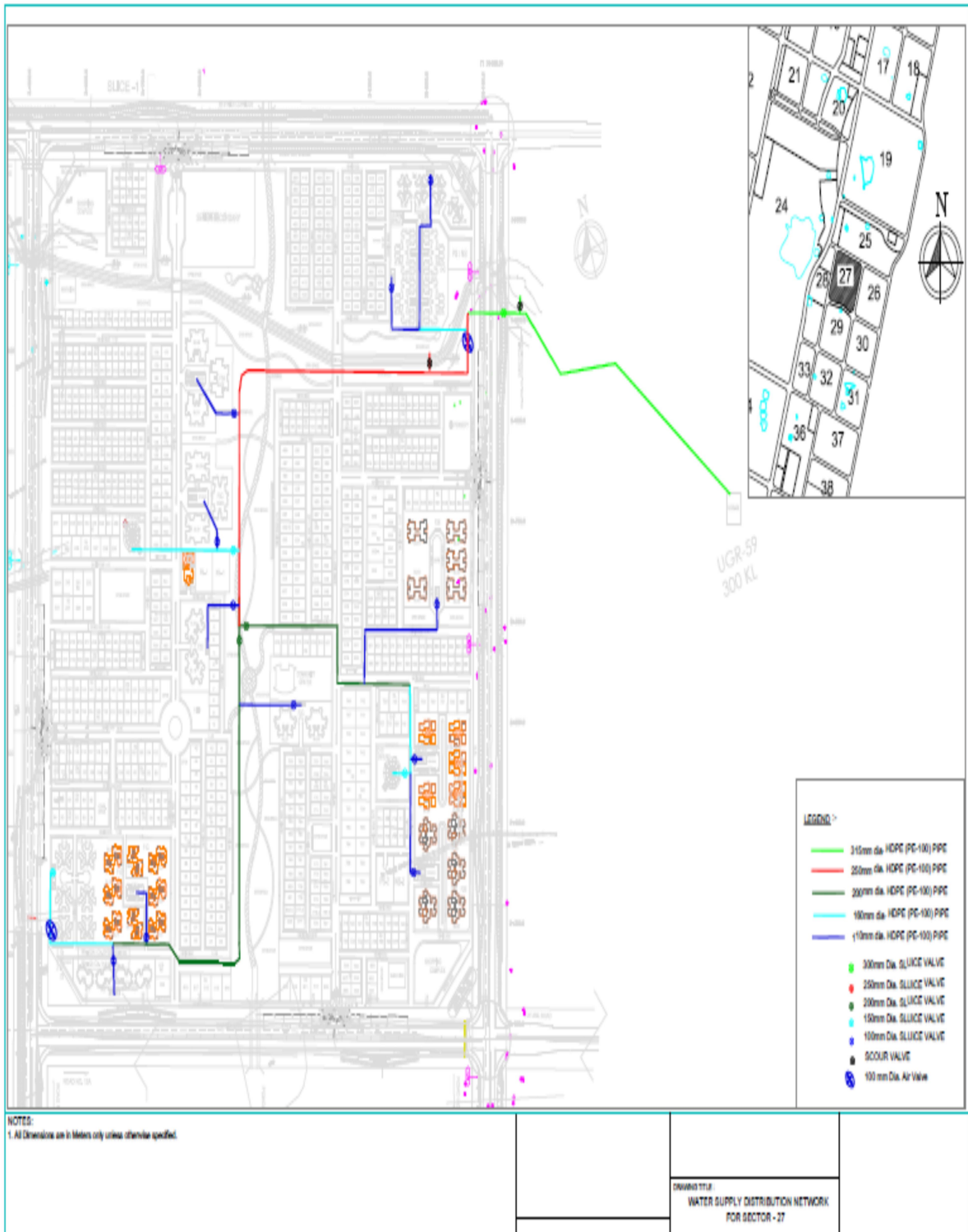
5. Internal distribution Network for sector 19 and sector 27

5A. Proposed instrumentation at internal distribution network for sectors 19 and 27

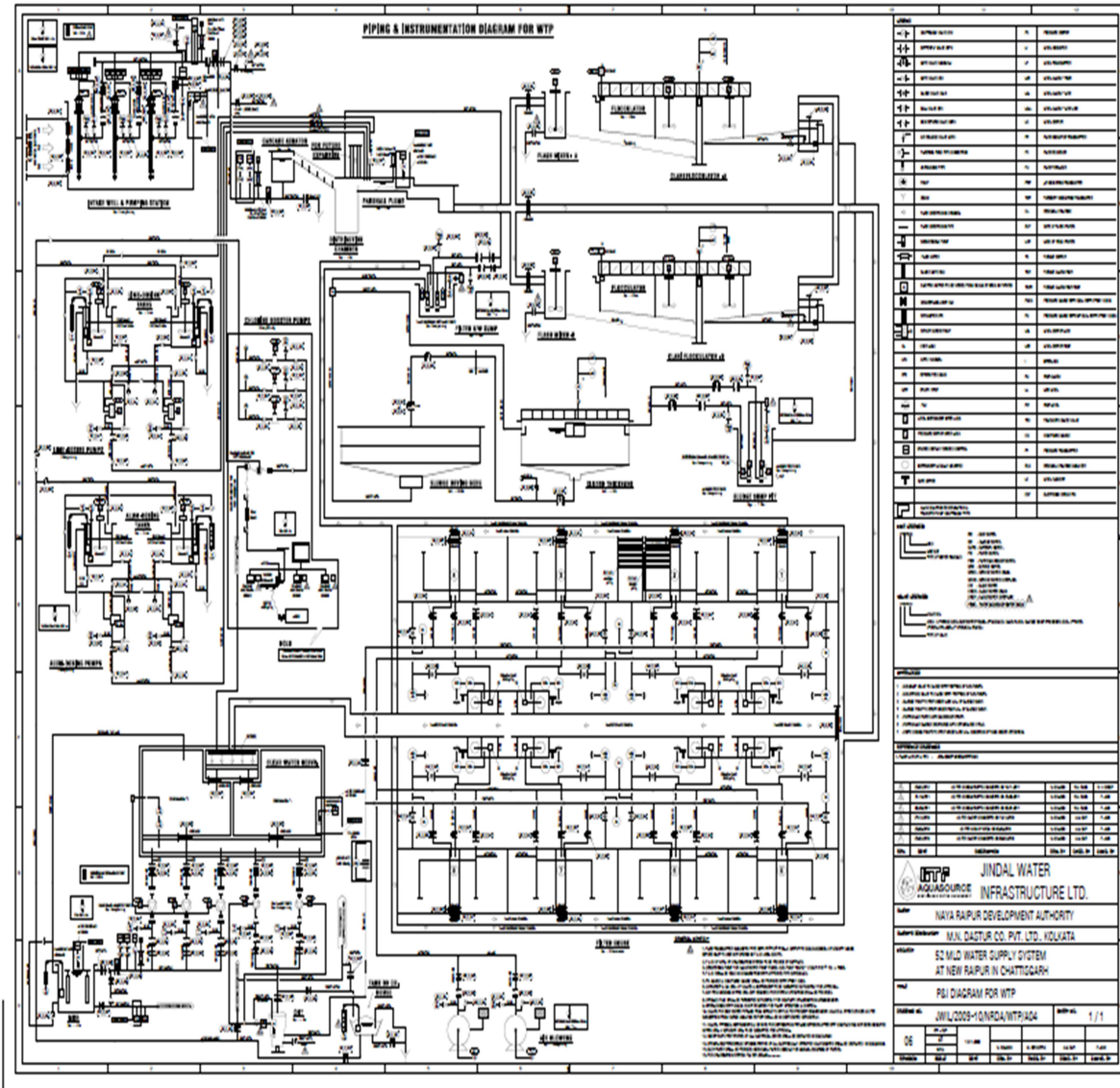
All instruments like Flowmeters, Pressure Sensors, Turbidity Analyzers, Chlorine Analyzers, motorized valves etc. required for NRW calculation/leak detection, remote monitoring and control through Water SCADA and as required to meet the functional requirements and SLAs of this RFP, are to be included by the bidder in his submitted quote.*

Enclosed – Internal Distribution Network Drawings for Sector 19 and Sector 27.

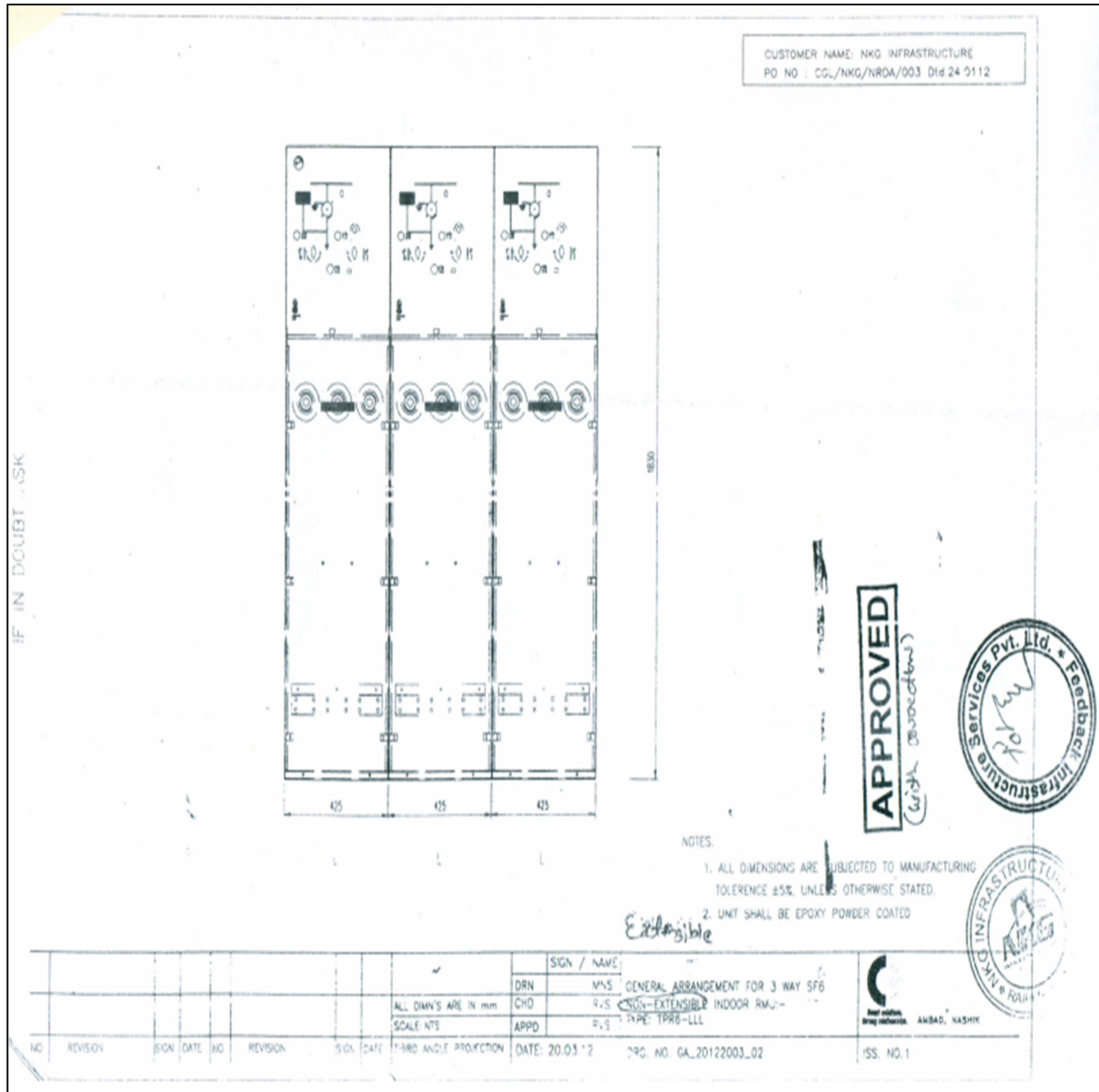


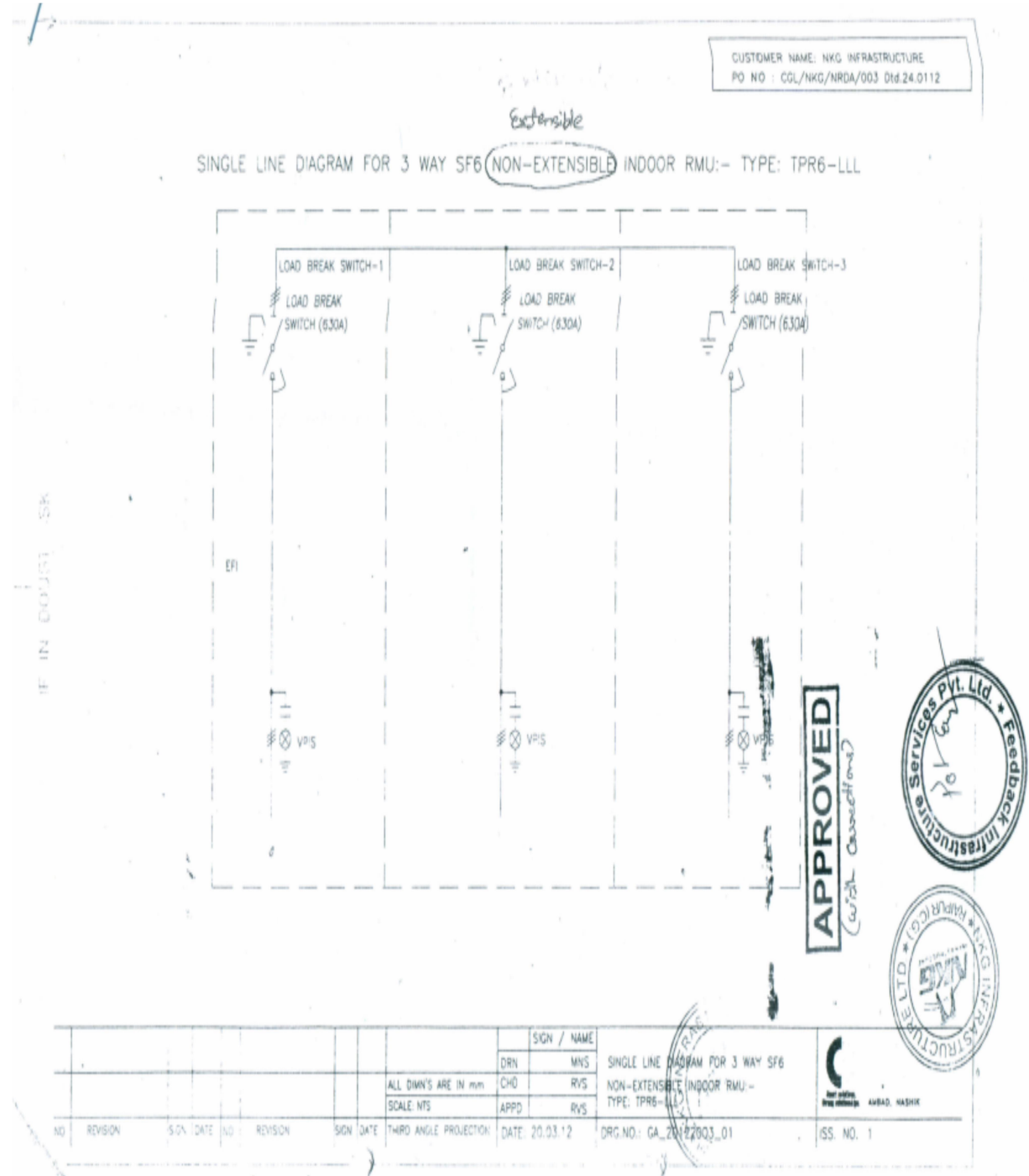


17. Annexure X: Process & Instrument diagram for WTP



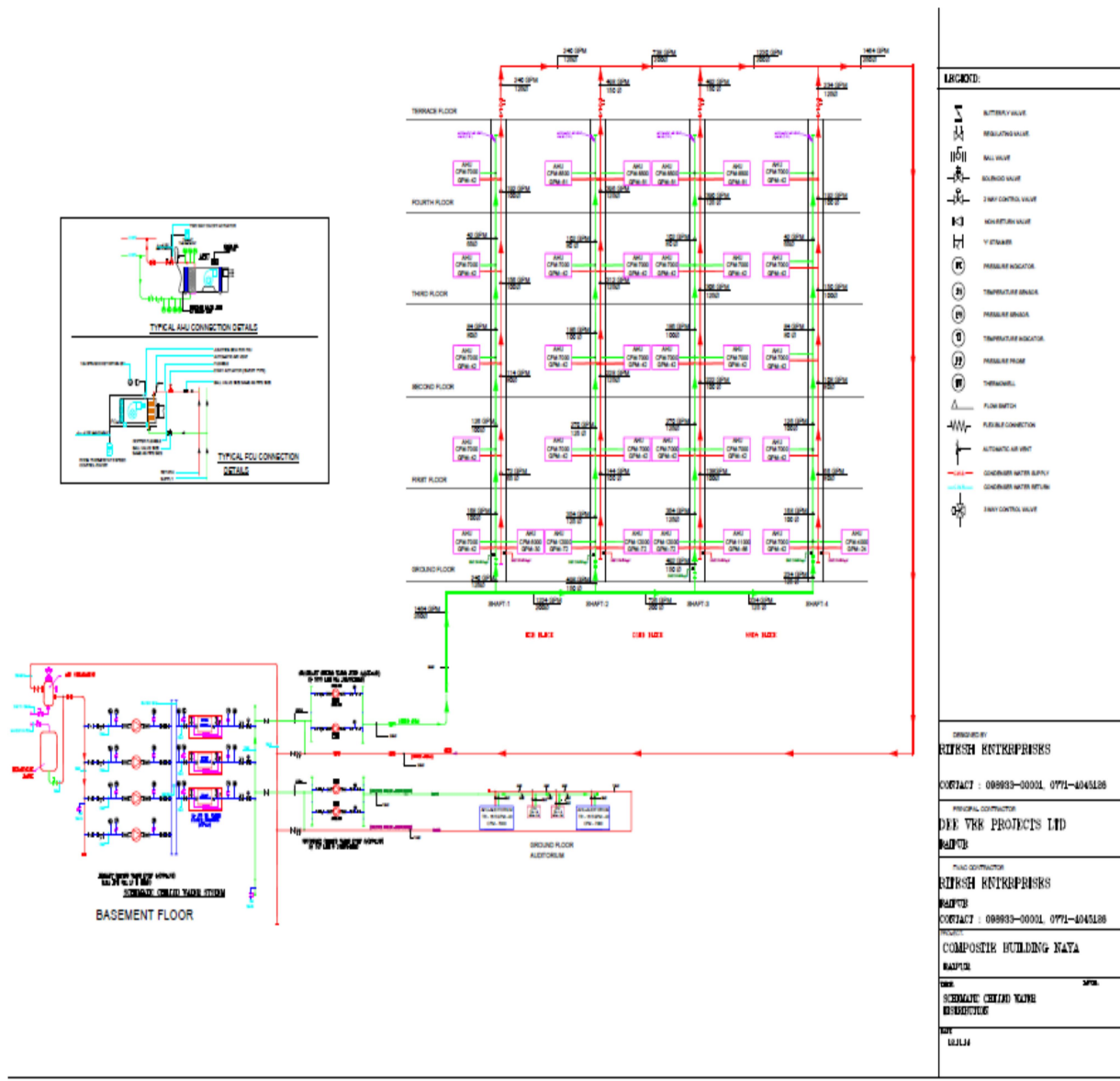
18. Annexure XI: RMU Drawings



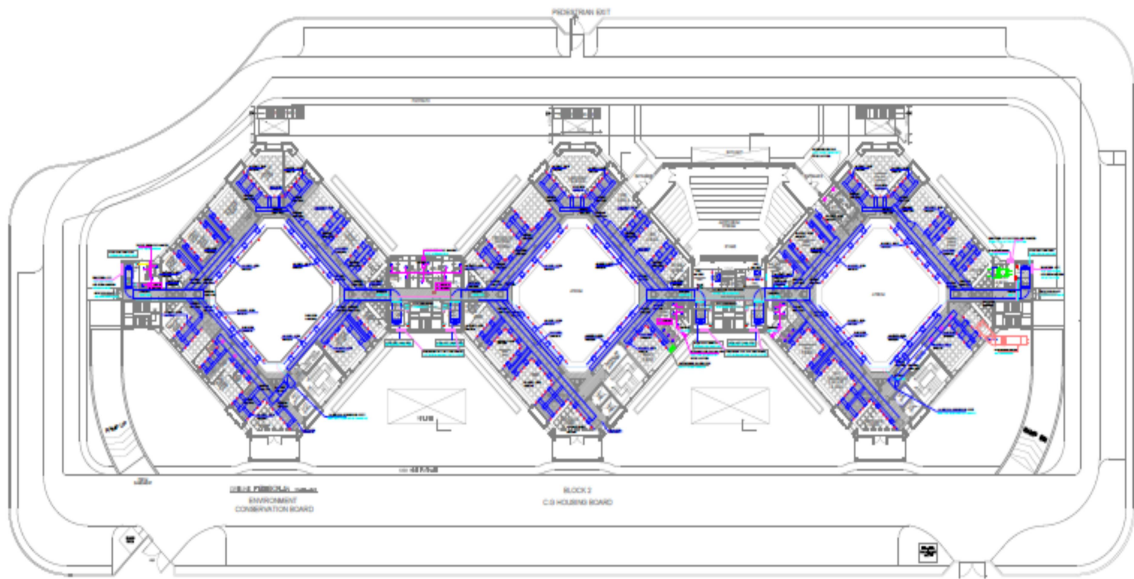


19. Annexure XII: HVAC Drawings of Paryavas Bhawan

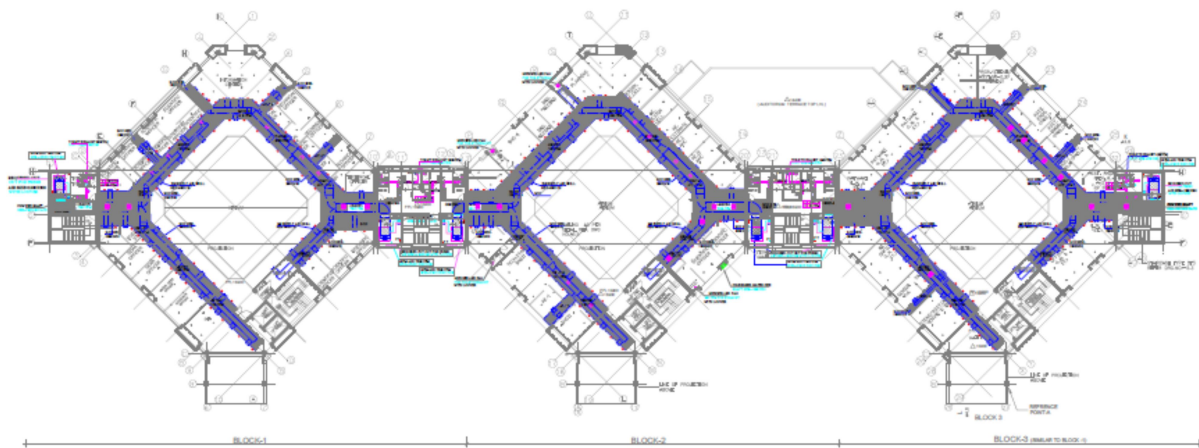
Schematic Drawing



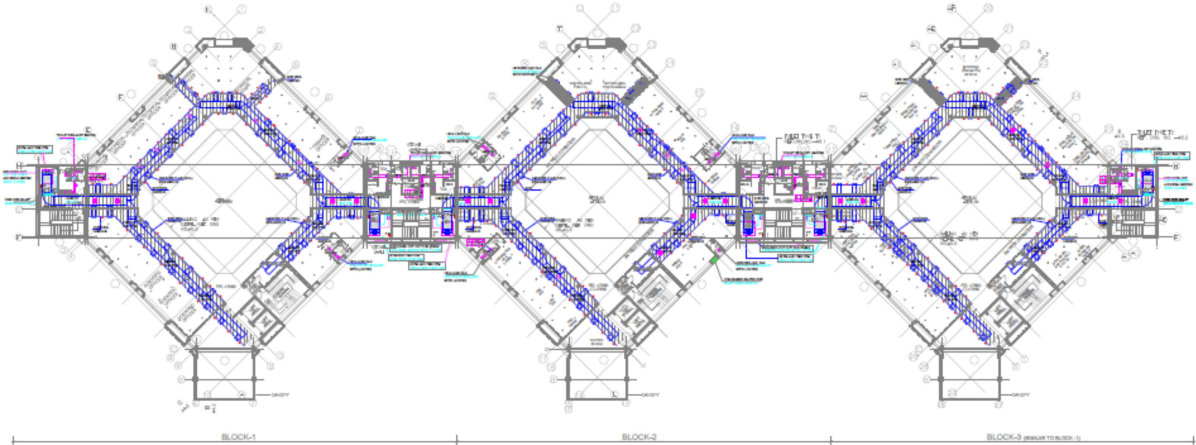
Ground Floor



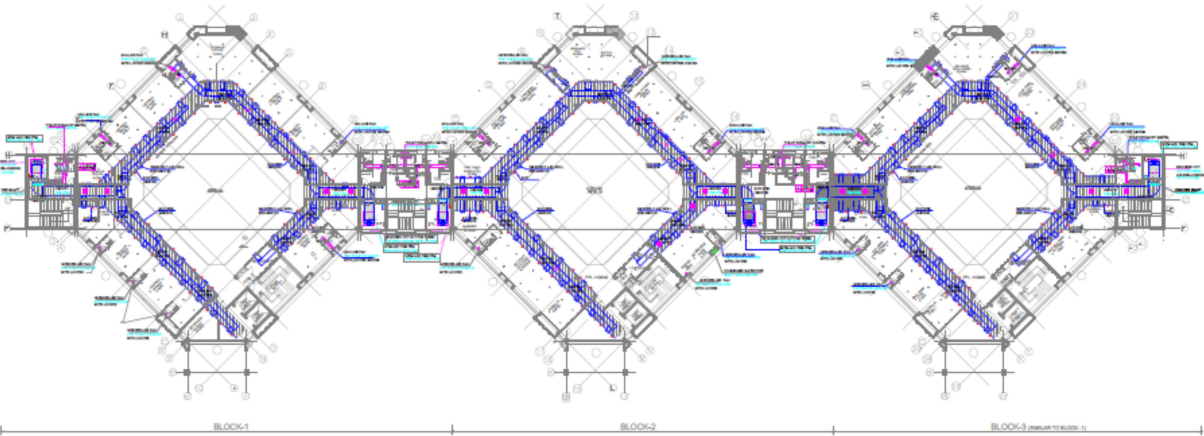
First Floor



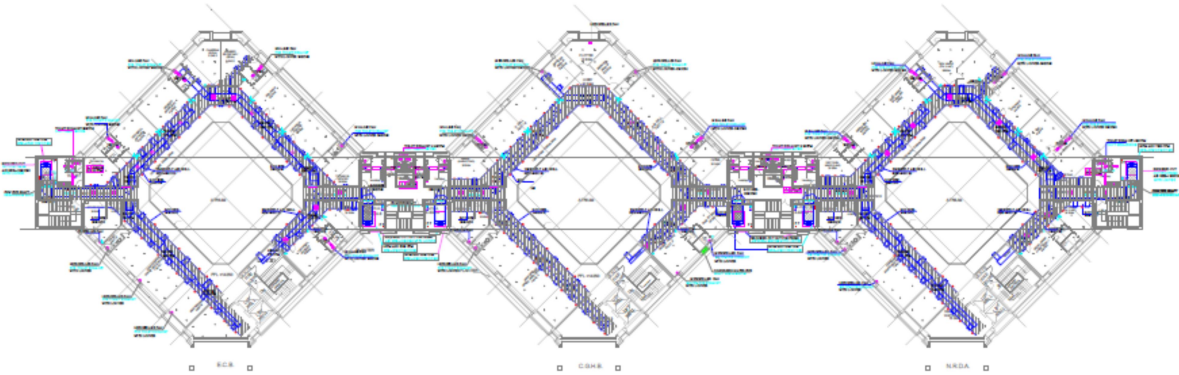
Second Floor



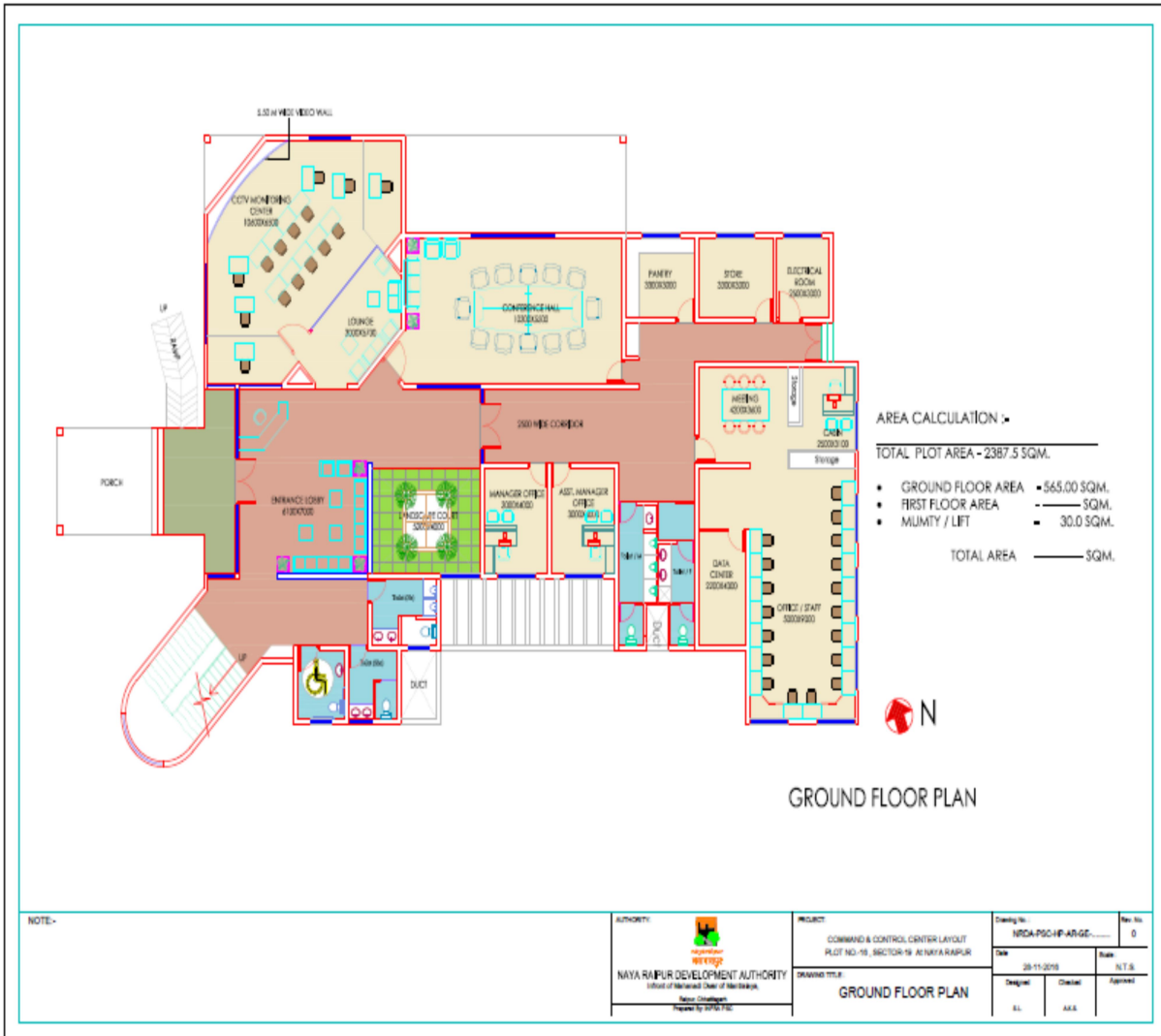
Third Floor



Fourth Floor



20. Annexure XIII: Command and Control Centre Layout(illustrative)



NOTE:-

AUTHORITY:  NAYA RAIPUR DEVELOPMENT AUTHORITY Office of Municipal Officer of the District, Raipur Chhattisgarh Project No. 2012/11	PROJECT: COMMAND & CONTROL CENTER LAYOUT PLOT NO-15, SECTOR-19, ANAYIA RAIPUR DRAWING TITLE: GROUND FLOOR PLAN	Drawing No. NRDA-PC-14P-AR-GE-.....	Rev. No. 0
		Date 26-11-2015	Scale 1:100
		Designer A.L.	Checker A.K.S.

21. Annexure XIV: List of Cloud Service Provider empaneled by MeitY

List of the successful CSPs cloud offerings against the RFP for “Provisional Empanelment of Cloud Service Offerings of Cloud Service providers (CSPs)”

With reference to the RFP dated 30th December 2015, MeitY (Ministry of Electronics and Information Technology) has successfully concluded the evaluation process of provisionally empaneling the Cloud Service Offerings of Cloud Service Providers.

Letter of Provisional Empanelment has been awarded to the following Cloud Service Providers for two years, subject to the written acceptance of Terms and conditions within 15 days. The list of such CSPs is as below:-

Sno	Name of CSP	Contact Person	Contact details
1	Microsoft Corporation (India) Private Limited	Sh. Manish Lodha Director, Microsoft Corporation (India) Pvt. Ltd. Level 10, Tower C, Epitome, Building No.5 DLF Cyber City, Phase-3, Gurgaon – 122002	E- mail- manishl@microsoft.com Tel no. no. +91 124 4158000
2	Hewlett Packard Enterprise India Private Limited	Sh. Ravi Agarwal Hewlett Packard Enterprise India Pvt. Ltd., 5 th Floor, Tower D&E, DLF Cyber Green, DLF Cyber City, Phase-III Gurgaon-122002	E- mail- ragrawal@hpe.com Tel no. +91 124 3886000
3	IBM India Private Limited	Sh. Vikas Singh IBM India Pvt. Ltd. Barakhamba Road, 1 st Floor, Birla Tower New Delhi-110001	E-mail- vikasingh@in.ibm.com Tel no. -+91 9811144437
4	Tata Communications Limited	Sh. Amit Kumar Sharma Account Manager, Tata Communications Limited, 5 th Floor New IDC Building, Greater Kailash –I, New Delhi-110048	E mail- amitkumar.sharma@tatacommunications.com Tel no.+918586977657
5	Bharat Sanchar Nigam Limited (BSNL)	Sh. Ritesh Kumar BSNL, SDE, O/o CGM NTR, 2 nd Floor, Kidwai Bhawan, Janpath	E mail- riteshkumar@bsnl.co.in Tel no. +911 11 23713343

		New Delhi-110001	
6	ESDS Software Solutions Private Limited	Sh. Sanchit Taraiya ESDS, Regional Manager- North, Plot No. B-24 &25 NICE, Industrial Area, Satpur, MIDC Nashik-422007	E mail- sanchit@esds.co.in Tel no. +91 8750069842
7	Net Magic IT Services Private Limited	Sh. Varun Kumar Verma AGM Sales, Netmagic IT Services Limited, 24 & 30 Ground Floor Okhla Industrial Estate, Phase-III, New Delhi-110020	E mail- varun.verma@netmagicsolutions.com Tel no. +91 11 49442704
8	Sify Technologies Limited	Sh. Tapan Verma Account Manager, Sify Technologies Limited, B-7, Sector -132 Noida-201301	E mail- tapan.verma@sifycorp.com Tel no. +91 120 4970000
9	CtrlS Data Centers Limited	Sh. Dilpreet Singh Ctrl S, Sr.Executive Solutions & Channel Sales, Madhapur, Hitech City, Hyderabad	E mail- dilpreet.s@ctrls.in Tel no. + 91 9643312817
10	Cyfuture India Private Limited	Sh. Sanjay Tripathi Cyfuture, Vice President, SDF Block, G 13 &14 Noida, Special Economic Zone, Phase-II Noida-201305	E mail- tender@cyfuture.com Tel no. +91 120 6667700 Ext. 793
11	Web Werks India Private Limited	Sh. Saurabh Gaggar WebWerks, 124, Prabhadevi Unique Industrial Estate Premises Off Veer Savarkar Marg, Twin tower lane, Prabhadevi Mumbai-400025	E mail- sourabh.gaggar@wwindia.com Tel no. +91 8586806211

END of volume II