# TULSA Water and Sewer Department

# SCADA System Improvements

# PLC Add-On Instruction

# FINAL


PRESENTED TO

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## Revision History

After the Add-On Instruction has been modified or updated, this document should be revised to reflect the changes. The version is broken into two parts: major (**X**.0) and minor (1.**X**). A major version is reserved for adding or removing sections of this document. A minor version is reserved for modifications to existing sections.

| Version | Date | Description |
|---|---|---|
| 1.0 | July 9, 2021 | AOI created in Studio 5000 Version 21.11, Draft submitted to client |
| 1.0 | April 4, 2022 | Final submitted to client. |

# 1 INTRODUCTION

The PLC Add-On Instruction (AOI) monitors key status indicators for the PLC hardware. The AOI includes a battery alarm to indicate if the PLC battery has faulted. It also includes a heartbeat function that can be used to monitor communication with remote PLCs. The AOI monitors and controls the PLC's internal date and time settings, which can be adjusted through the HMI.

*Table 1-1 Embedded AOIs*

| Embedded AOIs |
|---|
| Discrete Alarm |
| Heartbeat |
| Wall Clock Data |

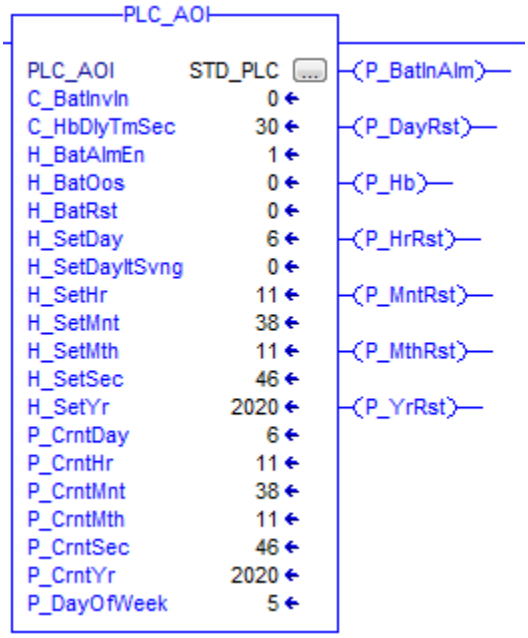


*Figure 1-1 PLC AOI as it appears in ladder logic*

# 2 TEMPLATE

Template logic can be found in the Unscheduled Programs/Phases task folder of the Tulsa ControlLogix Standard PLC file. Because the template task is unscheduled, the routines within it do not execute during runtime. The intention of the template routine is to provide a standard logic structure for the AOIs that can be copied into the executable tasks of the MainProgram.

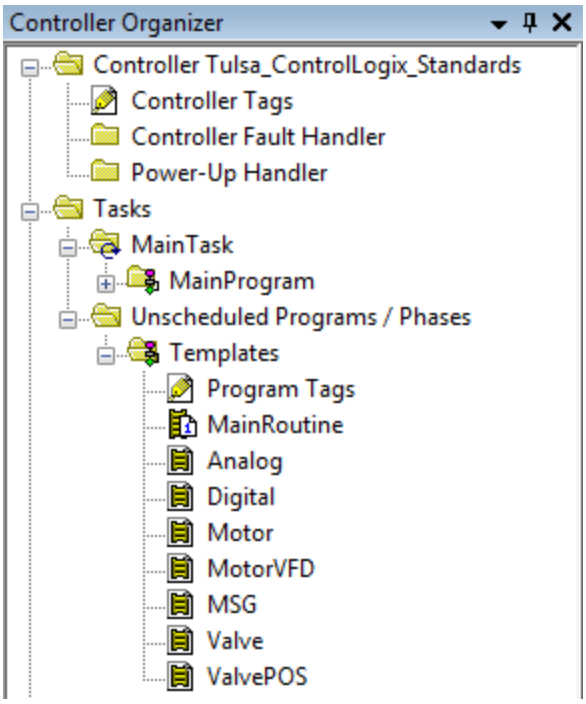


*Figure 2-1 Unscheduled Standard Logic Templates*

The MainRoutine template displays the standard logic for using the PLC AOI. The first rung indicates the first scan of the PLC, and the second rung resets it.

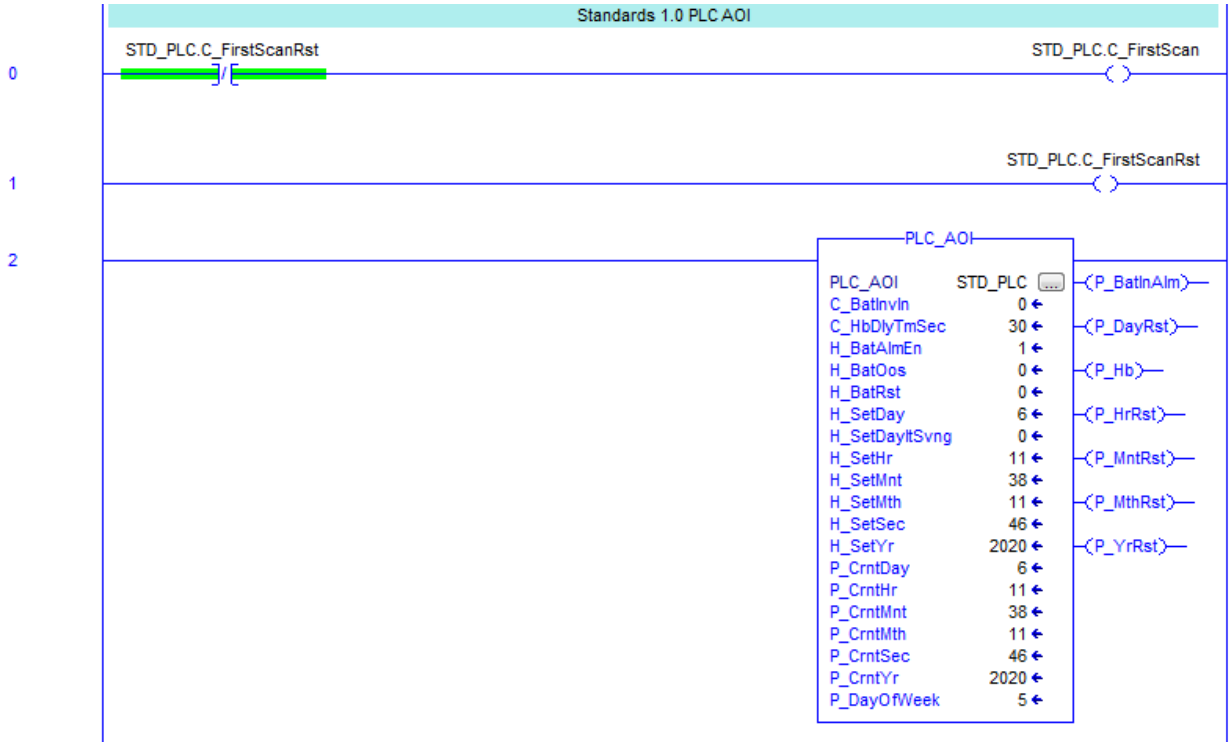


*Figure 2-2 Standard Template Logic for the PLC AOI*

# 3 FEATURES

## 3.1 Configuration Tags

Configuration tags are inputs to the AOI that are set by the engineer during programming and equipment start-up. A “C_” prefix is used to indicate that the tag modifies the configuration of an equipment or instrument.

*Table 3-1 Configuration Tags*

| Parameter | Data Type | Description | Default Value |
|---|---|---|---|
| C_BatHdshDlyTm | REAL | Battery alarm HMI handshake timer in seconds. | 30 |
| C_BatHdshEn | BOOL | Battery alarm HMI handshake logic enable. | False |
| C_BatInvIn | BOOL | When true, the battery alarm input is inverted and alarms when the input is false. | False |
| C_BatRst | BOOL | Battery alarm reset. | False |
| C_BatTypeAuto | INT | Alarm type when the battery alarm is in automatic mode. 1=permissive, 2=fault, 4=warning. | 4 |
| C_BatTypeMan | INT | Alarm type when the battery alarm is in manual mode. 1=permissive, 2=fault, 4=warning. | 4 |
| C_HbDlyTmSec | DINT | Heartbeat time in seconds. | 5 |
| C_FirstScanRst | BOOL | First scan bit reset. | False |
| C_FirstScan | BOOL | Indicates the first scan of the PLC. True when C_FirstScanRst is false. | False |

## 3.2 Input Tags

Input tags are inputs to the AOI that are set by the I/O and indicate equipment status. The “I_” prefix is used to indicated that the tag is displaying an equipment or instrument status. The PLC AOI does not contain any input tags.

## 3.3 Output Tags

Output tags are outputs from the AOI that are used to control equipment. The “O_” prefix is used to indicate that the tag controls a real-world output within the PLC. The PLC AOI does not contain any output tags.

## 3.4 HMI Tags

HMI tags are inputs to the AOI that are set by the operator. The “H_” prefix is used to indicate that the tag modifies a PLC register from the operator interface.

*Table 3-2 HMI Tags*

| Parameter | Data Type | Description | Default Value |
|---|---|---|---|
| H_BatAlmDlyTm | REAL | Battery alarm delay timer in seconds. | 5 |
| H_BatAlmEn | BOOL | Battery alarm enable. | False |
| H_BatHdsh | BOOL | Used to indicate that the HMI has received the battery alarm when C_BatHdshEn is true. | False |

| | | | |
|---|---|---|---|
| H_BatOos | BOOL | Battery alarm out of service. | False |
| H_BatRst | BOOL | Battery alarm HMI reset. | False |
| H_SetDay | DINT | PLC clock day setting from HMI. | 0 |
| H_SetDayItSvng | INT | Apply daylight savings time to the PLC clock. | 1 |
| H_SetHr | DINT | PLC Clock hour setting from HMI. | 0 |
| H_SetMnt | DINT | PLC Clock Minute setting from HMI. | 0 |
| H_SetMth | DINT | PLC Clock Month setting from HMI. | 0 |
| H_SetSec | DINT | PLC Clock Second setting from HMI. | 0 |
| H_SetTm | BOOL | Moves the HMI clock settings into the PLC clock. | 0 |
| H_SetYr | DINT | PLC Clock year setting from HMI. | 0 |

## 3.5 PLC Logic Tags

PLC Logic tags are attributes internal to the AOI. The “P_” prefix is used to indicate that the tag is modified or calculated within the PLC.

*Table 3-3 PLC Logic Tags*

| Parameter | Data Type | Description | Alarm |
|---|---|---|---|
| P_BatInAlm | BOOL | PLC Battery in alarm. | Yes |
| P_CrntDay | DINT | PLC clock current day. | No |
| P_CrntHr | DINT | PLC clock current hour. | No |
| P_CrntMnt | DINT | PLC clock current minute. | No |
| P_CrntMth | DINT | PLC clock current month. | No |
| P_CrntSec | DINT | PLC clock current second. | No |
| P_CrntYr | DINT | PLC clock current year. | No |
| P_DayRst | BOOL | Daily reset. Indicates that a new day has started. | No |
| P_DayOfWeek | DINT | 0=Sunday, 1=Monday, 2=Tuesday, 3=Wednesday, 4=Thursday, 5=Friday, 6=Saturday | No |
| P_Hb | BOOL | PLC Heartbeat. Toggles on and off based on C_HbDlyTmSec. | No |
| P_HrRst | BOOL | Hourly reset. Indicates that a new hour has started. | No |
| P_LastScanTm | DINT | Last program scan time. | No |
| P_MntRst | BOOL | Minutely reset. Indicates that a new minute has started. | No |
| P_MthRst | BOOL | Monthly reset. Indicates that a new month has started. | No |
| P_YrRst | BOOL | Yearly reset. Indicates that a new year has started. | No |