

6.1.2 Technical Term of Reference for Upgradation of Existing Smart Pre-Payment Metering System

TECHNICAL TERMS OF REFERENCE (TOR)
FOR
UPGRADATION OF EXISTING SMART PRE-PAYMENT METERING SYSTEM
ON TURNKEY BASIS INCLUDING 5 YEARS OPERATION & MAINTENANCE SUPPORT

1. INTRODUCTION AND BACKGROUND

West Zone Power Distribution Company Limited (WZPDCL), under the Government of the People's Republic of Bangladesh, is responsible for electricity distribution in the western zone of the country. In line with its commitment to modernizing power distribution infrastructure and improving operational efficiency, WZPDCL has implemented a Smart Pre-payment Metering System to enhance billing accuracy, reduce commercial losses, and improve customer service.

The existing system currently serves a significant customer base and comprises Unified Prepaid System, Head End System and Meter Data Management (HES/MDM), Agent Management System (AMS), and various integration modules with internal and external systems. However, due to technological advancements, increased customer base, evolving regulatory requirements from the Bangladesh Energy Regulatory Commission (BERC), and the need for enhanced security and functionality, WZPDCL intends to upgrade the existing smart metering ecosystem.

This Technical Terms of Reference (TOR) defines the comprehensive requirements, scope of work, deliverables, timelines, and performance criteria for the upgradation project to be executed on a turnkey basis, including supply, installation, testing, commissioning, data migration, system integration, and five years of operational and maintenance support.

2. OBJECTIVES OF THE ASSIGNMENT

The primary objective of this assignment is to upgrade the current smart pre-payment metering system into a unified, scalable, secure, and multi-functional platform that meets current and future operational requirements of WZPDCL. The upgraded system shall achieve the following specific objectives:

1. Ensure reliable, accurate, and timely acquisition of meter data from all connected smart meters across the WZPDCL distribution network.
2. Enable seamless online and offline energy vending mechanisms to ensure uninterrupted service to consumers.
3. Support automated billing processes, real-time alerts, event notifications, and comprehensive analytics capabilities for operational efficiency.
4. Enhance consumer experience through improved mobile applications, web portals, and self-service capabilities.
5. Ensure full compliance with BERC rules, regulations, and WZPDCL business logic and operational requirements.
6. Strengthen system security through implementation of modern cryptographic measures, Hardware Security Modules (HSM), and secure key management protocols.
7. Integrate comprehensively with all existing WZPDCL internal systems including meter management, Customer Information System (CIS), SCADA, GIS, CRM, mobile applications, and third-party payment systems.
8. Provide scalability to support up to 20 lakh (2 million) meters initially with capability to expand to 40 lakh (4 million) meters.
9. Enable advanced features including Net Metering, Mother-Child Metering configuration, remote disconnection, firmware upgrade capabilities, and comprehensive fraud detection mechanisms.

3. Additional SCOPE OF WORK for MDM

The selected bidder shall execute all activities described in this section on a comprehensive turnkey basis. The scope encompasses design, development, supply, installation, integration, testing, commissioning, data migration, training, documentation, and five-year operational and maintenance support.

3.1 Smart Pre-payment System Upgrade Requirements

3.1.1 Core System Components

The bidder shall design, supply, install, test, and commission an upgraded Smart Pre-payment Metering System Software including the following components:

- Unified Prepaid System with centralized management capabilities
- Head End System (HES) with advanced data acquisition and device management
- Meter Data Management (MDM) system with comprehensive analytics
- Agent Management System (AMS) for vending agent administration
- Command center interface for centralized monitoring and control

3.1.2 Remote Meter Management

The system shall provide comprehensive remote meter management capabilities:

- Remote meter reading using configurable push and pull intervals
- Data acquisition frequency minimum once per day, configurable for 15 minutes, 30 minutes, or 1 hour intervals
- Remote firmware upgrade capability for both smart meters and Data Concentrator Units (DCU)
- Remote connect and disconnect functionality with automated reconnection capabilities
- Time synchronization across all meters and network devices

3.1.3 Pre-payment Operations

The upgraded system shall support comprehensive pre-payment operations in accordance with BERC rules and WZPDCL business logic:

- Online and offline token-based vending mechanisms
- Multiple payment channel integration (mobile banking, internet banking, agent network, kiosks)
- Real-time balance updates and low balance alerts to consumers
- Tariff-based energy calculation and credit management
- Emergency credit functionality as per utility policies

3.1.4 Advanced Metering Features

The system shall enable the following advanced metering functionalities:

- Net Metering configuration and management for solar and renewable energy integration
- Mother-Child Metering setup for multi-tenant buildings and commercial complexes
- Load curtailment limit setting and enforcement
- Comprehensive alarm and event management system
- Tamper detection and anti-tampering measures
- Power quality monitoring and voltage level tracking

3.1.5 System Scalability and Performance

The upgraded system must meet the following scalability and performance requirements:

- Support for up to 20 lakh (2 million) meters initially
- Scalability architecture to expand up to 40 lakh (4 million) meters without major system redesign
- System response time of less than 3 seconds for meter data retrieval

- Concurrent user support for at least 500 active users
- High availability architecture with minimum 99.5 percent system uptime

3.1.6 Data Storage and Management

The system shall provide comprehensive data storage and management capabilities:

- Customer and meter configuration data storage including complete consumer profiles
- Geographic Information System (GIS) data integration for spatial representation
- Historical consumption data retention as per BERC guidelines (minimum 5 years)
- Selective archiving and purging based on utility-defined retention policies
- Database backup and disaster recovery mechanisms

3.2 System Parameter Configuration and Management

The upgraded system shall support comprehensive parameter configuration and management capabilities to ensure operational flexibility and regulatory compliance.

3.2.1 Meter Parameter Programming

The system shall enable remote programming of the following meter parameters:

- Tariff structure configuration including time-of-use (TOU) tariffs, seasonal tariffs, and multi-tier tariffs
- Prepaid parameter display settings and consumer interface configuration
- Load curtailment limit setting based on sanctioned load and consumer category
- Event configuration for connect and disconnect operations
- Auto-reconnection settings with configurable delays and conditions
- Time synchronization settings with NTP server configuration

3.2.2 Exception Management

The system shall provide comprehensive exception management features including:

- Meter tamper alert generation and notification with event classification
- Over-consumption and under-consumption pattern detection
- Outage indication and restoration tracking at meter and distribution transformer level
- Missing interval data identification and notification
- Communication failure alerts and network health monitoring
- Threshold exception notifications for voltage, current, and power factor deviations

3.2.3 Firmware and Software Management

The system shall support firmware and software management capabilities:

- Firmware upgrade scheduler for meters and DCUs with batch processing
- Rollback mechanisms in case of failed firmware updates
- Version control and tracking of all deployed firmware versions
- Push schedule configuration for automated data collection

3.2.4 System Logging and Audit Trail

All system activities must be logged and maintained for audit purposes. The system shall maintain comprehensive logs for:

- Successful and unsuccessful login attempts with user identification, timestamp, and IP address
- Privilege changes and role modifications
- Password changes and security credential updates
- Unauthorized access attempts and security violations
- System configuration changes including parameter updates
- Data modification and deletion activities
- Critical system events and error conditions

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3.2.5 Future Upgrade Provisions

The system architecture shall provide provisions for future upgrade features including integration with emerging technologies, support for new meter types, enhanced analytics capabilities, and integration with smart grid infrastructure as may be required by WZPDCL in the future.

3.3 System Integration Requirements

The upgraded system must integrate seamlessly with all existing and planned WZPDCL systems through standard Application Programming Interfaces (APIs) and industry-standard protocols. Integration is critical for ensuring data consistency, operational efficiency, and unified business processes.

3.3.1 Integration with Internal WZPDCL Systems

The system shall integrate with the following internal WZPDCL systems:

- Online New Connection System for automated meter assignment and service provisioning
- Call Center Application for customer service representative access to real-time meter and account information
- Agent Management System (AMS) for vending agent network management
- Customer Information System (CIS) for bi-directional data exchange on customer accounts, billing, and service requests
- Supervisory Control and Data Acquisition (SCADA) system for operational monitoring and control
- Customer Relationship Management (CRM) system for complaint tracking and service request management
- Consumer Portal and mobile applications for self-service capabilities
- Geographic Information System (GIS) - optional integration for spatial data visualization
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3.3.2 Integration with External Systems

The system shall support integration with the following external systems and service providers:

- Third-party vending and payment systems including mobile financial services (bKash, Nagad, Rocket, etc.)
- Mobile applications for both Android and iOS platforms
- Web-based applications and consumer portals
- SMS gateways for alert and notification delivery
- Email gateways for official communication and reporting
- Hand Held Unit (HHU) and manual reading systems for backup data collection
- Interactive Voice Response (IVR) systems for automated customer service
- Kiosk and mobile recharge centers for offline vending
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3.3.3 Standards Compliance

All integration interfaces must comply with the following industry standards:

- Common Information Model (CIM) IEC 61968 (CIM 2.0) or equivalent open standards
- RESTful API architecture for web service integration
- JSON or XML data interchange formats
- OAuth 2.0 or similar secure authentication protocols
- TLS 1.2 or higher for encrypted communication
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3.3.4 Standard API Requirements

The bidder shall provide standard, well-documented APIs for the following functional areas:

- Vending operations - token generation, validation, and transaction processing
- Meter Data Management (MDM) - data retrieval, meter commands, and configuration
- Payment processing - payment confirmation, reconciliation, and settlement
- Outage management - outage detection, notification, and restoration tracking
- Billing operations - consumption data, billing determinants, and bill calculation

- Analytics and reporting - data extraction, report generation, and dashboard services

3.3.5 Bidder Responsibilities for Integration

The selected bidder shall be responsible for:

- Supplying all required Head End System (HES) licenses and network management software licenses
- Integration with the updated Meter Data Management (MDM) system
- Configuration and optimization of automated node data acquisition processes
- Comprehensive integration testing and validation
- Documentation of all integration interfaces with detailed API specifications
- Training of WZPDCL staff on integration management and troubleshooting

3.4 Analytics and Business Intelligence Requirements

The upgraded system shall provide comprehensive analytics and business intelligence capabilities to support operational decision-making, fraud detection, demand-side management, and regulatory compliance reporting.

3.4.1 Consumption and Load Profile Analytics

The system shall support the following consumption and load profile analytics:

- Consumption and load profiles by configurable time periods including 15-minute, 30-minute, hourly, daily, monthly, and yearly intervals
- Load pattern analysis categorized by peak hours, off-peak hours, and super off-peak hours
- Consumer-wise consumption trends and comparative analysis
- Consumer category-wise aggregated consumption patterns
- Seasonal consumption variation analysis

3.4.2 Distribution Transformer Monitoring

The system shall provide distribution transformer (DT) level monitoring and analysis:

- Real-time and historical load monitoring at transformer level
- Transformer loading analysis with overloading identification
- Energy balance calculation at transformer level
- Technical and commercial loss estimation per distribution transformer
- Load curve visualization and analysis tools

3.4.3 Tamper, Outage, and Event Analytics

The system shall provide comprehensive event analytics capabilities:

- Tamper event analysis with classification by tamper type
- Outage event tracking and restoration time analysis
- System Average Interruption Duration Index (SAIDI) calculation
- System Average Interruption Frequency Index (SAIFI) calculation
- Geographic and temporal distribution of outage events
- Customer interruption analysis and reliability metrics

3.4.4 Fraud Detection and Revenue Protection

The system shall include advanced fraud detection capabilities using pattern recognition and machine learning techniques:

- Abnormal consumption pattern detection algorithms
- Tamper event correlation and fraud scoring
- Zero consumption or low consumption anomaly detection
- Reverse energy flow detection
- Sudden consumption change detection
- Peer group comparison for outlier identification

3.4.5 Demand Response Analytics

The system shall support demand-response program management and analytics:

- Load curtailment program effectiveness measurement
- Time-of-use (TOU) tariff impact analysis
- Peak demand reduction measurement
- Consumer participation tracking and incentive calculation

3.4.6 Data Archiving and Purging

The system shall provide selective archiving and purging capabilities based on utility-defined requirements. Historical data retention policies shall comply with BERC regulations and WZPDCL business requirements. The system shall support automated archiving of aged data while maintaining query capabilities for archived information.

3.5 Consumer Online Portal and Mobile Application Requirements

The upgraded system shall include a comprehensive consumer-facing web portal and mobile applications for Android and iOS platforms to enhance consumer experience and enable self-service capabilities.

3.5.1 Core Consumer Portal Features

The consumer portal and mobile applications must provide the following functionalities:

- Online energy recharge and top-up functionality with multiple payment options
- Real-time account balance and credit status display
- Daily, monthly, and historical consumption data visualization
- Purchase history and transaction records with detailed breakdown
- Token purchase and recharge history
- Real-time alerts and notifications for low balance, high consumption, and system messages
- Estimated remaining days of electricity based on consumption patterns

3.5.2 Service Request Management

Consumers shall be able to submit and track the following service requests through the portal:

- Meter checking and verification requests
- Load increase or decrease applications
- New service connection requests
- Complaint registration and tracking
- Service request status tracking with automated updates

3.5.3 Security and Authentication

The consumer portal shall implement robust security measures:

- Secure login using consumer ID, registered mobile number, and password
- One-Time Password (OTP) based two-factor authentication
- Encrypted communication using TLS 1.2 or higher
- Session timeout and automatic logout mechanisms
- Password strength requirements and periodic change enforcement

3.5.4 Payment Gateway Integration

The portal must integrate with existing WZPDCL-approved payment gateways supporting:

- Credit and debit card payments (Visa, MasterCard, American Express)
- Mobile financial services (bKash, Nagad, Rocket, etc.)
- Internet banking from all major banks in Bangladesh
- Digital wallets and other emerging payment methods

3.5.5 User Interface and Experience

The consumer portal and mobile applications shall provide:

- Intuitive and user-friendly interface design
- Support for Bengali and English languages
- Responsive design for various screen sizes and devices
- Fast loading times and optimized performance
- Accessibility features for users with disabilities

3.6 Reporting and Business Intelligence Requirements

The upgraded system shall provide comprehensive reporting capabilities with a flexible report builder interface and business intelligence tools to support operational, financial, and regulatory reporting requirements.

3.6.1 Standard Reports

The system shall provide the following standard reports (but not limited to):

Consumption and Billing Reports:

- Consumption (kWh) reports by consumer, consumer category, distribution transformer, feeder, and circle
- Customer recharge and top-up reports with payment method breakdown
- Revenue reports with collection efficiency analysis
- Customer-wise detailed consumption and payment history

Operational Reports:

- Daily data collection status report with communication success rates
- Connect and disconnect reports from Customer Information System
- Missing interval and event data reports
- Communication infrastructure health reports

Exception and Alert Reports:

- Usage exception reports identifying abnormal consumption patterns
- Tamper event reports with classification and geographic distribution
- Overload and threshold exception reports
- Defective meter identification reports

Reliability and Quality Reports:

- System Average Interruption Duration Index (SAIDI) reports
- System Average Interruption Frequency Index (SAIFI) reports
- Power quality reports including voltage level analysis
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3.6.2 Report Export Capabilities

The utility must be able to export all reports in multiple formats:

- Portable Document Format (PDF) for official documentation
- Comma-Separated Values (CSV) for data analysis
- Microsoft Excel format (XLS/XLSX) for detailed analysis
- HTML format for web-based viewing
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3.6.3 Report Builder and Ad-hoc Query Interface

The system shall provide a comprehensive report builder interface with the following capabilities:

- User-driven custom report creation without programming knowledge
- Drag-and-drop interface for field selection and layout design
- Flexible filtering, sorting, and grouping options
- Calculated fields and aggregation functions
- Report template saving and sharing capabilities

- Scheduled report generation and automated email delivery

3.6.4 Dashboard and Visualization

The system shall include interactive dashboards with real-time data visualization:

- Executive dashboard with key performance indicators (KPIs)
- Operational dashboard for monitoring system health and performance
- Financial dashboard for revenue tracking and collection monitoring
- Geographic visualization using map-based interfaces
- Interactive charts, graphs, and heat maps
- Drill-down capabilities for detailed analysis

3.7 Advanced Security and Key Management Requirements

Security is of paramount importance for the smart metering system. The upgraded system must implement state-of-the-art security measures to protect against unauthorized access, data breaches, cyberattacks, and fraudulent activities.

3.7.1 Cryptographic Key Management

The system shall implement comprehensive cryptographic key management infrastructure:

Hardware Security Module (HSM):

- FIPS 140-2 Level 3 or higher certified Hardware Security Module
- Secure generation, storage, and management of cryptographic keys
- Tamper-evident and tamper-resistant physical security

Software Security Module (SSM):

- Backup key management through Software Security Module
- Secure key distribution and lifecycle management

Encryption Standards:

- Advanced Encryption Standard (AES) with minimum 128-bit key length
- Key Encryption Key (KEK) management for master key protection
- Security Association (SA) management for device authentication

Message Authentication:

- Downstream message authentication to prevent command injection
- Digital signatures for critical commands and firmware updates
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3.7.2 Communication Security

All communication channels must be secured using industry-standard protocols:

- End-to-end encrypted communication between command center and smart meters
- Segmented broadcast keys for group communication security
- Individual unicast keys for direct meter-to-system communication
- Transport Layer Security (TLS) 1.2 or higher for web-based communication
- Virtual Private Network (VPN) support for remote access
- Certificate-based authentication for system components

3.7.3 Access Control and User Management

The system shall implement robust access control mechanisms:

- Role-Based Access Control (RBAC) with granular permission management
- Multi-factor authentication for administrative access
- Separation of duties and least privilege principles

- Account lockout mechanisms after failed login attempts
- Session management with automatic timeout
- Privileged access monitoring and recording
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3.7.4 Mobile Administration Security

Mobile administration tools must implement enhanced security:

- Device authentication and authorization
- Secure mobile admin tool with encrypted storage
- Certificate-based authentication for mobile devices
- Remote wipe capability for lost or stolen devices
- Activity logging and audit trail for mobile operations
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3.7.5 Security Compliance and Standards

The system security architecture must comply with the following standards:

- ISO/IEC 27001 Information Security Management
- NIST Cybersecurity Framework
- IEC 62351 Power Systems Management and Information Exchange Security
- NERC CIP (Critical Infrastructure Protection) standards where applicable
- Bangladesh government cybersecurity guidelines and regulations
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3.7.6 Security Monitoring and Incident Response

The system shall include comprehensive security monitoring capabilities:

- Real-time security event monitoring and alerting
- Intrusion detection and prevention systems
- Security Information and Event Management (SIEM) integration
- Incident response procedures and automated containment mechanisms
- Vulnerability assessment and penetration testing capabilities
- Regular security audits and compliance reporting
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3.8 Data Migration Requirements

The successful bidder must migrate all data from the existing smart metering system to the new upgraded system without any data loss or corruption. Data migration is a critical component of this project and must be executed with utmost care and precision.

3.8.1 Data Migration Scope

The following data categories must be migrated:

- Master data including all customer information, account details, and consumer profiles
- Meter inventory data including meter serial numbers, configurations, and installation details
- Historical consumption data for minimum past 5 years or as available
- Transaction history including all recharge and payment records
- Event logs, tamper records, and alarm history
- Network infrastructure data including DCU and communication node configurations
- Geographic Information System (GIS) data and spatial references
- User accounts, roles, and permission configurations

3.8.2 Data Migration Process

The bidder must follow a structured data migration process:

- 1.Data Assessment and Profiling: Comprehensive assessment of existing data structure, quality, and volume
- 2.Data Mapping and Transformation: Detailed mapping between old and new data structures with transformation rules
- 3.Data Cleansing and Validation: Identification and correction of data quality issues
- 4.Pilot Migration: Test migration using a subset of data to validate process
- 5.Full Migration Execution: Complete data migration in phases as approved by WZPDCL
- 6.Post-Migration Verification: Comprehensive verification of migrated data accuracy and completeness
- 7.Data Synchronization: Ensure clean and accurate synchronization of all meter and consumer data

3.8.3 Data Migration Quality Assurance

The following quality assurance measures must be implemented:

- Zero data loss guarantee with 100 percent record migration
- Data integrity verification using checksums and hash validations
- Reconciliation reports comparing source and target data volumes
- Sample data accuracy testing across all data categories
- End-to-end business process testing post-migration
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3.8.4 Rollback and Contingency Planning

The bidder must prepare comprehensive rollback and contingency plans:

- Complete backup of existing system before migration
- Documented rollback procedures with clear triggers and timelines
- Parallel operation period where both old and new systems run simultaneously
- Business continuity measures to ensure uninterrupted customer service

3.8.5 User Acceptance Testing (UAT) After Migration

After completion of data migration, comprehensive User Acceptance Testing must be conducted:

- UAT scenarios covering all business processes and use cases
- Involvement of WZPDCL subject matter experts in testing
- Performance testing under peak load conditions
- Security testing and penetration testing
- Formal UAT sign-off by WZPDCL before go-live
- Data migration validation report documenting all verification activities

4. DELIVERABLES

The selected bidder must deliver the following items as part of this turnkey project:

1. Upgraded Pre-payment Software Suite including Unified Prepaid System, Head End System (HES), Meter Data Management (MDM) system, and Agent Management System (AMS)
2. Consumer-facing Mobile Applications for Android and iOS platforms with source code
3. Web-based Consumer Portal with responsive design
4. Complete integration with all internal WZPDCL systems (CIS, SCADA, CRM, GIS, Call Center, AMS, Online Connection System)
5. Integration with external third-party payment gateways and mobile financial services
6. Hardware Security Module (HSM) and Software Security Module (SSM) with complete key management infrastructure
7. Complete database migration with all historical data successfully transferred
8. Comprehensive Documentation Package including: