PROCUREMENT SPECIFICATION

PlantPAx® Distributed Control System
General Requirements

Jan. 28, 2020

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PART 1 GENERAL

1.01 SUMMARY

A. The Distributed Control System provided by the System Integrator shall:

1. Consist of servers, workstations, controllers, I/O modules, graphic user interfaces, and third-party equipment, along with all necessary network infrastructure.
2. Have the support of state-of-the-art and user-friendly human-machine interface (HMI) and control software.
3. Use Ethernet-based supervisory communication.
4. Include engineering services, coordination with other contractors, installation, testing, training, and remote and emergency technical support.
5. Be fully-integrated and operational as specified herein and in related drawings, except for those services and materials specifically noted.

B. The distributed control system’s architecture shall be scalable and customizable to meet the needs of this application, along with those of future expansions, having the capability for:

1. Connectivity to existing field instrument devices, human-machine interfaces (HMIs), control components, skid equipment, electrical systems, and monitoring systems.
2. Provide reference architectures that guide users to achieve multiple levels of network resiliency to limit effects of network failures throughout the control system.
3. Execution of on-line program modifications without shutting down the process under control.
4. Removal or insertion of network devices without disturbing the network.

1.02 RELATED WORK

A. Use this Section in conjunction with the Specification Sections listed below. [Modify list to include necessary Sections for this application.]

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B. Use this Section in conjunction with the following related contract documents to establish the total requirements for the distributed control system and referenced associated items:

1. The Project Contract.
2. System architecture drawings, electrical schematics, and piping and instrumentation drawings (P&ID).
3. I/O list.
4. Preliminary design schedules for distributed control system deliveries.

1.03 REFERENCE STANDARDS

A. Distributed control system installations shall conform to the following codes and standards:

1. National Electrical Code (NEC) (ANSI/NFPA 70) and ANSI/NFPA 79, Industrial Control Equipment
2. Occupational Safety and Health Act (OSHA) Standards
3. Federal Communications Commission (FCC) Regulations
4. ANSI-EIA, NEMA, and IEEE Standards, including National Electrical Safety Code (NESC) (ANSI Standard C)
5. Applicable local electrical and safety codes and standards

B. Distributed control system hardware shall achieve certifications including:

1. cULus Certification
2. Compliance with European Union Directives
3. Compliance with Australian Acts
4. Certification for Marine and Off-shore Applications
5. UL, CSA Certification
6. Functional Safety Certifications

Specific certifications shall be as specified in the related Sections.

C. Ethernet devices, as required, shall further be:

1. ODVA conformance-tested to EtherNet/IP specifications.
2. In compliance, as required, with Directive 2014/53/EU (RED). [OPTION]

1.04 SYSTEM INTEGRATOR QUALIFICATIONS

A. The distributed control system project delivery integrator shall be regularly engaged in the design and installation of similar systems and subsystems in this type of industry application, and shall meet the following qualifications:

1. Presents proof of member status as a Rockwell Automation Solutions Partner, Level Integrator including the Process Program recognition, or a Rockwell Automation Recognized System Integrator, Level Integrator including the Process Program recognition.
2. Assigns to this project personnel trained on general process instrumentation, along with the specific computers, controllers, and proposed software. As it applies, their training program shall have been administered by the distributed control system manufacturer.
3. Provides references from projects similar in size to this project, including a minimum of one PlantPAx project.
4. Holds a valid UL 508 certification for panel fabrication.
5. Maintains a service facility with a staff capable of design, fabrication, installation, programming, and testing the distributed control system and its components and has the capacity to respond to on-site issues.

B. The system integrator shall allow the facility manager and engineer to witness the factory testing procedure before shipment and shall provide a completed PlantPAx System Checklist document.

1.05 SYSTEM INTEGRATOR RESPONSIBILITIES

A. System integrator responsibilities shall comprise the design, installation, testing, training, and start-up for the PlantPAx Distributed Control System, including equipment selection, Studio 5000 Logix Designer and FactoryTalk software programming, network communication, and security. The system integrator shall coordinate equipment supplied by the manufacturer, existing equipment and materials, and work supplied by other subcontractors. All equipment shall be compatible or configured to become compatible.

1. The system integrator shall provide field instruments for measurement and other inputs and outputs ...
2. The system integrator shall provide controller hardware and software for monitoring and controlling all field devices.
3. The system integrator shall provide workstations including HMI panels for monitoring and controlling operation on-site and shall provide hardware and software to enable remote access to the information.
4. The system integrator shall provide engineering workstations for maintaining system operation: configuration, application development, and maintenance.
5. The system integrator shall provide all necessary servers to host essential software components of the system. Initial software loading, application software programming, and operating system configuration will be among the responsibilities of the system integrator.
6. The system integrator shall provide and configure infrastructure (Ethernet switches and cabling) to integrate the system network.
7. The system integrator shall provide for communications between all connected devices (servers, controllers, HMI, and field instruments).
8. The system integrator shall configure a virtual infrastructure, with virtual machines running different operating systems and applications from separate locations on the same server. [OPTION]

B. The system integrator shall coordinate all work with plant operating personnel to minimize impact on operation.

1.06 PROJECT/SITE REQUIREMENTS

A. Operating and Non-operating Conditions:

1. Infrastructure equipment shall be designed to operate at project ground elevation, within ranges of:
   a) At minimum 0°C to 60°C (32°F to 140°F).
   b) 5 to 95% non-condensing relative humidity.

2. Infrastructure equipment shall be designed for storage within ranges of:
a) At minimum -40°C to 85°C (-40°F to 185°F).

b) 5 to 95% non-condensing relative humidity.

3. Other equipment-specific operating and non-operating condition requirements shall be as specified in the related Sections. Control rooms and server rooms shall be air-conditioned to meet all sensitive equipment requirements. Area ventilation and condensation control shall be provided as necessary.

B. Environmental and Hazardous Area Classifications: Refer to Section XX XX XX and electrical drawings.

1.07 SUBMITTALS

A. General: All submittals shall be made in conformance with Section XX XX XX and shall provide a complete record of the equipment as manufactured and delivered.

1. Throughout the project, any deviations from previous submittals shall be noted on the affected document or on a formal deviation list and accepted or refused with the facility engineer’s initials.

2. When manufacturer catalog cuts or other general product documents are submitted, non-applicable information shall be stricken.

B. Project Plan and Schedule: The system integrator shall submit a project plan and schedule within 45 calendar days after the notice to proceed, including the following, at a minimum.

1. Description of the proposed distributed control system and its coordination with other systems, along with a preliminary system architecture drawing. Approaches to installation, testing, training, and start-up shall be described in detail.

2. List of controller and HMI software to be used, including versions and descriptions of project application. The software list shall be approved before programming is developed.

3. An organizational chart of the system integrator’s project personnel, along with each person’s resume and project involvement, unless the information was unchanged from a prior submittal.

4. Preliminary or sample shop drawings, loop diagrams, interconnect diagrams, and schematics.

5. Distributed control system project schedule, coordinated with the demands of the general contractor schedule and including, at minimum, the following milestones:

   a) Project coordination meeting dates
   b) Purchase, fabrication, and assembly dates for hardware
   c) Purchase and configuration dates for controller and HMI software
   d) Shipment dates for distributed control system equipment
   e) Installation dates for distributed control system equipment
   f) Testing dates
   g) Start-up dates for subsystems (controllers, workstations)
   h) Training dates (factory and application training)
   i) Dates of subsequent submittals

C. Report from the PlantPAx System Estimator Tool: The system integrator shall submit a report based on component selection and sizing results from processor utilization.
calculation of the Rockwell Automation tool, including the tool’s developed bill of material (BOM) of controllers, I/O, networks, drives, cabling, and devices.
D. Input/Output (I/O) List: The system integrator shall submit a complete I/O address list (active and at least 20% spare) for equipment connected to the distributed control system.

1. The I/O list shall be organized so that all control panel devices show:
   a) Tag numbers with loop numbers designated for sorting
   b) Description of function
   c) Wiring location
   d) Point address (rack, slot, and point/channel)
   e) Type (DO, DI, AO, AI, PO, or PI) (where D=Digital, A=Analog, P=Pulse)
   f) Range/State
   g) Engineering units
   h) Alarm limits
   i) Drawing location

2. The I/O list shall be submitted in both hard copy and electronic file formats.

E. Software Packages Submittals: The system integrator shall submit descriptive literature, manufacturer catalog cuts, and detailed descriptions of distributed control system project application for controller and HMI software packages.

F. Network Infrastructure Submittals: The system integrator shall submit shop drawings or edited manufacturer catalog cuts and interconnection drawings for network switches. Drawings shall show dimensions, physical configurations, connection methods, and mounting details.

G. Component Submittals: The system integrator shall submit shop drawings or edited manufacturer catalog cuts, layout drawings, and interconnection drawings for all distributed control system equipment as specified in the related Sections. Schematics shall be included when systems cannot be clearly defined on a single line diagram.

   [Modify list to include components of this application.]

1. Computer System Hardware
2. Controller Hardware
3. Control Panels and Panel-Mounted Equipment
4. XX

H. Services Submittals

1. Testing: The system integrator shall submit a plan for system demonstration and final testing that includes subsystem descriptions, scope of testing, testing instruments to be used, and testing methods. Test reports shall be submitted for each subsystem.
2. Training: The system integrator shall submit a plan for both factory and application training, including descriptions of training sessions.

I. Final Submittals: The system integrator shall make a final submittal, including the following, at minimum.

1. Operation and maintenance manuals for all distributed control system equipment in both hard copy and electronic file format – All documents shall be edited to strike out information that is not applicable.
2. Parts lists and spare parts recommendations.
3. As-built documentation – Final shop drawings, interconnection diagrams, and schematics shall be edited to incorporate change orders and modifications. Equipment and device wiring diagrams and other drawings shall be included to reflect the “as-built” condition, showing device tags, conduit/piping runs, supports, mounting details, and termination numbers.

4. Original Licensed Software and Licenses – Software shall be licensed to the facility at the time of purchase. Submittal shall include actual software, software documentation, and the license agreement with serial numbers and user registration numbers.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The system integrator shall ensure that instruments and equipment are boxed or crated and covered with sheeting for protection during shipment and storage.

1. All components shall be kept unexposed to elements which could degrade them, including weather, moisture, dust, and corrosive liquids and gases. Packaging shall include dehumidifying agents as necessary.

2. Finished surfaces shall be protected from damage, such as impact, abrasion, and discoloration.

B. The system integrator shall ensure that instruments and equipment are mounted on skids for delivery to the jobsite.

1. Lifting rings and/or other accommodations shall be provided for moving without removing protective sheeting.

2. Weights and handling instructions shall be present on clearly visible and protected shipping tags.

C. The system integrator shall ensure that control rooms and server rooms comply with the environmental requirements of sensitive equipment before its delivery.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Rockwell Automation – PlantPAx® Distributed Control System.
B. XXXX
C. Manufacturers listed above are classified as sole source. No substitution will be considered.

2.02 SYSTEM COMPONENTS

A. The distributed control system’s network shall use Ethernet-based supervisory communication.

B. The distributed control system shall utilize the following reference architectures to ensure it complies with the project’s network resiliency requirements:

1. Redundant (PRP) - Multiple fault tolerant architecture providing zero recovery time upon failure.

2. Resilient (DLR) – Single fault tolerant architecture providing fast recovery time
3. Simplex – Simplex architecture providing the most freedom but least resilient option.

C. The distributed control system, classified with the following architecture, shall be scalable. [Choose current applicable architecture]

1. Skid architecture with no servers or workstations.
2. System architecture with single station (Independent workstation – IndWS) that acts as Process Automation System Server (PASS), Operator Workstation (OWS), and Engineering Workstation (EWS).
3. Distributed system architecture with a single server and multiple Operator Workstations (OWSs) and Engineering Workstations (EWSs).
4. Distributed system architecture with multiple servers and multiple Operator Workstations (OWSs) and Engineering Workstations (EWSs).

D. The distributed control system’s network shall use Ethernet-based supervisory communication.

E. The distributed control system’s components shall be selected and properly sized using the PlantPAx System Estimator Tool.

F. Controllers, network media, and adapters shall support enhanced redundancy on EtherNet/IP networks.

G. Process control components shall support continuous process and batch applications.

H. I/O components shall deploy efficiently and provide flexible expansion.

I. Motor control components shall offer simplified programming and configuration.

J. Skid-based equipment, as specified in the related Sections, shall be fully integrated into the distributed control system.

K. Development software shall be used to configure the various system components seamlessly.

L. General Specifications:

1. Instrumentation and electronic equipment shall use printed circuitry and be coated with epoxy or similarly treated to prevent contamination by dust, moisture, and other contamination. All on-site equipment and system components shall be designed for installation in dusty and humid conditions.

2. Appropriate mounting hardware, floor stands, wall brackets, and racks shall be provided. Galvanized fasteners shall be used for wall-mounting and floor-mounting enclosures. Stainless steel fasteners shall be used in corrosive areas. Anchors shall be of appropriate depth.

3. Modular construction-type equipment, capable of field expansion, shall be provided.

4. Equipment, cabinets, and devices furnished shall be designed for continuous service. The products shall be similar, from a single manufacturer, and models which are currently in production.

5. Instrument and transmitter indicators shall be linear in process units, accurate to two percent or less.

6. To achieve protection from radio frequency interference, effective equipment separation, grounding, and bonding techniques shall be used.

7. The network components shall be interoperable with standard network equipment using IEEE 802.3 technology and there shall be no modifications of Ethernet protocol that create incompatibility.

8. The system’s hardware components that are not herein specified shall be as specified in the related Sections.
M. Electrical Specifications

1. Materials and electrical equipment shall have all necessary approvals and certifications, including UL.
2. Electrical equipment shall be operable on 60 Hz at 120 VAC power, except as noted.
   a) Regulators shall be provided between power supply and connected equipment where necessary.
   b) Constant voltage transformers shall be supplied as required.
   c) Switches with double-pole, double-throw contacts rated at a minimum of 600 VA shall be provided.

3. Electronic instrumentation shall use
   a) Isolated 4 to 20 mA DC, capable of 750 ohms.
   b) EtherNet/IP
   c) HART
   d) Profinet
   e) Foundation FieldBus

4. Zero-based signals will not be allowed. Noted exceptions to standard signals shall include:
   a) Devices connected to field device networks.
   b) Instruments within the same panel.
   c) Equipment outputs that are converted to compatible standard signal.

5. Provisions shall be made in the design and construction to ensure that, if a power interruption occurs, the system shall go through an orderly shutdown with no memory loss and resume normal operation without a manual reset.

   a) Surge protection shall be provided for:
      i. 120 VAC power feeds.
      ii. Analog signal.
      iii. RF coaxial cable.
      iv. Inductive loads.
      v. Telephone lines.
   b) Surge protection for components shall be as specified in the related Sections.

2.03 SYSTEM INFRASTRUCTURE

A. Managed Ethernet switches shall be installed and configured to connect devices.

[Choose applicable switches and switch components]

1. Layer 3 Managed Ethernet Switches, Cisco Catalyst 9300, shall have the following attributes:
   a) 19-in. rack mount, scalable
b) Network modules available as required: Cisco StackWise stacking ports: copper-based Cisco StackWise cabling.
c) 12 Gigabit Ethernet (GE) for PoE/PoE+.
d) Minimum 12 100MB/1GB Ethernet small form-factor pluggable (SFP) slots.
e) Power supply installed, providing 60 W for PoE/PoE+.
f) Second power supply installed, providing 185 W total for PoE/PoE+. [OPTION]
g) Cisco StackPower: Cisco proprietary power stacking cables
h) Redundant Power Supplies
i) Conformal coating. [OPTION]
j) Environmental ratings, including –
   i. -40°C to 60°C (-40°F to 140°F) operating temperature
   ii. 5 to 95% relative humidity
   iii. IP30
k) Certifications/compliances, including –
   i. cULus File E65584, Industrial Control Equipment
   iii. Australian Radiocommunications Act EN 61000-6-4, Industrial Emissions
   iv. European Union 94/9/EC ATEX Directive EN 60079-0, General Requirements
   v. KC Article 58-2 of Radio Waves Act, Clause 3
   vi. RED Directive 2014/53/EU

l) ODVA conformance tested to EtherNet/IP specifications.
m) Meets IEEE-1588 standard for synchronization accuracy.

2. Distribution Layer 3 Managed Ethernet Switches, Allen-Bradley Stratix 5400, shall have the following attributes:
   a) DIN rail, scalable, 12 to 20 port versions, including RJ45, Combo, and PoE/PoE+.
   b) 4 or 8 Gigabit Ethernet (GE) small form-factor pluggable (SFP) slots. [OPTION]
   c) 24V DC power input.
   d) Environmental ratings, including –
      i. -40°C to 70°C (-40°F to 158°F) operating temperature
      ii. 5 to 90% relative humidity

   e) Certifications/compliances, including –
      i. cULus File E65584, Industrial Control Equipment
      iii. Australian Radiocommunications Act ACMA EMC Std 08
      iv. European Union 94/9/EC ATEX Directive EN 60079-0, General Requirements
      v. KC Article 58-2 of Radio Waves Act, Clause 3

   f) ODVA conformance tested to EtherNet/IP specifications.
   g) Meets IEEE-1588 standard for synchronization accuracy.

3. Access Layer 2 Managed Ethernet Switches, Allen-Bradley Stratix 5400, shall have the following attributes:
   a) Scalable, 8 to 20 port versions, including RJ45, Combo, and PoE/PoE+.
   b) 4 or 8 Gigabit Ethernet (GE) or 4 or 8 Fast Ethernet (FE) small form-factor pluggable (SFP) slots. [OPTION]
   c) 24V DC power input.
   d) Environmental ratings, including –
      i. -40°C to 70°C (-40°F to 158°F) operating temperature
      ii. 5 to 90% relative humidity
e) Certifications/compliances, including –
   i. cULus File E65584, Industrial Control Equipment
   iii. Australian Radiocommunications Act ACMA EMC Std 08
   iv. European Union 94/9/EC ATEX Directive EN 60079-0, General Requirements
   v. KC Article 58-2 of Radio Waves Act, Clause 3

f) ODVA conformance tested to EtherNet/IP specifications.

g) Meets IEEE-1588 standard for synchronization accuracy.

4. Access Layer 2 Managed Ethernet Switches, Allen-Bradley Stratix 5700 or 5800 shall have the following attributes:

   a) Scalable, 10, 18, or 20 port versions, including RJ45, Combo, and PoE/PoE+.
   b) 2 Fast Ethernet (FE) small form-factor pluggable (SFP) slots. [on 20 port]
   c) 24V DC power input.
   d) Conformal coating. [OPTION]
   e) Environmental ratings, including –
      i. -40°C to 60°C (-40°F to 140°F) operating temperature
      ii. 5 to 90% relative humidity
      iii. IP30
   f) Certifications/compliances, including –
      i. cULus File E65584, Industrial Control Equipment
      iii. Australian Radiocommunications AS/NZS CISPR 11, Industrial Emissions
      iv. European Union 94/9/EC ATEX Directive EN 60079-0, General Requirements
      v. KC Article 58-2 of Radio Waves Act, Clause 3
   g) ODVA conformance tested to EtherNet/IP specifications.
   h) Industry standards, including –
      i. IEEE-1588, Synchronization Accuracy.
      ii. IEEE 1613, IEC 61850-3, Substation KEMA
      iii. IEEE 1613, Electric Power Station Communications Networking
      iv. IEC 61850-3, Electric Substations Communications Networking

5. Small Form-factor Pluggable (SFP) Transceivers, Allen-Bradley Stratix, shall have the following attributes:

   a) Multi-mode or single mode.
   b) Gigabit Ethernet (GE) connections for distances up to 550 m (1804 ft) or Fast Ethernet (FE) connections for distances up to 10 km (32,808 ft).
   c) Industrial rated for -40°C to 85°C (-40°F to 185°F).
   d) Support Digital Optical Monitoring (DOM) via the command-line interface (CLI).

6. Service Router (Layer 2/3), Allen-Bradley Stratix 5900, a fixed-configuration data router that provides four 10/100 Fast Ethernet (FE), 1 Gigabit Ethernet (GE), and
WAN connections over a serial communication port, shall have the following attributes:

a) Wall-, floor-, or DIN rail-mounted chassis rated for use in industrial automation and harsh environments.
b) Powered by an external AC power adapter.
c) Capable of bridging and multi-protocol routing between LAN and WAN ports.
d) Class A compliance, IP41.
e) Rated for -25°C to 60°C (-13°F to 140°F) with additional shock/vibration protection.

Ethernet switches and switch components not herein specified shall be as specified in the related Sections.

B. Ethernet physical media shall be Cat 5e industrial-grade cabling, or better, with rugged connector construction.

1. Cabling components shall be selected based on an assessment of environmental factors of each area of the network:
   a) Using M.I.C.E. (Mechanical - Ingress - Climatic/Chemical - EMI) analysis.
   b) Complying with EtherNet/IP, ODVA, and EIA/TIA 569B ISO/IEC standards.

2. 2-pair and 4-pair twisted-pair cable (shielded or unshielded) lengths shall meet the transmission performance requirements formulated in the ODVA installation specification.

2.04 SERVERS

A. Servers shall be hosted on server class computers.

[Choose applicable servers]
B. Process Automation System Server(s) (PASS) shall host essential software components to run the system, along with the HMI servers, data server, and alarm server.

1. FactoryTalk Directory (FTD) server shall secure information from software across the network, allowing central administration and making applications and settings available without duplication.
2. FactoryTalk Activation server shall manage the files required for over-the-Internet activation of the Rockwell Automation software products.
3. FactoryTalk View HMI server shall store HMI project components, such as graphic displays, serving these components to workstations. The HMI server shall be capable of managing tag databases and logging historical data.
4. FactoryTalk View Data server shall provide access to information from the process controllers to servers and workstations.
5. FactoryTalk View Alarm and Event server shall publish information from controllers and servers, making it available to all subscribing workstations.

C. Engineering Workstation Application Server (AppServ-EWS) shall use Microsoft Remote Desktop Services (RDS) to serve up to five engineering workstations as thin clients from a single server.

D. Operator Workstation Application Server (AppServ-OWS) shall use Microsoft Remote Desktop Services (RDS) to serve up to ten operator workstations as thin clients from a single server.

E. Information Management Application Servers (AppServ-Infos) shall offer data management and decision support functionalities. Each AppServ-Info shall be a separate server.

1. Historian Server shall collect, store, and manage data from the facility in the system.
2. VantagePoint Server shall act as a decision support tool by using VantagePoint software.
3. SQL Server shall use an SQL database to store and access process data from all SQL-base applications.

F. Asset Management Server (AppServ-Asset) shall add maintenance and plant operations to the system, providing controller data backup for disaster recovery, diagnostics, calibration, real-time monitoring, and auditing of equipment and network health.

G. Domain Controller shall be local (within the local firewall) and shall store user account information, authenticate users, and enforce security policies.

H. The distributed control system shall have a virtual infrastructure, where virtual machines run different operating systems and applications from separate locations on the same server, reducing downtime and maintenance costs. [OPTION]

I. Server component details not herein specified shall be as specified in the related Sections.

2.05 WORKSTATION COMPONENTS

A. Engineering Workstations (EWSs) shall include all necessary hardware and software to monitor and maintain system operation: configuration, application development, and maintenance. There shall be X [choose 1 through 5] EWSs. Each EWS shall include at minimum: [Sample specs]
1. 4 GB RAM computer
   a) Intel Core 2 Duo
   b) 2.40 GHz CPU
   c) Windows 10, 64 bit operating system
   d) Antivirus software

2. Graphics display
3. Printer

B. Operator Workstations (OWSs) shall include all necessary hardware and software to provide the operator with graphical view and interface. Each OWS shall include at minimum: [Sample specs]

1. 2 GB RAM computer
   a) Intel Core 2 Duo
   b) 2.40 GHz CPU
   c) Windows 10, 64 bit operating system
   d) Antivirus software

2. Graphics display
3. Printer

C. Independent Workstation (IndWS) — combining engineering, operator, server roles — shall act as a network station and shall be available to provide a “shadow system” for emergency purposes. IndWS shall include at minimum: [Sample specs]

1. 8 GB RAM computer
   a) Intel Core 2 Duo
   b) 2.40 GHz CPU
   c) Windows 10, 64 bit operating system
   d) Antivirus software

2. Graphics display
3. Printer

D. Workstation components not herein specified shall be as specified in the related Sections.

2.06 PROCESS CONTROLLERS

[Choose applicable controllers]

A. Each controller shall be sized considering its capacity for I/O count, including smart device signals.

1. Controllers shall optimize use of network processing time, CPU processing time, and network bandwidth [when applicable].
2. Controllers shall define the schedule and priority of how programs are executed by using periodic tasks.
B. Simplex (Non-redundant) Controllers shall provide the memory, speed, and processing capabilities to meet the demands of this process application.

1. Allen-Bradley ControlLogix 1756-L8xP shall have the following attributes (x can be 1, 3, or 5):
   a) Enhanced SDRAM memory technology
   b) High capacity, allowing more control strategies per task
   c) On-board display
   d) Energy Storage Module (ESM), eliminating the need for lithium batteries
   e) Secure Digital (SD) card, rated for use in SIL 2 applications
   f) Conformal coating
   g) Environmental ratings, including –
      i. -25°C to 50°C (-13°F to 122°F) operating temperature
      ii. 5 to 95% relative humidity
   h) Certifications/compliances, including –
      i. UL, ULH, cULus, cULH, CE, ATEX, Australia, Korea, Maritime, and Russian certifications
      ii. Meets ANSI/ISA 71.04.2013 G2 Environment
      iii. Meets ANSI/ISA 71.04.2013 G2 Environment (10-year exposure)

2. Simplex Controllers shall use an EtherNet/IP bridge to support both real-time I/O messaging and message exchange.

3. Simplex Controllers shall use a ControlNet bridge to support real-time, high-throughput applications using the Common Industrial Protocol (CIP). [OPTION]

C. Redundant Controllers shall be used in a redundant controller system, which includes: [OPTION]

1. Two matching 8 to 32 MB Allen-Bradley ControlLogix 1756-L8xP (x can be 1, 3, or 5): controllers with the same number of slots, module placement, and redundancy firmware revisions. The controllers shall have two additional nodes outside the redundant chassis pair.

2. One Allen-Bradley 1756-RM2 Redundancy Module per chassis which shall have the following attributes:
   a) Allows establishing redundancy without additional controller programming.
   b) Automatically sends data between controllers to keep both updated with changes.
   c) Supports Device Level Ring and star topologies.
   d) Supports import of offline changes without stopping the controller.
   e) Conformal coating. [OPTION]

3. EtherNet/IP bridge to support both real-time I/O messaging and message exchange.
D. Allen-Bradley CompactLogix Process controllers (5069-L32P, or 5069-L34P) shall be used for integration of skid-based equipment into the distributed control system by:

1. Controlling loops or operating a subsystem with sequencing and automation.
2. Accepting reference inputs and communicating with a supervisory controller.

E. Controller components not herein specified shall be as specified in the related Sections.

2.07 FIELD NETWORKS

A. The distributed control system shall use an EtherNet/IP network with native interface cards to support controller downlinks and to provide supervisory connectivity to remote I/O and field device interfaces.

B. The distributed control system shall also provide controller connectivity to intelligent instrumentation and field device components, using communication through:

[Choose applicable communication and field devices]

1. EtherNet/IP.

   a) Field instrumentation communicating via EtherNet/IP shall have pre-engineered Add-On Instructions (AOIs) and Add-On Profiles (AOPs), along with configurable faceplates that leverage the intelligence of process instrumentation to the PlantPAx Distributed Control System. The field instrumentation shall be capable of providing seamless preferred integration with the control platform and shall have full interoperability testing and joint integration documentation. The field instrument transmitters with E/IP output shall communicate directly to the PlantPAx network. Using an external third party E/IP signal converter is unacceptable.

   b) Linking devices shall support:

      i. H1 FOUNDATION Fieldbus networks, redundant media, and DLR capability.
      ii. EtherNet/IP networks, redundant media, and DLR capabilities.
      iii. PROFIBUS PA, redundant media, and DLT capability.

2. ControlNet. Linking devices shall support:

   a) H1 FOUNDATION Fieldbus networks and redundant media.
   b) PROFIBUS PA and redundant media.

3. DeviceNet. Networked control devices shall be connected.

4. FOUNDATION Fieldbus network. FF field devices shall be connected.

5. PROFIBUS PA network. PROFIBUS PA devices, including transmitters shall be connected.

6. HART protocol. HART analog devices shall be connected via I/O modules and Endress+Hauser handheld devices.
2.08 I/O PRODUCTS

A. The distributed control system shall include I/O components from the following families:

[Choose applicable I/O components]

1. 1756 ControlLogix I/O, chassis-based modules, supports online expansion
2. 1444 Dynamix I/O, condition monitoring module
3. 1715 Redundant I/O, high availability platform
4. 1719 Class 1, Div 2 I/O, Intrinsically Safe
5. 5094 Flex 5000 I/O, distributed, high channel density, small form factor
6. 5069 Compact I/O, Modules for skid based equipment
7. 1711 Configured Panels, pre-fabricated assemblies using 1756 hardware

B. The processor, Ethernet communication module, and each I/O component shall be supported with an Add-On Instruction (AOI), or embedded instructions, and the appropriate diagnostic faceplate to ensure the system has rich operator interface diagnostics.

C. I/O components shall be as specified in the related Sections.

2.09 MOTOR CONTROL COMPONENTS

A. The distributed control system shall include motor control components with simplified programming and configuration as required by this application. Safety features shall protect personnel and assets, reducing downtime. Each motor control device shall be connected via the appropriate Process Library Object, if available. To ensure the system has rich operator interface diagnostics, each connected device shall include the appropriate AOI and diagnostic faceplate. The devices shall work seamlessly with the process control via automatic device configuration.

[Choose applicable motor control components]

B. Low voltage drives shall provide scalability, powerful performance, and flexibility. Low voltage drives included in the distributed control system shall be capable of receiving configuration downloads from a Logix controller:

1. PowerFlex® 525 AC drives shall have seamless integration into the Logix control architecture, along with automatic device configuration.
2. PowerFlex 753 AC drives and PowerFlex 755 shall have embedded I/O along with option slots for communications, safety, and additional I/O.

C. Medium voltage AC drives and relays shall provide motor control and electrical protection.

1. PowerFlex 6000 and 7000 drives, capable of controlling asynchronous or synchronous AC motors, shall have embedded communication. PowerFlex 7000 shall have full regeneration capabilities with an arc resistant system rated up to 50 kA of arc fault, meeting Type 2B accessibility protection standards.
2. Allen-Bradley 857 relays shall protect feeders and motors in the distributed network using programmable functions, such as arc protection [OPTION], thermal, trip circuit supervision, and circuit breaker protection.
3. Allen-Bradley 865 relays shall provide selective differential over-current, short-circuit protection of generators, transformers, and motors.

D. Soft starters shall be included to reduce power requirements and equipment wear.
   1. SMC™ Flex Smart Motor Controllers shall have optimized configuration, advanced performance, and diagnostics in a modular design.
   2. SMC 50 Solid-State Smart Motor Controllers shall have advanced monitoring and scalable design with network integration capabilities.

E. Across-the-line starters, along with the following electronic overload relays that integrate the starters with Logix controllers, shall be included:
   1. E3 Plus™ Electronic Overload Relays.
   2. E300 Electronic Overload Relays.

F. A motor control center shall be included to integrate control in one centralized location.
   1. CENTERLINE 2100 MCC.
   2. CENTERLINE 2500 MCC.

G. Each motor control component shall be supported with a communication interface.

H. Motor control components shall be as specified in the related Sections.

2.10 SOFTWARE

A. Integrated Architecture® Builder software, part of the Studio 5000 Architect™ application, shall be used in the design of the distributed control system. Its PlantPAx System Estimator shall be used in the selection and sizing of components.

B. Studio 5000® applications shall be used for programming, managing, and updating the distributed control system.
   1. Process strategies, which contain pre-connected objects for the control of process devices from the Rockwell Automation Library of Process Objects, and Add-On Instructions (AOI) shall be moved into the controllers using Studio 5000 Logix Designer®, included in the Studio 5000 Architect™ application.
   2. Engineers shall be able to manage and update the system using Studio 5000 Logix Designer.

C. FactoryTalk® applications shall be resident on servers. [Select applicable software]
   1. The HMI server, data server, alarm and event server shall all be configured within the FactoryTalk View SE application.
   2. FactoryTalk Activation software shall apply and manage Rockwell Automation licenses for Rockwell Automation software products. The activation files shall be generated and distributed electronically over the Internet.
   3. FactoryTalk Historian software shall be used to configure the Historian server.
   4. FactoryTalk VantagePoint, a web-based reporting software, shall be used to map process objects, the modular components of the system, to a business information model.
   5. FactoryTalk AssetCentre software shall be used to configure the Asset Management server.
D. FactoryTalk® View SE shall be used for configuring, editing, and viewing HMI graphic displays.

1. Standards-based display elements (global objects) and their faceplates from the Rockwell Automation Library of Process Objects shall be used. Skid subsystems shall be integrated to ensure interface with a fully functional distributed control system.

2. Graphic screens shall be developed making use of the global objects to address the needs of process control, incorporating field condition visualization, animation, and continuous updating.
   a) Secure logon.
   b) Facility overview, along with process, equipment, and device status displays.
   c) Operator control of equipment functions, including set point adjustment and parameter tuning.
   d) Alarms reporting, management, and history.
   e) Trending for I/O values.
   f) System diagnostics.

3. International standards for color, functionality, and symbols shall be utilized, based on those built into the global objects.

4. Consistent, template-based user interface shall enable quick identification of abnormal situations.

5. Modular design shall ease system modifications and reduce programming maintenance time.

E. VMware firmware [OPTION]: shall allow creation of virtual machines that run different operating systems and applications from various locations on the same server, facilitating:

1. Hardware upgrades without stopping operation or replacing the operating system on the server or workstation system elements.
2. Reduced downtime and maintenance costs.

F. Microsoft and Rockwell Automation Licensing in the facility’s name shall be provided with the distributed control system.

2.11 DATA MANAGEMENT FUNCTIONS[Select applicable software]

A. FactoryTalk Historian software shall use historical points (tags) in the system to enable the collection, management, and analysis of data.

1. The System Management Tool (SMT™) within FactoryTalk Historian shall be used to create time series data points at given intervals.
2. Data shall be collected continuously and compressed storage data algorithms shall be used to contain a vast amount of data in a small format.
3. Past data shall be made available for review, allowing process events to be researched and explained.
4. Analytical data produced shall include process variables, trends, and reporting.
B. The distributed control system shall have the capacity to develop, publish, and print reports.

1. Logged data from Historian tags shall be stored in an internal file set or an ODBC-compliant database, and shall be available to be:
   a) Shown in trends.
   b) Archived for future use.
   c) Analyzed using any ODBC-compatible reporting software, such as Microsoft Excel or Business Objects Crystal Reports.

2. FactoryTalk software shall use logged data to produce reporting tools such as time-series trends, bar charts, pie charts, Pareto charts, and tabular trends.

C. FactoryTalk® InnovationSuite, hosted on an information management server, is a comprehensive portfolio that brings edge-to-enterprise analytics, machine learning, industrial internet of things (IIoT) and augmented reality (AR) to process applications. [OPTION]

1. Products within this suite:
   a) Thingworx
   b) Thingworx Analytics
   c) Vuforia
   d) Thingworx Connectivity

D. FactoryTalk® Analytics Platform software, hosted on an information management server, provides ability to scale from edge to enterprise while ingesting data from a variety of data types. It also enables capabilities like self-service machine learning and data mash-ups for collaborative data analysis. [OPTION]

1. Products within this suite:
   a) Edge ML
   b) DataFlowML
   c) DataView

E. Pavilion8® MPC is a modular software platform and the foundation for our industry-specific solutions. Leveraging a powerful modeling engine, Pavilion8 MPC includes modules to control, analyze, monitor, visualize, warehouse, and integrate, and combines them into high-value applications. [OPTION]

1. PlantPAx® model predictive control (MPC) is designed to run within standard Logix hardware and control the most challenging advanced control problems. PlantPAx MPC is fundamentally derived from the Pavilion8® server-based MPC product.

F. FactoryTalk® Analytics LogixAI, located in standard Logix hardware, provides embedded analytics that empower customers to apply machine learning concepts without needing expertise in data science. Applying analytics within the controller application is a new fundamental approach to achieving process improvements. [OPTION]

G. FactoryTalk® Analytics For Devices is an all-in-one pre configured hardware/software appliance that provides the user with health and diagnostic analysis from EtherNet/IP smart devices. [OPTION]
H. FactoryTalk VantagePoint software, hosted on an information management server, shall bring all data together into a single decision-support system to be used via web browser.  

[OPTION]

1. All manufacturing data shall be accessible in real time.
2. Pre-configured reports, current dashboards, and real-time Key Performance Indicators (KPIs) shall be published and viewable on the browser.
3. Enhanced HMI trending shall be available.

2.12 SECURITY FUNCTIONS

A. The foundation of PlantPAx security guidance is the industry standard IEC 62443-3-3

B. FactoryTalk software security shall prevent unauthorized access by verifying the user’s identity during logon and allowing only those permissions assigned to that user’s access level group. FactoryTalk Security allows for integration with Active Directory for domain management.

1. The distributed control system shall have X [up to 7] access level groups, including:  
   [choose applicable groups]
   a) Administrator
   b) Engineering
   c) Maintenance
   d) Maintenance Supervisor
   e) Manager
   f) Operating Supervisor
   g) Operators

2. The distributed control system shall be configured to allow or deny access for each group to view or make changes to any part of the system.
3. The distributed control system shall have the capacity to track security access.

C. Controllers in the distributed control system shall have enhanced protection from data intrusion risks independent of the FactoryTalk software security.

1. Controllers shall accept communication only through selected slots.
2. Programmed tag attributes shall control access and shall safeguard against value changes.
3. Source keys shall be available to guard against the editing of programming code.

D. Network Guidance

1. PlantPAx documentation and guidelines describe characterized architectures that use good security practices such as Logical Segmentation using vLANs and Firewall setup. As well as describing good practices for switch setup including port administration.
2. High Availability architecture architectures are recommended unless customers risk assessment determines otherwise.

E. Disaster Recovery
1. PlantPAx documentation provides guidelines for good disaster recovery planning. This includes guidelines for server and configuration backup plans for implementation.

2. The use of AssetCentre allows for the backup of critical files such as controller logic, graphics, documentation, switch configurations, and device configurations.
   a) AssetCentre is also designed to keep track of changes in programs and files informing the user of any discrepancies between the latest files and what is running in the plant.

2.13 ALARM AND STATUS FUNCTIONS

A. An alarm procedure shall be established to ensure system performance and alignment with industry standards.
   1. The distributed control system shall implement the complete alarm state model defined in ANSI/ISA-18.2-2009, Management of Alarm Systems for the Process Industries, or the equivalent international standard IEC 62682 Ed. 1.0:2014, Management of Alarm Systems for Process Industries, providing three mechanisms to prevent prolonged indications of an alarm.
      a) The alarm shelving mechanism shall provide an operator-initiated means to prevent an alarm from indicating for a configurable time period.
      b) The alarms suppressed by design mechanism shall provide a logic-initiated means to prevent an alarm from indicating based on process condition.
   2. The “out of service” (disable) alarms mechanism shall provide a maintenance-initiated means to prevent an alarm from indicating, safely taking the alarm out of service and preventing alarm status from logging into the historical database. When an alarm condition is detected, the server shall publish information to an operator workstation via FactoryTalk Alarm and Event Services.
      a) Configured visualization components shall include an alarm summary, an alarm log viewer, and an alarm banner.
      b) Audible alerts shall be configured according to priority, from low priority to urgent.
      c) Sound information shall be sent to the controller for a physical horn. [OPTION]

B. Operators shall have access to information about status changes.
   1. All objects from the Rockwell Automation Library of Process Objects that are used in programming the distributed control system shall bring with them built-in modes of control.
      a) Operator Mode shall be controlled from the HMI.
      b) Program Mode shall be controlled from the application code.
      c) Override Mode shall bypass selected interlocks and permissive conditions.
      d) Maintenance Mode shall bypass all interlocks, permissive conditions, and internal checks.
      e) Hand Mode shall be controlled by hardwired control stations.
2. Components shall be monitored and information shall be gathered and displayed on a system health screen for diagnostics.
   a) Controller status information shall include CPU utilization, communication usage, memory usage, task scan times, and controller loading.
   b) Server status information shall include diagnostics on the software components that run on the PASS, including an HMI server, data server, and an alarm and event server.
   c) Information such as network status and where a break is in the EtherNet/IP network shall be gathered using data from the Device Level Ring (DLR).

PART 3 EXECUTION

3.01 INSTALLATION AND CONFIGURATION

A. The distributed control system integrator shall ensure complete equipment, hardware, and network infrastructure installation according to the submitted project plan, including approved deviations.

1. Controllers shall be installed in accordance with manufacturer specifications and shall be field-wired using best industry practices.
   a) Installation areas shall be maintained free of dirt and dust during and after installation of controller products.
   b) Anchoring and enclosures shall be provided as recommended by the manufacturer.
   c) Ventilation slots shall not be obstructed.
   d) All required cables, cords, and connective devices for interface with other control system components shall be provided.

2. Instrumentation devices and accessories shall be mounted and installed in accordance with manufacturer or third party provider specifications.
   a) Instrument panels shall be provided with single-point grounding.
   b) Installation methods shall minimize the introduction of electromagnetic interference (EMI) into the system.
   c) Operator accessibility to devices for viewing, operating, and servicing shall be ensured.

3. Servers and other computer equipment shall be protected from exposure to dirt, fumes, water, corrosive substances, and physical damage. Their installation shall protect them from all forms of electrical and magnetic energy that could reasonably cause damage.

4. Network installation shall be trouble-free and reliable, meeting specified ODVA conformance.
   a) All cables, terminations, data ports, and IP addresses shall be properly labeled.
   b) Jack numbering schemes shall be documented in a plan view.
   c) Ethernet network switches shall be configured to integrate systems as specified on the system architecture drawings.
d) A network certification report shall be provided, showing conformance with specified standards and certifications.

B. The system integrator shall ensure software configuration and programming achieves a fully-integrated and operational PlantPAx Distributed Control System as herein specified and as specified in the related Sections.

1. Controller software shall be fully configured using Studio 5000 capabilities and conforming to the planned control processes.
2. Signals coming from third party vendor package panels shall be identified and fully integrated into the PlantPAx Distributed Control System using library object instances and Add-On Instructions.
3. HMI software shall be fully configured using FactoryTalk View SE programming to establish interactive graphical interfaces for monitoring, control, and alarm features.
4. FactoryTalk Historian software shall be programmed to collect data and establish the required report capabilities.
5. Ancillary component software shall be configured to interact with the PlantPAx Distributed Control System.

3.02 TESTING

A. General: The system integrator shall plan and execute an extensive procedure for testing the functionality of the component equipment, subsystems, network infrastructure, and the entirety of the installed distributed control system.

1. The system integrator’s responsibilities shall include:
   a) Instituting a testing status sign-off form, a “PlantPAx Check List”, for the testing sub-procedures. Testing shall not be considered complete until all testing sub-procedures are approved and the sign-off form is submitted.
   b) Furnishing all testing equipment and personnel required. As applicable, test equipment shall bear current calibration certification from a certified laboratory.
   c) Performing tests using actual process variables, equipment, and data, whenever possible. Where actual process variables, equipment, and data are not available, the system integrator shall provide all special testing materials necessary for simulation.
   d) Assuming the costs of travel when retesting is required.

2. The procedure shall include factory and field testing. Preliminary unwitnessed tests shall be performed before the facility manager or representative attends tests.

B. Factory Testing: No equipment shall be shipped to the jobsite until all factory testing results are approved. Factory testing shall ensure conformance with standards and certifications herein specified or specified in the related Sections, along with satisfaction of the manufacturer’s additional electrical and mechanical parameters.

1. Factory testing shall be provided on:
   a) All control system components shown on the system architecture drawings and provided by the system integrator.
   b) Network configuration. Temporary network connections shall be provided as required for factory network testing.
2. Before factory testing, a system audit shall be performed to confirm equipment model numbers and serial numbers, installed software (including improvement modules), and controller firmware configuration parameters. The audit documentation shall be available to testing personnel.

3. Factory component testing shall include:
   a) Inspection of all panels and enclosures, their layout, structure and finish – The testing personnel shall review drawings to ensure they are updated for current panel layout and wiring. Wire pull tests shall be performed.
   b) An I/O point checkout (loop test) to verify proper I/O operation of equipment connected to the distributed control system – The submitted I/O list shall be available to testing personnel. Testing methods appropriate to the I/O types shall be used.
   c) Logic verification for performance, using simulation or other means – Control strategy, as documented, shall be verified for listed faults and failure conditions.

4. Factory system testing shall include, but not be limited by, demonstration of:
   a) Ability to share data between operator workstations and servers.
   b) Ability of workstations to read and write received files.
   c) Ability of workstation report printers.
   d) Operability of data storage methods.
   e) Communication failure recovery.
   f) Power failure recovery.
   g) Capability of servers.

C. Field Testing: After installation, the system integrator shall coordinate all operational readiness, functional demonstration, and site acceptance testing.

1. Operational readiness testing shall be performed on all equipment after installation and field wiring.
   a) Inspections shall be performed on mountings, cable routing, wire runs, fan/blower air flow, and power conditioning.
   b) All equipment shall be tested for calibration, configuration, and setup. Actual settings shall be recorded via forms or electronic file back-up.
   c) A new I/O point I/O checkout (loop test) shall be performed to ensure setup is correct for monitoring and controlling.
   d) Control strategy logic shall be re-verified as installed.
   e) System testing, including the same demonstrations as during factory testing, shall be performed.

2. Functional demonstration testing shall be performed after initial start-up.
   a) With the distributed control system running in automatic control, performance demonstrations shall be made of each of the subsystems to demonstrate stability.
   b) A black start of the distributed control system shall be performed to demonstrate that operation recovers as specified.

3. Site acceptance testing shall be performed with only actual operating personnel controlling live processes. System integrator personnel familiar with the system shall
be available for consultation. Successful completion of testing shall result in certification of installation.

3.03 FACTORY TRAINING

A. The manufacturer shall provide training programs for those working with the PlantPAx Distributed Control System, including programming and design engineers and maintenance technicians. Available recommended instructor-led classes include:

1. PlantPAx System Fundamentals
2. PlantPAx System Design and Configuration
3. Studio 5000 Logix Designer: CompactLogix Fundamentals and Troubleshooting
4. FactoryTalk View SE Programming – designing and configuring HMIs
5. Essentials of Industrial Ethernet Networks
6. EtherNet/IP Configuration and Troubleshooting
7. NetLinx System Maintenance and Troubleshooting – EtherNet/IP, ControlNet, and DeviceNet hardware and software

Specialized and advanced courses shall also be available.

B. The manufacturer shall provide access to TechConnect™ Knowledgebase content as an ongoing resource.

3.04 APPLICATION TRAINING

A. The system integrator shall provide training programs for management, operators, maintenance technicians, and control systems engineers that are tailored to this application.

1. The manufacturer shall assist the system integrator in developing an overall training plan. The assistance shall include:
   a) Online workforce assessment tools.
   b) Identification of potential training needs.
   c) Assistance in developing post-training workforce testing.

2. The system integrator shall submit the proposed training plan for approval. Upon approval, training schedules shall be developed.

B. Training shall consist of classroom sessions and hands-on instruction using the installed distributed control system.

1. On-site training personnel shall be:
   a) Familiar with this application's specific programming, operation, maintenance, troubleshooting, and debugging procedures.
   b) Capable of teaching qualified personnel.

   [Modify the following to include offerings for this application.]

2. The PlantPAx Distributed Control System overview (targeted to facility management and engineers) shall include:
   a) Introduction to hardware and software.
b) Discussion of the information flow diagram.
c) Explanation of workstation capabilities.
d) Walk-through of installed system.

3. Operator training shall include both pre-start-up sessions using a simulator and more in-depth sessions after start-up, referencing user manuals and final P&IDs. Topics of these sessions shall include:

   a) HMI control and navigation basics.
   b) Specific automated control processes.
   c) How alarms and interlocks work.
   d) Failure modes and what to do.

4. Software maintenance training sessions for engineers shall include topics and procedures covered in the software user manuals:

   a) Introduction to software user manuals.
   b) Controller program structure.
   c) HMI configuration.
   d) Program modification.
   e) Backups.

5. Historian and reports training sessions for engineers and operators shall include:

   a) Data entering.
   b) Report running and printing.
   c) Data query execution.
   d) FactoryTalk Historian software configuration.
   e) Report repair.
   f) Database backups.

3.05 SERVICE AND SUPPORT

A. The manufacturer shall offer tailored annual support agreements including the following:

   1. Access to remote support engineers — A specialized engineer shall examine the system to help prevent downtime and optimize performance, offering step-by-step assistance.
   2. Emergency on-site engineering services — Factory-trained, skills-matched service professionals shall be dispatched to help troubleshoot unplanned downtime events, critical operations problems, and other automation-related issues.

      a) 24 x 7 breakdown support.
      b) Experience with varied applications and anomalies.
      c) Assistance for start-up, special projects, and peak workloads.
      d) Technical support during maintenance activity.

B. Expanded support shall be available from the manufacturer, including:

   1. On-site preventive maintenance.
   2. Ongoing Installed Base Evaluations and Storeroom Assessments.
   3. Customized application-level support.
5. Full-time resident engineering and/or asset management professionals.

3.06 SPARE PARTS

A. Spare parts inventories for components shall be as specified in the related Sections.
B. Spare parts for controllers shall include at least one spare processor for each process controller type installed.
C. Spare I/O and slots shall include the following:
   1. For panels containing controller I/O, 20% spare I/O points of each type, wired to terminals.
   2. For chassis-based controller systems, 2 spare slots for future I/O.
   3. For non-chassis-based controller systems, space for the expansion of at least 2 I/O cards.
   4. One spare I/O module and one I/O card for each I/O module type installed.
   5. For spare output points requiring external relays, one external relay of the type installed.

D. The manufacturer shall offer a Parts Management Agreement (PMA) to minimize downtime and reduce carrying costs associated with spare parts management. The PMA: [OPTION]
   1. Allows the facility 24 x 7 on-site access to Allen-Bradley® and Rockwell® replacement parts — The manufacturer shall own and manage an on-site inventory of spare parts, including remanufacturing and renewal parts services.
   2. Eliminates initial capital expense of purchasing spare inventory.
   3. Replenishes consumed spares in as little as 24 hours.
   4. Avoids unnecessary inventory buildup.

3.07 WARRANTY

A. The manufacturer shall provide a standard parts warranty for control equipment during the twelve (12) months following the date of the successful completion of the site acceptance testing.
B. Up to four-year extensions of the warranty shall be available, each including:
   2. A simple parts protection plan.

END OF SECTION