TECHNICAL PROPOSAL

Market Management System (MMS)

Tender Details

Tender ID: 21535679
Tender Reference: T-269/12-25
Tender Title: Achizitionarea si implementarea unui Sistem de Management al Pietei (MMS)

Consortium

Ringhel Team SRL / PROCESIO (Leader)
ETA2U S.R.L.

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1. Executive Summary

This Technical Proposal outlines the comprehensive solution for the implementation of a Market Management System (MMS) for Moldelectrica, designed to optimize energy market operations, improve data management, and enhance regulatory compliance.

Proposed Solution

The solution is built on the PROCESIO platform—an enterprise-grade, low-code/no-code automation and integration platform—combined with specialized hardware infrastructure from ETA2U and the proven energy sector expertise of Ringhel Team SRL. The MMS will consist of seven integrated modules: Scheduling Process (SP), Balancing Market (BM), Cross-border Capacity Management (CM), Grid Losses Procurement (GL), Market Participant Registration (MPR), Settlement (ST), and Reporting & Analytics (RS).

Consortium Structure

This tender is delivered by a strategic consortium combining complementary expertise:

- **Ringhel Team SRL / PROCESIO (Leader):** Enterprise automation platform, integration backbone, energy sector domain expertise, and all software deliverables.
- **ETA2U S.R.L.:** Infrastructure design, hardware provisioning, virtualization, security, and operational support.

Key Differentiators

- No rip-and-replace: The solution integrates with existing energy market systems, preserving current investments and minimizing adoption risk.
- Proven energy expertise: Over 100 successful implementations across power supply, trading, balancing, and distribution—including direct cooperation with the Romanian energy regulator (ANRE) on market infrastructure.
- Enterprise-grade infrastructure: Dual-datacenter deployment with active/passive failover, redundant storage, advanced security, and 24/7 operational readiness.
- Fixed commercial offer with transparent change control: Protects Moldelectrica against scope creep while remaining flexible for reasonable refinements.

2. Company Presentation - Ringhel Team SRL / PROCESIO

About Ringhel Team SRL

Ringhel Team SRL is the legal entity behind PROCESIO—enterprise foundational technology for orchestrating systems, workflows, and business intelligence across complex organizations. We contract, deliver, and support all engagements directly. PROCESIO is infrastructure for how organizations operate: connecting the systems they already trust, automating the work between them, and giving teams governed, real-time visibility without replacing what works.

PROCESIO Platform

PROCESIO is enterprise-grade foundational technology designed to orchestrate systems and AI across the full complexity of an organization. The platform offers a full spectrum of development: no-code for business-configured workflows, low-code for rapid integration mapping, and full-code where custom logic is required—all in one governed environment. Core capabilities include system integration and API orchestration, workflow automation, custom portal and interface generation, document generation and processing, and AI embedding for classification and extraction. PROCESIO deploys cloud or on-premise, scales to enterprise load, and is designed as an integration and orchestration layer—it does not replace systems of record; it connects and coordinates them.

Energy Sector Expertise

Ringhel Team SRL brings over 100 successful implementations across the energy and utility sectors, including comprehensive solutions for:

- Power supply, gas supply, and energy trading modules
- Balancing and last-resort supply operations
- Distribution and retail market management
- Contract management, billing, and reporting systems
- Balancing Responsible Party (BRP) member management
- Mass data import, integrations, and automation services
- End-to-end energy market participant solutions

Technology Recognition

Ringhel Team SRL has earned international recognition as a Technology Provider of the Year, validating the PROCESIO platform's capability, reliability, and innovation in enterprise automation.

Technology Stack

The MMS solution leverages:

- **PROCESIO Platform:** Enterprise automation, integration, and orchestration core
- **ibd15 Calculation Engine:** Licensed COTS calculation engine for market settlement and pricing
- **Microsoft SQL Server:** Enterprise-grade relational database
- **Proxmox VE:** Open-source virtualization platform for flexible infrastructure
- **Dell Hardware:** Enterprise-class servers (PowerEdge R7625), storage (PowerStore), and networking
- **Fortinet Security:** Multi-layered firewall and web application protection

ANRE Cooperation

Ringhel Team SRL has direct contractual experience with the Romanian Energy Regulatory Authority (ANRE). In 2020, Ringhel was selected through public procurement (SCN 1074857/10.09.2020) to lead an association that delivered a comprehensive study for ANRE on the design and architecture of Romania's centralized online platform for energy supplier switching (POSF — Platforma Online pentru Schimbarea Furnizorului). Under Contract Nr. 237/17.11.2020, the Ringhel-led team delivered: (1) a complete analysis of the EU regulatory framework governing energy supplier switching, including Directive 2019/944 and Regulation (EU) 2019/943; (2) a comparative study of centralized platform implementations across six EU member states (Norway, Denmark, United Kingdom, Germany, Italy, and Estonia); (3) the functional and technical high-level architecture for the centralized datahub platform, designed as a Service-Oriented Architecture (SOA) based on microservices with hybrid cloud/on-premise deployment capability; (4) a comprehensive stakeholder analysis covering all energy market participants (end consumers, suppliers, aggregators, distribution operators, transmission system operators, and ANRE); (5) authentication and authorization architecture design incorporating KYC procedures, two-factor authentication, qualified digital signatures, and API-based integration; (6) a full GDPR compliance framework; and (7) concrete legislative modification proposals required for platform implementation. All deliverables were formally accepted by ANRE. This project demonstrates Ringhel's proven capability to design and architect centralized energy market platforms at the national regulatory level — directly relevant to the Moldelectrica MMS implementation.

Contract References

Ringhel Team SRL's energy sector portfolio includes the following representative contracts:

- ANRE (Autoritatea Nationala de Reglementare in Domeniul Energiei) — Comprehensive study for the design and architecture of Romania's centralized energy supplier switching platform (POSF), including EU regulatory analysis, 6-country comparative study, high-level SOA/microservices architecture, and legislative proposals (Contract Nr. 237/17.11.2020, public procurement SCN 1074857/10.09.2020, 2020–2021)
- S.N.G.N. ROMGAZ S.A. — Digital platform for natural gas supply management, trading operations, and ANRE regulatory compliance (approx. EUR 1,210,000, 2019–present)
- ENGIE Romania S.A. — Energy portfolio management system with integrated balancing, nominations, and POSF supplier switching automation (approx. EUR 424,000, 2020–present)
- MET Romania Energy S.A. — Energy trading and portfolio optimization platform supporting cross-border transactions and market coupling (approx. EUR 617,000, 2021–present)
- E.ON Energie Romania S.A. — Retail energy management platform with automated billing, consumption forecasting, and regulatory reporting (approx. EUR 351,000, 2020–present)
- Tinmar Energy S.A. — Integrated energy supply and trading platform covering procurement, balancing, and wholesale market operations (approx. EUR 626,000, 2021–present)

These 6 representative contracts demonstrate Ringhel Team SRL's extensive experience across the full spectrum of energy market operations, regulatory compliance, and platform architecture at both commercial and national regulatory levels. Total portfolio value: approximately EUR 3,228,000.

3. Company Presentation - ETA2U S.R.L.

About ETA2U

ETA2U is a specialized IT infrastructure and hardware provider based in Timisoara, Romania. The company brings deep expertise in enterprise IT infrastructure, virtualization, security, and managed services—with a proven track record across critical sectors including financial services, government, and telecommunications.

Relevant Experience

ETA2U's infrastructure and software implementation experience totals over 43 million RON (approximately 8.6 million EUR) across critical projects in the last three years:

Project	Client	Value (RON)	Period
Distributed Big Data Processing & Human-Robot Interaction Platform	Politehnica University Bucharest	5,900,000	Nov 2023
Treasury Settlement Platform HW/SW Upgrade	Ministry of Finance	6,900,000	Oct 2024-Feb 2025
Network Infrastructure Equipment & Telecontrol Support Services	Retele Electrice Romania S.A.	24,600,000	Mar-Aug 2025
Virtualization System	ANCOM	5,700,000	Aug-Dec 2025

Total similar experience: 43.1 million RON (approximately 8.6 million EUR) in critical infrastructure projects over the last 3 years.

Core Technology Stack

ETA2U specializes in and is certified on:

- Dell PowerEdge and PowerStore enterprise server and storage platforms
- Cisco Catalyst networking and switching
- Fortinet FortiGate and FortiWeb security appliances
- Proxmox VE virtualization platform
- IBM TS storage and tape libraries

4. Proposed Solution Overview

Architecture Summary

The Market Management System is architected as an integrated, enterprise-grade platform built on the PROCESIO orchestration layer. The solution combines proven integration and workflow automation capabilities with a specialized calculation engine (ibd15) for settlement and market pricing operations. Detailed architecture documentation is provided in the separate Architecture Reference Document.

PROCESIO Platform as the Core

PROCESIO serves as the orchestration and integration backbone of the MMS. The platform connects to existing energy market systems, automates workflows between modules, manages data transformation, and provides real-time monitoring and audit trail capabilities. All business logic, workflow routing, and integration logic are implemented within PROCESIO, allowing rapid configuration changes and minimal reliance on third-party integrations.

ibd15 Calculation Engine

The ibd15 engine is a specialized COTS (Commercial Off-The-Shelf) calculation module integrated into the MMS for market settlement, pricing, and balancing calculations. This engine is licensed and provided through established commercial licensing models (e.g., Microsoft license model, VEAM license model, or equivalent), ensuring compliance with software licensing best practices.

MMS Functional Modules

The MMS delivers seven integrated functional modules, each directly addressing the requirements specified in the Terms of Reference. The modules share a common standing data repository, unified authentication and authorization framework, and consistent user interface design. Below, each module is described in terms of its functional scope, key capabilities, and alignment with Moldelectrica’s operational requirements.

4.4.1 Scheduling Process (SP)

The Scheduling Process module manages the complete lifecycle of energy schedules within the Moldovan control area, fully aligned with ENTSO-E Scheduling System (ESS) standards and the IEC 62325-451-2 message format. The module supports the creation, validation, matching, aggregation, and publication of schedules for all Balance Responsible Parties (BRPs) registered within Moldelectrica’s balancing area.

Key capabilities include: schedule submission via both the MMS operator interface and the market participant web portal, with support for XML-based automated submission; counterpart schedule matching across interconnection points with Ukrenergo (Ukraine) and Transelectrica (Romania); automatic detection and notification of schedule mismatches; schedule aggregation at control area, balancing area, and individual BRP levels; multi-version schedule management with full audit trail.

The module implements a configurable market calendar and gating mechanism, supporting the Moldovan scheduling timeline from D-2 nomination through real-time. Gate opening and closing times, schedule versioning rules, and submission deadlines are fully configurable by MMS operators without developer intervention. The scheduling engine performs automatic validation against registered capacity limits, interconnection NTC values, and standing data constraints.

Schedule data exchange with neighboring TSOs (Ukrenergo, Transelectrica) follows the ENTSO-E ESS standard, with support for both bilateral schedule exchange and integration with the European Schedule Exchange platform. The module generates all required

schedule documents including individual BRP schedules, aggregated netted area schedules (NAS), and cross-border exchange schedules.

4.4.2 Balancing Market (BM)

The Balancing Market module covers the full spectrum of balancing operations as defined in the ToR: procurement of balancing capacity, activation of balancing energy, and real-time balancing management. The module supports all four balancing product types defined by ENTSO-E: Frequency Containment Reserves (FCR), automatic Frequency Restoration Reserves (aFRR), manual Frequency Restoration Reserves (mFRR), and Replacement Reserves (RR).

For balancing capacity procurement, the module implements a competitive tendering process where prequalified Balancing Service Providers (BSPs) submit bids for balancing capacity products. The system manages the full tender lifecycle: publication of tender specifications, bid submission with validation, merit order ranking, award determination, and contract issuance. Bids are validated against BSP prequalification data, registered unit capabilities (ramp rates, minimum/maximum power, synchronization times), and standing data constraints.

For balancing energy activation, the module maintains a Common Merit Order List (CMOL) that ranks available balancing energy bids by price. Upon receiving activation signals from the SCADA-EMS system, MMS calculates optimal activation volumes per BSP, dispatches activation instructions, and tracks delivery confirmation. The activation optimization algorithm considers unit ramp rates, minimum activation volumes, cross-border exchange constraints, and grid security requirements.

The module implements the complete ENTSO-E balancing data exchange framework using IEC 62325-451-7 message formats. The MMS architecture is designed to be integration-ready for European balancing platforms, specifically PICASSO (Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation, for aFRR) and MARI (Manually Activated Reserves Initiative, for mFRR). When Moldova achieves eligibility for participation in these platforms, the MMS will support the required data exchange interfaces, bid forwarding mechanisms, and activation signal processing without requiring architectural modifications.

Real-time balancing data, including activated volumes, costs, and system imbalance indicators, are available to MMS operators through dedicated dashboards with configurable refresh intervals and alert thresholds.

4.4.3 Cross-border Capacity Management (CM)

The Cross-border Capacity Management module handles allocation, nomination, and tracking of transmission capacity on Moldova’s interconnections. This module implements the ENTSO-E Capacity Allocation and Nomination (ECAN) standard and manages the interface with the Joint Allocation Office (JAO) allocation platform for explicit capacity auctions.

The module supports capacity products across multiple timeframes: yearly, monthly, and daily auctions for cross-border transmission rights. Capacity traders and interconnection trade responsible parties can nominate allocated capacity through the MMS participant portal, with automatic validation against allocated rights, nomination deadlines, and standing data. The system manages physical transmission rights (PTRs), including the use-it-or-sell-it (UIOSI) mechanism and the use-it-or-lose-it (UIOLI) curtailment procedures.

For each cross-border section (Moldova–Romania via Transelectrica and Moldova–Ukraine via Ukrenergo), the module tracks Available Transfer Capacity (ATC), Net Transfer Capacity (NTC), and Transmission Reliability Margin (TRM). HVDC ramping constraints, where applicable, are incorporated into the capacity nomination validation logic. Capacity

nomination and counter-nomination matching with neighboring TSOs is automated via the ECAN messaging framework.

4.4.4 Grid Losses Procurement (GL)

The Grid Losses procurement module implements an electronic auction-based system for procuring energy to cover transmission grid losses, as specified in the ToR. The module supports the complete auction lifecycle: prequalification of eligible suppliers, announcement of tender specifications (including auction calendar, products, and volume requirements), offer submission, automated evaluation, negotiation rounds, and final award.

Grid loss products are defined by delivery profile (base load, day load, night load) and timeframe, with configurable product definitions that can be adjusted as Moldelectrica's procurement strategy evolves. Individual offers include volume (MW), price (currency/MWh), and divisibility flags. The system evaluates offers using merit order ranking with ascending prices, supports up to 3 independent offers per product per tenderer (5 for no-volume auctions), and handles offer versioning with a 5-year retention period.

After preliminary results are announced, the module supports an open negotiation phase where participants can improve their price offers (downward only). Final results are determined through re-evaluation after the negotiation window closes. The module also supports auction cancellation under predefined conditions (no offers submitted, fewer than three prequalified suppliers, or buyer determination that the auction purpose was not achieved) and repeated auctions with appropriate referencing.

Settlement-related data from winning offers flows automatically to the Settlement module, ensuring seamless integration between procurement and financial settlement.

4.4.5 Settlement (ST)

The Settlement module is the most functionally complex component of the MMS, serving as the financial backbone for all market transactions. Built on the ibd15 calculation engine, it provides a fully configurable settlement formula framework capable of handling the constantly evolving Moldovan Market Rules without requiring software development changes.

The module covers all settlement categories defined in the ToR: (1) BRP imbalance settlement, calculating imbalance payments as the product of imbalance volume and the price of balancing energy per BRP balancing status (shortage or surplus) for each settlement period; (2) System imbalance settlement; (3) Balancing services settlement with BSPs, covering both balancing capacity payments and balancing energy activation payments; (4) Grid losses procurement settlement with energy suppliers; (5) TSO-TSO settlements including FSKAR (Financial Settlement of Kf, ACE and Ramping Period) process support, Imbalance Netting process support, MARI process support, PICASSO process support, settlement of emergency help, day-ahead market coupling, and intra-day market coupling.

The settlement engine supports configurable formula definitions through a graphical user interface, allowing trained settlement operators to create, modify, and version settlement formulas without developer intervention. Formulas support multiple time resolutions (1, 5, 15, 30, 60 minutes, daily, weekly, monthly, yearly), attribute-based aggregations, element-by-element matrix operations, and complex filtering conditions. Each formula has a validity period, enabling the system to maintain historical calculation configurations and support what-if analyses.

The module implements a comprehensive settlement business process workflow: loading input data from partner systems (Metering System, Scheduling, Balancing, Grid Losses), validating data integrity and completeness, executing calculations, publishing preliminary results for reconciliation, managing dispute resolution, correcting results based on appeals, and publishing final settlement data for invoicing. Settlement runs are scheduled via a built-in calendar function with support for daily automated settlements and monthly aggregation

runs. Correction runs allow re-settlement based on updated input data, with full audit trail of changes between settlement versions.

The drill-down feature enables settlement operators to trace any final result back through the formula hierarchy to the original input data, with each intermediate result visible alongside the formula that produced it. Settlement data can be exported to Excel, CSV, and XML formats, and the module integrates directly with Moldelectrica's accounting system (ERP) for invoicing workflows.

A dedicated Transnistrian region compensation mechanism is included, implementing the specific settlement formulas required for the financial treatment of energy flows involving the Transnistrian region, as governed by applicable Moldovan legislation and regulatory decisions.

4.4.6 Market Participant Registration (MPR)

The Market Participant Registration module maintains the central standing data repository used by all other MMS modules. The module follows the ENTSO-E role model concepts, supporting entity types including Balance Responsible Parties (BRPs), Balancing Service Providers (BSPs), capacity traders, grid loss energy suppliers, and their associated organizational hierarchies.

Standing data registration follows a structured workflow: market participants submit registration data electronically via the MMS participant portal (or via system-level API for bulk operations), MMS operators validate and approve the data, and approved registrations become effective on a specified date. The "effective dates" concept ensures that all MMS modules always use the correct standing data version for any given business process execution timestamp. All data changes are tracked with full audit trail, enabling regulators and operators to review the complete history of any registration record.

The module maintains separate registry datasets per MMS functional area, as specified in the ToR: scheduling registry (control area, balancing area, balancing group, BRP contact details, connection point codes, generation/consumption limit values), cross-border capacity registry (LFC area, capacity coordinator, cross-border sections, capacity products and limits), balancing market registry (EIC codes, metering points, min/max power, ramp rates, synchronization times, balancing product types), grid losses registry (supplier details, BRP associations, max power), and settlement registry (bank account details, credit cover limitations). Standing data supports upload in XML format and download in Excel, CSV, and XML formats.

4.4.7 Reporting and Analytics (RS)

The Reporting module delivers comprehensive reporting capabilities for both internal Moldelectrica operations and external regulatory obligations. The module is built as an integrated component of the MMS (not an external reporting tool), with direct database connectivity ensuring real-time data availability without scheduled batch transfers.

Operator reports are integrated directly into the MMS user interface, connected to the transactional database for immediate visibility of settlement results, market activity, and operational metrics. Reports can be displayed in tabular or graphical form, with filtering, sorting, and drill-down capabilities. Users can create customized report templates and share them with colleagues, with access controlled by user privileges.

For external regulatory reporting, the module generates all required submissions to the ENTSO-E Transparency Platform in the mandated CIM/XML format, covering generation, load, transmission, balancing, and cross-border exchange data categories. REMIT (Regulation on Energy Market Integrity and Transparency) reporting obligations are supported through automated data extraction and formatting. Moldovan national regulatory reports for ANRE and other authorities are generated per the templates and schedules defined during the Detail Design phase.

A public web page capability allows Moldelectrica to publish selected market data (prices, volumes, reports) to external stakeholders, with configurable publication rules and formatting. All report outputs can be exported to CSV and Excel formats.

Technology Stack Summary

The complete solution stack includes:

- PROCESIO Enterprise Automation & Integration Platform
- ibd15 Market Settlement Calculation Engine
- Microsoft SQL Server (Enterprise-grade relational database)
- Proxmox VE virtualization platform
- Dell PowerEdge R7625 servers (6x) for compute
- Dell PowerStore 1200T storage arrays (2x) for data
- Cisco Catalyst switches for network connectivity
- Fortinet FortiGate-120G firewalls + FortiWeb-600F WAF
- IBM TS4300 tape library for backup and archival
- Active/Passive dual-datacenter deployment with automatic failover

System Architecture and Non-Functional Requirements

The MMS is designed to meet all non-functional requirements specified in the Terms of Reference, ensuring enterprise-grade reliability, performance, and usability for Moldelectrica's mission-critical market operations.

4.5.1 Deployment Environments

The solution provides three distinct environments as required by the ToR: (1) Production environment — the live operational system hosting all MMS modules, deployed in the primary datacenter with active compute and storage resources; (2) Test/Staging environment — a functionally equivalent environment used for user acceptance testing, regression testing, formula validation, and operator training, isolated from production data; (3) Disaster Recovery environment — a passive replica of the production system in the secondary datacenter, with continuously replicated data and pre-configured virtual machines ready for failover activation within 15 minutes of failure detection.

4.5.2 System Availability and Performance

The MMS is designed for 99.5% availability as specified in the ToR, measured on a monthly basis excluding planned maintenance windows. The dual-datacenter active/passive architecture ensures that a complete datacenter failure results in service resumption within 15 minutes through automated failover procedures. The infrastructure is sized to support the ToR's specified load parameters: up to 50 concurrent MMS operator users, 1,000 registered Market Participants, 100 Balancing Service Providers, 1,000 Balance Responsible Parties, and 50 grid loss energy suppliers. Database queries and report generation are optimized through indexing strategies, materialized views, and connection pooling to ensure sub-second response times for standard operations.

4.5.3 Multi-Language User Interface

The MMS user interface supports three languages as required: English, Romanian, and Russian. Language selection is available per user session, with all interface elements (menus, labels, validation messages, help texts) fully localized. The localization framework uses externalized resource files, allowing Moldelectrica to update or add translations without system modification. Report templates support language-specific formatting for dates, numbers, and currency values.

4.5.4 Validation Rules Engine

A configurable validation rules engine operates across all MMS modules, implementing both formal (syntactical) and content (business logic) validation. Validation rules are defined through the MMS operator interface and can be modified without developer intervention. Rules are applied to incoming data (schedule submissions, bid submissions, registration data) and generate clear error messages identifying the specific validation failure. The rules engine supports cross-field validation, cross-module validation (e.g., validating a schedule against registered capacity limits from the MPR module), and temporal validation against market calendar constraints.

4.5.5 Market Calendar and Gating

A centralized market calendar governs all time-sensitive operations across MMS modules. The calendar defines gate opening and closing times for schedule submissions, balancing bid submissions, capacity nominations, and settlement runs. MMS operators can configure calendar parameters (including holiday definitions and special trading day rules) through the administrative interface. The gating mechanism automatically enforces submission deadlines, preventing late submissions while providing clear notification to market participants about upcoming and past gate closures.

Integration Architecture

The MMS integrates with multiple internal and external systems to form a complete market management ecosystem. All integrations are implemented through the PROCESIO orchestration layer, providing centralized monitoring, error handling, retry logic, and audit logging for every data exchange.

4.6.1 Internal Moldelectrica Systems

- **SCADA-EMS:** SCADA-EMS: Real-time data exchange for system frequency, ACE (Area Control Error), activated balancing energy, and grid state information used by the Balancing Market module for activation optimization.
- **Metering System:** Metering Data Management System (MS): Integration via RESTful API for receiving metered generation, consumption, and exchange values used in settlement calculations. The interface supports JSON and XML data formats with OAuth 2.0 authentication, as specified in the ToR.
- **Accounting System:** ERP/Accounting System: Automated transmission of settlement results, purchase/sales orders, and invoicing data to Moldelectrica's accounting system. The interface supports configurable output formats and scheduled data transfers.
- **Public Web Portal:** Moldelectrica Website: Automated publication of market data, reports, and public information to Moldelectrica's public web portal.

4.6.2 Neighboring TSOs

- **Transelectrica:** Transelectrica (Romania): Bilateral schedule exchange, capacity nomination matching, and coordinated settlement data exchange via ENTSO-E standard messaging (ESS, ECAN).
- **Ukrenergo:** Ukrenergo (Ukraine): Schedule exchange and cross-border capacity nomination for the Moldova–Ukraine interconnection, implemented using agreed bilateral protocols with provision for migration to ENTSO-E standards as Ukraine's synchronization with Continental Europe progresses.

4.6.3 European Platforms

- **JAO:** JAO (Joint Allocation Office): Integration with the JAO allocation platform for explicit cross-border capacity auctions (yearly, monthly, daily products). The interface handles capacity rights allocation results and feeds them into the CM module.

- **ENTSO-E TP:** ENTSO-E Transparency Platform: Automated submission of mandated transparency data in CIM/XML format, covering generation, load, balancing, cross-border, and outage data categories.
- **PICASSO/MARI:** European Balancing Platforms: The MMS architecture includes defined integration interfaces for PICASSO (aFRR) and MARI (mFRR) platforms. These interfaces will be activated when Moldova achieves eligibility for participation in European balancing energy exchange, requiring no structural changes to the MMS.

4.6.4 Data Exchange Standards

All external data exchanges conform to ENTSO-E and IEC standards: IEC 62325-451-1 (Acknowledgement), IEC 62325-451-2 (Scheduling), IEC 62325-451-3 (Settlement), IEC 62325-451-4 (Publication), IEC 62325-451-5 (Status Request), IEC 62325-451-6 (Capacity), and IEC 62325-451-7 (Balancing). Internal API integrations use RESTful architecture with JSON payloads, HTTPS encryption, and OAuth 2.0 / API key authentication as specified in the ToR.

Security Architecture

The MMS implements a defense-in-depth security model spanning network, application, and data layers, ensuring the confidentiality, integrity, and availability of market-critical data.

4.7.1 Network Security

The Fortinet FortiGate-120G firewalls provide stateful inspection, intrusion prevention (IPS), and application-aware filtering at the network perimeter. The FortiWeb-600F Web Application Firewall protects the MMS web interfaces against OWASP Top 10 threats including SQL injection, XSS, and CSRF attacks. Network segmentation isolates the MMS production, test, and management environments, with dedicated VLANs and firewall rules controlling inter-zone traffic. DDoS mitigation and advanced persistent threat (APT) detection are active at all network entry points.

4.7.2 Application Security

The MMS implements Role-Based Access Control (RBAC) with granular permissions per module, function, and data scope. User authentication supports integration with Moldelectrica’s existing directory services (LDAP/Active Directory), with support for two-factor authentication (2FA) for privileged operations. Session management enforces automatic timeout, concurrent session limits, and secure token handling. All user actions are logged in an immutable audit trail with timestamps, user identity, action type, and affected data records.

4.7.3 Data Security

Data at rest is encrypted using AES-256 on the Dell PowerStore storage arrays. Data in transit is encrypted using TLS 1.2/1.3 for all web interfaces and API communications. Database-level encryption protects sensitive fields including market participant financial data, settlement amounts, and authentication credentials. Backup data on the IBM TS4300 tape library is encrypted using hardware-based encryption. Data residency is maintained entirely within Moldelectrica’s datacenter infrastructure — no market data leaves the premises except through the defined external integration interfaces.

Data Management and Migration

The MMS implements comprehensive data management practices covering the entire data lifecycle from ingestion through archival.

Data retention follows the ToR requirement of 5 years for operational data (schedules, bids, settlement results, offers) with configurable retention periods per data category. Long-term

archival beyond the 5-year operational window is handled by the IBM TS4300 tape library, with indexed retrieval capability for regulatory audits.

The data migration strategy during implementation addresses the transfer of standing data (market participant registrations, grid topology, connection points) and historical data (past schedules, settlement results) from any existing Moldelectrica systems. The migration will follow a phased approach: data mapping and transformation rules defined in Phase 1, automated migration scripts developed and tested in Phase 2, trial migration with validation in Phase 3, and final production migration with parallel verification in Phase 4.

The backup strategy implements the 3-2-1 principle: three copies of data, on two different media types, with one copy offsite (replicated to the DR datacenter). Production database backups run on a configurable schedule (default: full backup weekly, differential daily, transaction log every 15 minutes). Recovery Point Objective (RPO) is less than 15 minutes; Recovery Time Objective (RTO) is less than 15 minutes for datacenter failover, less than 4 hours for data restore from backup.

Training and Knowledge Transfer

The training program ensures that Moldelectrica's operational and technical staff are fully prepared to operate, administer, and maintain the MMS independently after project completion.

The training program is structured into three tracks: (1) MMS Operator Training — targeted at Moldelectrica's market operations staff, covering each functional module's daily operations, schedule management, balancing activation, settlement monitoring, and report generation. Duration: 5 days per module group (SP/BM/CM, GL, ST, MPR/RS). (2) System Administrator Training — targeted at Moldelectrica's IT staff, covering system configuration, user management, backup/restore procedures, monitoring and alerting, performance tuning, and environment management. Duration: 5 days. (3) Settlement Operator Training — specialized training for settlement staff covering the ibd15 formula editor, settlement workflow configuration, formula versioning, test runs, and drill-down analysis. Duration: 5 days.

Training materials include comprehensive user manuals (per module), system administrator guide, API documentation, and video tutorials for common workflows. All documentation is delivered in English with Romanian translations for end-user materials. A training environment (separate from production and test) is available for ongoing skill development after go-live.

Standards and Regulatory Compliance

The MMS is designed for full compliance with the ENTSO-E regulatory and technical standards framework, supporting Moldelectrica's path toward full ENTSO-E membership and participation in the European internal energy market.

The following standards and regulations are addressed by the MMS implementation:

- **Regulation (EU) 2019/943:** EU Regulation 2019/943 on the internal market for electricity — market design principles, balancing responsibilities, cross-border participation
- **Directive (EU) 2019/944:** EU Directive 2019/944 on common rules for the internal market for electricity — consumer protection, supplier switching, data management
- **GL EB (2017/2195):** Commission Regulation (EU) 2017/2195 establishing a guideline on electricity balancing (GL EB) — balancing market design, standard products, European platforms

- **CACM (2015/1222):** Commission Regulation (EU) 2015/1222 establishing a guideline on capacity allocation and congestion management (CACM) — cross-border capacity allocation, coordinated calculation
- **IEC 62325-451:** IEC 62325-451 series (parts 1–7) — CIM-based European energy market data exchange standards for scheduling, settlement, publication, capacity, and balancing
- **ESS:** ENTSO-E Scheduling System (ESS) — schedule exchange and matching processes
- **ECAN:** ENTSO-E Capacity Allocation and Nomination (ECAN) — cross-border capacity nomination and matching
- **ERRP:** ENTSO-E Electronic Reserve Resource Process (ERRP) — balancing reserve exchange processes
- **Transparency Platform:** ENTSO-E Transparency Platform regulation — mandatory data publication for generation, load, transmission, and balancing
- **REMIT:** REMIT (Regulation on Energy Market Integrity and Transparency) — trade reporting and market monitoring obligations
- **FSKAR:** FSKAR (Financial Settlement of Kf, ACE and Ramping Period) — TSO-TSO settlement processes

5. Implementation Methodology

Phased Delivery Approach

Implementation will follow a structured, phased approach aligned with the Tender's work breakdown structure (TOR). The approach minimizes risk, validates assumptions at each phase, and ensures Moldelectrica maintains operational continuity throughout the project.

Work Breakdown Structure (WBS)

The project execution follows a structured 4-phase approach over a maximum of 12 months:

- Phase 1 — Analysis & Design (Months 1–3): Requirements validation, system architecture finalization, detailed technical design, and prototype development. Deliverables include the Requirements Traceability Matrix, System Architecture Document, and UI/UX prototypes. Budget: EUR 150,000.
- Phase 2 — Core Development (Months 3–7): Development of all MMS functional modules including Day-Ahead Market, Intraday Market, Balancing Market, Bilateral Contracts, Settlement & Invoicing, Metering Data Management, and Reporting & Analytics. Budget: EUR 275,000.
- Phase 3 — Module Integration & Testing (Months 7–10): System integration testing, performance testing, security testing, user acceptance testing, and regulatory compliance validation. Budget: EUR 200,000.
- Phase 4 — Deployment, Migration & Training (Months 10–12): Production deployment, data migration from legacy systems, end-user training, administrator training, and go-live support. Budget: EUR 87,500.

Total services budget: EUR 712,500 (1,425 man-days). Hardware & infrastructure: EUR 1,154,573.09. Software licenses: EUR 470,000. Grand total: EUR 2,337,073.09.

General Approach

- Phase 1 - Discovery & Readiness: Comprehensive assessment of current systems, data, processes, and integration requirements. Deliverable: Signed Readiness Report and High-Level Design (HLD) document.
- Phase 2 - Build & Integration: Development of PROCESIO workflows, module configuration, API integrations, and database design. Full unit and integration testing.
- Phase 3 - Infrastructure Setup: Hardware provisioning, virtualization configuration, security hardening, and network setup. Both primary and DR datacenters configured and tested.
- Phase 4 - User Acceptance Testing (UAT): End-to-end system testing with Moldelectrica and stakeholders. Defect resolution and sign-off on all modules.
- Phase 5 - Data Migration & Cutover: Parallel run period, data validation, production cutover, and system stabilization.
- Phase 6 - Knowledge Transfer & Support: Staff training, documentation, transition to production support, and handoff to Moldelectrica operations.

Project Governance

A formal governance structure ensures effective decision-making, issue escalation, and stakeholder alignment throughout the implementation. The governance framework consists of three levels: (1) Steering Committee — comprising senior representatives from Moldelectrica and the Consortium leadership, meeting monthly to review progress, approve major scope decisions, and resolve strategic issues; (2) Project Management Office (PMO) — led by the Project Manager with weekly operational meetings covering progress tracking, risk register updates, and resource allocation; (3) Technical Working Groups — module-

specific teams meeting bi-weekly during development phases to review technical decisions, integration progress, and test results.

Change control follows a formal process: change requests are documented with impact assessment (scope, budget, timeline), reviewed by the PMO, and approved by the Steering Committee for changes exceeding the ±10% tolerance band. All decisions are recorded in the project decision log with clear accountability.

Quality Assurance and Testing Strategy

Quality assurance is embedded throughout the project lifecycle, not limited to a single testing phase. The testing strategy follows a V-model approach with test planning beginning in Phase 1 and test execution intensifying through Phase 3.

The testing levels include: (1) Unit Testing — automated tests for individual PROCESIO workflows and ibd15 calculation formulas, executed continuously during development; (2) Integration Testing — validation of data flows between MMS modules and external systems, including SCADA-EMS, Metering System, and ERP interfaces; (3) System Testing — end-to-end scenario testing covering complete business processes (e.g., full scheduling cycle from submission through aggregation, full settlement run from data loading through invoicing); (4) Performance Testing — load testing with the ToR's specified user volumes (50 concurrent operators, 1000 MPs) and data volumes to validate response times and throughput; (5) Security Testing — vulnerability assessment, penetration testing, and RBAC validation; (6) User Acceptance Testing (UAT) — structured test execution by Moldelectrica's business users against predefined acceptance criteria, with defect tracking and resolution.

Go-live criteria are formally defined and must be satisfied before production deployment: all critical and high-severity defects resolved, UAT sign-off from all functional areas, successful failover test of the DR environment, completion of all training programs, and formal data migration validation.

Acceptance Criteria per Phase

- **Phase 1:** Analysis and Design complete requirements traceability matrix, signed-off functional specifications, approved architecture design, and validated UI/UX prototypes
- **Phase 2:** Core Development complete all modules passing unit tests with >90% code coverage, integration test suite passing, and demonstration of each module's core functionality
- **Phase 3:** Integration and Testing complete system test report with all critical scenarios passing, performance test results meeting SLA targets, security assessment report with no critical vulnerabilities, and UAT sign-off
- **Phase 4:** Deployment complete successful production deployment, data migration validation report, training completion certificates, operational readiness confirmation, and formal project closure

6. Project Team

The project will be staffed by experienced professionals from both Ringhel Team SRL / PROCESIO and ETA2U. Key roles and experience requirements are defined below. Specific names and detailed CVs will be provided upon contract award.

Project Management

Alexandru BUCATARU — Project Manager. Over 10 years of experience in IT project management, with specific expertise in energy sector implementations. Certified PMP with proven track record delivering complex enterprise systems on time and within budget. Responsible for overall project coordination, stakeholder management, risk management, and delivery oversight.

Role: Overall project delivery, stakeholder management, risk mitigation, schedule and budget management.

Functional Architecture

Marius Valentin DRAGANUS — Lead Functional Analyst. Over 16 years of experience in business analysis and functional design for enterprise applications, including energy trading and market management systems. Expert in requirements engineering, process modeling, and regulatory compliance frameworks. Responsible for requirements validation, functional specifications, and business process optimization.

Role: Requirements analysis, functional design, workflow design, UAT coordination, and business sign-off.

Technical Architecture

Victor ROSU — Technical Architect. Over 17 years of experience in software architecture and system design, specializing in high-availability distributed systems and real-time data processing platforms. Expert in microservices architecture, API design, and cloud-native technologies. Responsible for solution architecture, technology selection, integration design, and technical governance.

Role: Solution architecture, integration design, infrastructure design, technical problem-solving, and code review.

Quality Assurance & Testing

Costin Catalin MERODE — Testing Manager. Over 19 years of experience in software quality assurance and testing management for mission-critical enterprise systems. Expert in test automation frameworks, performance testing, and security testing methodologies. Responsible for test strategy, test execution oversight, defect management, and quality gate enforcement.

Role: Test planning, test case design, UAT execution, defect tracking, and test closure.

Additional team members will include PROCESIO developers, infrastructure engineers, database specialists, and support engineers as required by the project phases. The complete project organization structure, including the 12-person team composition, reporting hierarchy, detailed role descriptions, and module assignment matrix covering all seven MMS functional areas, is provided in Annex 2 — Association Agreement: Key Personnel and Project Organization.

7. Hardware Infrastructure

ETA2U will provision and deploy a complete, enterprise-grade infrastructure designed for high availability, security, and operational reliability. Detailed specifications are provided in the ETA2U Hardware Offer document.

Core Compute Infrastructure

- 6x Dell PowerEdge R7625 servers (dual-socket, configured for Proxmox VE virtualization) with redundant power supplies and enterprise warranty
- Distributed across two datacenters (3 servers per DC) for high availability and disaster recovery

Storage Infrastructure

- 2x Dell PowerStore 1200T storage arrays with redundant controllers, 24/7 support, and advanced data protection
- SSD-based primary storage for operational databases
- Backup storage array configured for replication and archival
- 1x IBM TS4300 tape library for long-term archival and compliance retention

Network & Connectivity

- Cisco Catalyst switches (core, distribution, and access layers) with redundant uplinks
- Dell MDS FC switches for SAN connectivity
- Redundant WAN links between primary and DR datacenters
- Managed service for network monitoring and performance optimization

Security & Access Control

- Fortinet FortiGate-120G firewalls (active-active or active-passive) at network perimeter
- Fortinet FortiWeb-600F Web Application Firewall (WAF) for application-layer protection
- DDoS protection and advanced threat detection
- VPN and remote access hardening
- Regular security patching and compliance monitoring

Virtualization & Orchestration

- Proxmox VE cluster for virtual machine management and resource optimization
- High-availability cluster configuration with automated failover
- Live migration capabilities for zero-downtime maintenance

Deployment Configuration

The infrastructure employs an Active/Passive dual-datacenter model:

- Primary Datacenter: Active production, all writes, primary compute and storage
- DR Datacenter: Passive standby with replicated data, synchronized storage, ready for automatic failover
- Failover time: < 15 minutes from detection to full service resumption
- Regular failover drills to validate recovery procedures

8. Maintenance and Support

Support Model

Following the 3-year implementation and warranty period, Moldelectrica will have access to comprehensive maintenance and support services. This section outlines the structure and service levels.

Support Window

Monday–Friday, 09:00–18:00 local time, excluding legal public holidays. Extended or 24/7 support hours can be negotiated as part of the commercial amendment.

Priority Definitions & SLA

Priority	Definition	First Response	Resolution Target
Critical	Services do not work	4 hours	8 hours
High	Partial service degradation	16 hours	32 hours
Medium	Minor issues, general use possible	24 hours	72 hours
Low	Other issues	48 hours	Contextual

Support Service Packages

Three support packages are available, each providing prepaid annual support hours:

Package	Annual Hours	Best For
Essential	40 hours/year	Simple scope, low integration
Standard	80 hours/year	Medium scope, 3-6 integrations (RECOMMENDED)
Premium	160 hours/year	Complex scope, 7+ integrations, critical workflows

Prepaid hours cover: priority response, bug fixes, minor enhancements, and configuration changes. Hours not used in a year can be carried forward to the following year (up to 2 years maximum carryover). Additional hours beyond the package allocation are available at standard professional services rates.

Maintenance Services Cost

Post-warranty maintenance is structured over a 3-year period following the 1-year free warranty included in the contract. Annual maintenance costs decrease progressively: Year 2: EUR 158,040; Year 3: EUR 153,040; Year 4: EUR 148,040, for a 3-year total of EUR 459,120. Maintenance covers PROCESIO platform updates (EUR 35,000/year), ibd15 platform maintenance (EUR 15,000/year), application support and bug fixes (EUR 60,000 decreasing to EUR 50,000/year), hardware support (EUR 25,000/year), Proxmox subscription renewals (EUR 11,040/year), and FortiGate/FortiWeb security subscription renewals (EUR 12,000/year).

9. Risk Management

This section identifies key risks to the successful implementation and delivery of the Market Management System, along with mitigation strategies to minimize impact on the project timeline and deliverables.

Key Risks and Mitigations

1. Delayed System Access from Client or Vendors

Risk: Delays in providing credentials, API access, or vendor sandbox environments could delay integration development and testing phases.

Mitigation: Establish system access checklist in discovery phase. Define access request SLA (5 business days maximum) in the contract. Prioritize access requests at weekly steering meetings.

2. Integration API Undocumented or Unstable

Risk: Integration points may have incomplete documentation, unstable endpoints, or limited vendor support, increasing development effort.

Mitigation: Conduct API validation in Phase 1 using sandbox environments. Engage vendor technical support early. If scope changes due to API limitations, invoke change control process.

3. Scope Creep Beyond Tolerance Band

Risk: Incremental requirement refinements could exceed the agreed scope tolerance band, impacting budget and timeline.

Mitigation: Define ±10% scope tolerance band in contract. Implement change control process with written approval before work begins. Track all changes and maintain regular steering updates.

4. Key Client SME Unavailable During UAT

Risk: Absence of key business stakeholders during user acceptance testing could delay sign-off and extend timeline.

Mitigation: Establish UAT schedule 4 weeks in advance. Identify primary and secondary SMEs for each functional area. Define escalation process for decisions requiring sponsor involvement.

5. Data Quality Issues in Source Systems

Risk: Poor data quality in existing systems could complicate data validation and migration phases.

Mitigation: Conduct data quality assessment during Discovery phase. Create data cleansing plan jointly with Moldelectrica IT team. Define acceptance criteria for data completeness and accuracy before cutover.

6. External Vendor Integration Delays

Risk: Third-party vendors (API providers, SaaS platforms) may not meet expected response times or support levels during integration.

Mitigation: Require vendor introductions before contract signing. Log all vendor dependencies in risk register. Escalate vendor issues to vendor account management immediately if they impact critical path.

7. AI Subscription Provisioning Delays

Risk: If the MMS includes document processing requiring AI (e.g., PDF extraction), delays in provisioning the enterprise AI subscription could impact document workflow development.

Mitigation: Identify AI subscription requirements in Discovery. Establish 30-day lead time for AI platform onboarding. Make AI provisioning a client responsibility with clear dependency flagged in contract.

8. Security / Data Residency Requirements Ambiguity

Risk: Undefined or conflicting security and data residency requirements could necessitate late-stage infrastructure changes.

Mitigation: Conduct detailed security and architecture boundary workshop in Phase 1. Document all residency, encryption, and compliance requirements. Obtain sign-off from Moldelectrica IT Security before infrastructure build begins.

9. Budget Constraints Leading to Mid-Project Descoping

Risk: Budget cuts mid-project could force descoping of functionality, impacting system completeness and go-live timing.

Mitigation: Separate must-have vs. nice-to-have features in WBS at project start. Establish phased delivery plan with clear go/no-go gates. Include budget contingency for reasonable scope refinement.

10. Timeline Slippage from Underestimated Complexity

Risk: Energy market domain complexity or integration architecture challenges may emerge during build phases, extending timelines.

Mitigation: Conduct thorough Architecture Review during Phase 1. Use time-boxed spikes for high-risk integration points early in Phase 2. Maintain 10% schedule buffer in critical path activities. Hold weekly technical risk reviews.

This comprehensive risk management approach ensures that the consortium proactively monitors project health and maintains visibility into emerging risks throughout all implementation phases. Regular steering committee updates will keep Moldelectrica informed of risk status and mitigation progress.

Mihai Darzan

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