



Invensys Pipeline Solutions – Control Room Management 49 CFR 195.446 Conformance

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1. Introduction

A new regulation from the U.S. Department of Transportation (DOT), 49 CFR 195.446, defines the minimum requirements for Supervisory Control and Data Acquisition (SCADA) systems used for pipeline monitoring and transportation.

Many current liquid and gas pipeline operating companies across the country were created and have grown by purchasing smaller pipeline companies. To date, a patchwork SCADA system approach was allowed. However, under the recently released regulation, owners migrating their SCADA systems to a central system or upgrading them to handle more lines will be required to conform to the regulation. Patchwork SCADA systems will no longer be permitted.

This white paper addresses each line item in the regulation and defines and comments on the Invensys solution. The document also discusses API 1165 and API 1168, which are called out in the regulation.

All of our products, including our SCADA system, employ ArchestrA technology. Interconnectivity between the applications is a critical Invensys strategy. This is especially important with a Pipeline Solution, which must conform to 49 CFR195.446. Our workflow and mobile operator solutions, web portal, training and alarm management systems all interface directly to the central database in our SCADA enterprise server. They use the same naming conventions, are upgraded as the SCADA system is modified, work in the same engineering environment, and are displayed in the same HMI. In fact, these systems work together as one unified system. Invensys is the only company in the world that can claim this capability.

2. Applications Integration

Today's SCADA system has expanded to be a SCADA enterprise server system, the base system with the mandatory control and data acquisition environment for the pipeline system.

When operators upgrade their SCADA system, applications for change management, training, field operations, shift handover, alarm management and revision management are mandated, but they are not required to be integrated with the SCADA system. However, this integration will certainly improve maintenance, safety, and operations of the entire pipeline system.

Virtually all of the 49 CFR requirements are directly related to real-time events and actions on the pipeline. Clearly, a SCADA system that can kick off workflows; direct field operators to respond accordingly; train operators on the SCADA interface; and provide instructions to operators and all 'downstream' information users is a valuable solution versus a patchwork of disjointed applications and hand-written procedures and training packages.

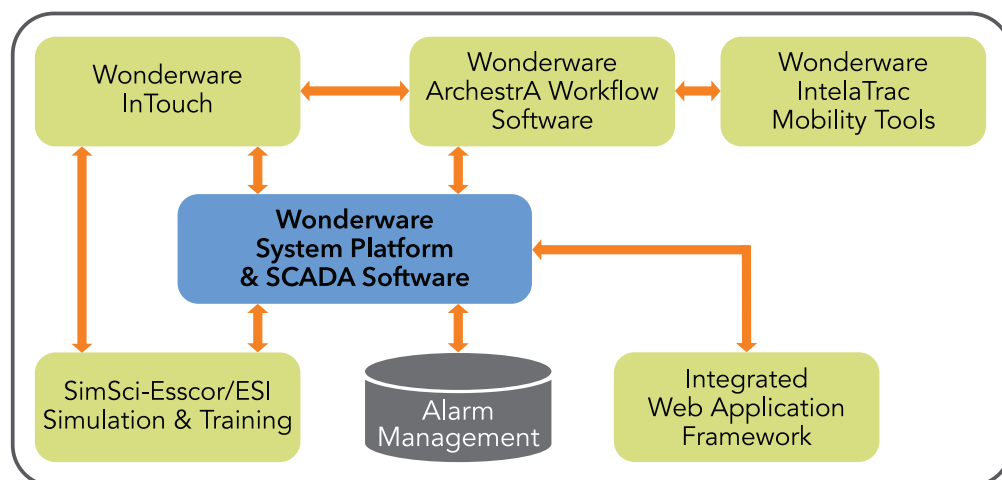


Diagram 1. Invensys' Integrated Application System

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3. Litmus Test for Certification

The regulation is a set of requirements for liquid pipeline operators. The DOT suggested in a recent workshop that validating a SCADA system based on the regulation should be at the discretion of the owner with regard to how the owner creates and manages the system. The term used was “Performance Based.” This means that owners should follow the regulation and document and implement changes in accordance with reasonable installation and adherence according to the owner’s system and operations. DOT will conduct evaluations of the SCADA system and requisite applications to ensure the owner follows their internal standards. Quantitative analysis should be done by the owner to evaluate the changes and confirm that lessons learned are instituted. Therefore, choosing applications or developing internal processes should always have a method to record the quantified results.

4. Value Proposition for the New Regulation

49 CFR part 195.446 identifies changes and recommendations for owners of SCADA systems. Invensys has been involved in the Oil & Gas industry at thousands of sites. Our SCADA system delivers all the required elements to meet the changes in 49 CFR 195.446, API 1165 and API 1168. Our base level enterprise SCADA server system, bundled in conjunction with other Invensys applications, provides pipeline companies with a solution that is in compliance with 49 CFR Part 195.446.

To better understand what the regulation means to our customers, we break down the August 2010 regulation by section and discuss the Invensys solutions as they relate to each section. Following that is a discussion of API 1165 and API 1168. These are specifically called out in the regulation and adherence to them is required.

5. Invensys SCADA Solutions

The following are short descriptions of each Invensys solution that could be applied to the SCADA system being installed. For more details on each solution, see the Industry Solution entitled “Invensys Pipeline Solutions – Control Room Management.” Detailed descriptions of each product also appear on our website.

1. Wonderware SCADA (SCADA enterprise server)

- a. HMI system complying with features required by *API 1165: Recommended Practice Pipeline SCADA Displays*: Human Factors, Equipment Layout, Display Navigation and Control Techniques.
- b. Trending, reporting, external communication technologies, alarming.
- c. The system consists of an engineering environment built on ArcestrA technology with a Wonderware InTouch HMI. The Wonderware SCADA system is highly productized and contains the features required to do fundamental configurations and provide pre-configured features such as faceplates, alarm pages, navigation, communication protocols, historization and much more. All of the suggested API 1165 graphics are standard templates and the engineering environment provides out-of-the-box configuration templates for network communications health status; protocol templates; standard drag and drop application blocks; and add-ins for Wonderware ArcestrA workflow and other typical SCADA applications.
- d. Since Wonderware SCADA leverages System Platform, all of the other System Platform products are directly connected to the base SCADA system environment. This means simple connection, common update procedures for SCADA system tag names, a common historization environment and a common engineering environment: Integration like no other system in the world.
- e. The engineering environment, ArcestrA “IDE” (Integrated Development Environment), is a critical component of the Invensys solution for 49 CFR. Our object oriented environment enables changes for the same tag to be deployed to multiple applications, simplifying maintenance. A more detailed discussion follows this section.

2. Alarm Management

- a. **Alarm philosophy and alarming management tools** — Invensys offers a comprehensive alarm strategy with System Platform and InTouch to provide the common engineering and HMI environment to manage alarms and specialized software to provide alarm management tools. The first step in deploying our Alarm Management solution is to work with customers to develop their strategy. Next, our software is applied to execute that strategy and conform to 49 CFR.

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Our Alarm Management software provides users with a closed loop solution for continual evaluation and modification of alarming strategies. Our Alarm Management software has access to real-time data and supports analysis of historical data, allowing users to achieve *superior operator performance* and *reduced vulnerabilities* during abnormal situations and steady state operations. Our software improves disturbance rejection, minimizes operator loading, optimizes situational awareness, enables accurate operator actions, expands layers of protection for safety, retains important plant knowledge, provides a collaboration platform, enables change tracking/defect detection and ensures accurate documentation.

3. SimSci-Esscor/ESI (Energy Solutions International)

- a. Pipeline design and simulation — off-line and dynamic
- b. Pipeline simulation and operator training

Our SimSci-Esscor/ESI Training system is directly linked to our System Platform-based Wonderware SCADA system. The training system gives operators and instructors an environment in which to create scenarios for operators to react to. Multiple scenarios can be created and existing scenarios can be changed on the fly. The operator works in the SCADA environment in the same way a pilot works in a flight simulator. To the operator, the training system looks exactly like the SCADA system. The training system also provides a grading system feature that the instructor can quantitatively and qualitatively define. Specific actions of the operator in response to the scenario are matched against a point system. These measurable results are critical to meeting the regulation. Equally important is the integration of the entire pipeline and associated workflows within the training system. This capability is also critical to meeting many sections of the regulation. Mandates from legal proceedings and specific language in the regulation define the integration of a PLC emulated training environment over a quasi-emulated training system. This means that the training system must completely emulate the real working SCADA system in terms of operator interaction, timing of processes and logic, which must be simulated exactly as it is in the control logic. This requires a system with a virtual PLC or controller.

4. Wonderware Mobility Solutions (IntelaTrac)

- a. Wonderware IntelaTrac is also part of our System Platform-based Wonderware SCADA system. It is a record keeping and procedural instruction tool for mobile field operators that accelerates and sustains operational process improvements and is a key component of an effective Operations Management system. IntelaTrac is a suite of tools that assists operators, field engineers and supervisors in creating inspection and regulatory procedures, assigns, schedules and executes rounds, and reports back findings with assigned levels of criticality and severity. 49 CFR 192 also spells out many requirements for Operations, Integrity Management and Maintenance. IntelaTrac's intelligent work process management capabilities offer significant productivity gains to operating companies by providing a system that empowers field workers with best practices while on their task routes, scheduling (including work load balancing), reporting and event recognition, alert handling and action validation to address this critical element of pipeline and terminal safety.

5. Wonderware ArchedrA Workflow

- a. Wonderware ArchedrA Workflow software is directly linked to our System Platform-based Wonderware SCADA system. This system uses our SCADA system's database and works in our SCADA system's engineering and HMI environment. This product is unique in the industry because it is the only completely integrated workflow and SCADA system in existence. The system provides full workflow and decision making tools and displays for control room operators and management.

6. Integrated Web Application and Reporting Framework

Our integrated Web Application Framework is directly linked to our System Platform-based Wonderware SCADA system. The system provides an environment that offers:

- Shift Handover tool/environment
- Online system documentation and field procedures at station level
- Documentation for all field equipment modifications and point-to-point verification between SCADA displays and field equipment (The system also allows storage of picture files of the SCADA displays (and comments) to keep an audit trail of changes.)
- Manual operations plan (The integrated Web Application Framework can maintain a local copy of an up-to-date network description, useful in case of a network/communications failure.)
- SCADA system software and display modification
- Backup SCADA system testing documentation and audit trail
- Compliance validation

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7. Wonderware SCADA Basic Functionality

As we address each line of the regulation, understand that each element of the regulation and each Invensys component are integrally tied to our System Platform/Archestra technology base. These products stand on their own, but the greatest value is that these modules are built or applied into our baseline Wonderware SCADA system. For example, Wonderware Archestra Workflow is integrally embedded in our Integrated Engineering Environment (IDE) and is tied to specific SCADA tags. The Wonderware Mobility Solution (IntelaTrac) is configured to be kicked off directly from Wonderware Archestra Workflow. SimSci-Esscor/ESI Training is integrally tied to our SCADA system via the SimSci-Esscor link software that bridges the gap between SCADA and ESI. It emulates the PLC and provides two way communications between each application. Our Alarm Management software links directly to our Historian database tags and is configured from our tag database. And our integrated Web Application Framework is driven directly from the same tag namespace.



In a truly integrated environment, a change in one attribute in the SCADA system object should deploy to all related objects regardless of the application module. If you change the SCADA tag for a valve in the primary HMI, the changed tag and its attributes should propagate instantly to any workflow application, two-way training simulation environment, remote field operator device applications, lessons learned section of a web portal, or any other application that incorporates that tag. Diagram 2, on the next page, shows how changing an alarm setpoint cascades to the following applications shown in the diagram:

- The associated workflow for the valve will be modified based on the new setpoint
- The notification to the field operator to act on the valve alarm
- The operator response to the alarm during a training exercise
- The lessons learned about how the alarm was handled and the cause/effect
- The shift manager's notes and related shift handover information based on the new setpoint

Unless integrated SCADA systems work this way, maintaining the relationship between all applications at the level necessary for affordable compliance to the new regulations is nearly impossible. The SCADA system object structure must be built on multiple compliance-driven attributes and applications that flow from the application engine. A typical object might, for example, represent a tag like "pump001_pressure," which describes the pressure transmitter on pump 001. The pump object then contains a variety of elements that are reproduced for every pump and, in some cases, reused for other tags. Each time the attribute for tag "pump001_pressure" updates, all related modules are updated automatically. This tagging strategy is significantly easier to maintain than a relational database. Diagram 2, on the next page, represents examples of object attributes and how they might be 'pushed and deployed' to SCADA modules which support 49 CFR requirements.



Diagram 2. Application Object contains attributes of all 49 CFR applications

The graphic on the left, , is the VALV_001 object, which contains all the attributes shown around the spoke. The VALV_001 object is applied to each application on the right as shown. For instance, as the alarm and event attribute, , is changed in VALV_001, it is deployed to all of the applications.

As you read through this document, remember that each application is tied directly to the real-time Wonderware SCADA system.

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6. Change Management

A fundamental element of the regulation -- including API 1165 and especially API 1168 -- revolves around Change Management. Just coming up with ideas to solve problems and create new procedures to enhance safety, improve knowledge, enhance communications and ensure consistency is not enough. Ensuring that a consistent application of the changes can be met by a series of automated processes is imperative. Automation drives consistent decisions during floods of events and actions, drives considered activities that can be discussed and fine tuned before they happen and ensures a repeatable set of actions that can be shown to regulators to convince them that operators are doing their best to meet the regulation. As you read through the discussion of each section, consider the implications and benefits of automated solutions integrally tied to the control system and consider the implications of quantifying and recording the actions to ensure that Change Management is being applied and perpetuated within your organization.

7. Regulation 49 CFR 195.446 – Control Room Management

§ 195.446 Control room management. (Full text.)

(Bold "**COMMENT**" sections are Invensys Solutions)

(a) General. *This section applies to each operator of a pipeline facility with a controller working in a control room who monitors and controls all or part of a pipeline facility through a SCADA system. Each operator must have and follow written control room management procedures that implement the requirements of this section. The procedures required by this section must be integrated, as appropriate, with the operator's written procedures required by §195.402. An operator must develop the procedures no later than August 1, 2011 and implement the procedures no later than February 1, 2013.*

(b) Roles and Responsibilities. *Each operator must define the roles and responsibilities of a controller during normal, abnormal, and emergency operating conditions. To provide for a controller's prompt and appropriate response to operating conditions, an operator must define each of the following:*

COMMENT: Wonderware SCADA, Wonderware ArchestrA Workflow and the integrated Web Application Framework are applied in this section. This section of the regulation implies that the controller should completely understand how to react to the situation. The statement 'prompt and appropriate response to the operating conditions' implies everything from manual takeover control to notification of emergency responders. Dozens of actions may be immediately required, so relying on a manual system could be overwhelming in certain situations. The system should be integrated and automated via the SCADA enterprise server and should have application modules embedded within the core namespace and database. The HMI should automatically show the controller what is happening and prompt him with what needs to be done manually. This can only be done if the set of activities is carefully and completely considered.

(1) A controller's authority and responsibility to make decisions and take actions during normal operations;

(2) A controller's role when an abnormal operating condition is detected, even if the controller is not the first to detect the condition, including the controller's responsibility to take specific actions and to communicate with others;

(3) A controller's role during an emergency, even if the controller is not the first to detect the emergency, including the controller's responsibility to take specific actions and to communicate with others; and

COMMENT:

- The Wonderware SCADA system provides the basic SCADA HMI interface and security level definition for operators.
- The Wonderware ArchestrA Workflow module provides documented procedural steps from the control room to virtually any internal or external interested party.

(4) A method of recording controller shift-changes and any hand-over of responsibility between controllers.

COMMENT:

- The Integrated Web Application Framework provides an environment to load shift handover comments.

(c) Provide Adequate Information. *Each operator must provide its controllers with the information, tools, processes and procedures necessary for the controllers to carry out the roles and responsibilities the operator has defined by performing each of the following:*

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COMMENT: This section implies that the operator must provide documentation and planning tools for the entire system as it changes architecture. The immediate conclusion is that it is largely a method to capture and record these changes in an off-line manner. That may be a solution, but maintenance of these changes is virtually impossible. Collecting these changes starts in the primary application engine. In the Wonderware SCADA system, any database changes can be captured by a simple database dump to the web portal. Since the database changes deploy to applications such as workflow, remote operator, training and alarm modules, those applications are also recorded in their individual environments as well.

COMMENT: Wonderware SCADA, Wonderware ArchestrA workflow, SimSci-Esscor/ESI Training, integrated Web Application Framework and Alarm Management are applied in the section.

(1) Implement API RP 1165 (incorporated by reference, see §195.3) whenever a SCADA system is added, expanded or replaced, unless the operator demonstrates that certain provisions of API RP 1165 are not practical for the SCADA system used;

COMMENT:

- The Wonderware SCADA system is applied here. API 1165 is the requirement to meet very specific HMI color coding, screen view features, etc. All systems are centrally coordinated with respect to color, color meaning, priority, quality, alarm state and all other HMI elements.

(2) Conduct a point-to-point verification between SCADA displays and related field equipment when field equipment is added or moved and when other changes that affect pipeline safety are made to field equipment or SCADA displays;

COMMENT: The integrated Web Application Framework solution has a built-in utility to keep track of all (required) IO points. Its tools allow users to upload new or updated IO tables in different formats. Based on rules, the system will identify new or modified tags.

(3) Test and verify an internal communication plan to provide adequate means for manual operation of the pipeline safely, at least once each calendar year, but at intervals not to exceed 15 months;

COMMENT:

- SimSci-Esscor/ESI Training provides operators the ability to train on the SCADA system and react to dynamic changes as instructors introduce various scenarios.
- Wonderware ArchestrA Workflow used in conjunction with the SimSci-Esscor/ESI Training system delivers an environment for operators to test and verify the written or formalized communications plans during simulated scenarios.

(4) Test any backup SCADA systems at least once each calendar year, but at intervals not to exceed 15 months; and

COMMENT:

- The integrated Web Application Framework provides a tool to maintain various back-up instructions that are tied directly into Wonderware SCADA.

(5) Implement section 5 of API RP 1168 (incorporated by reference, see §195.3) to establish procedures for when a different controller assumes responsibility, including the content of information to be exchanged.

COMMENT:

- Alarm Management, integrated Web Application Framework, Wonderware ArchestrA Workflow, IntelaTrac and Wonderware SCADA are used to address API 1168.
- Note: Much of API 1168 defines Management of Change (MOC). Most of this section defines how to handle various control room situations. A separate section at the end of this White Paper reviews the elements of API 1168.

(d) Fatigue Mitigation. *Each operator must implement the following methods to reduce the risk associated with controller fatigue that could inhibit a controller's ability to carry out the roles and responsibilities the operator has defined:*

COMMENT: This section primarily deals with fatigue training that is conducted by internal training staff to educate controllers on fatigue and to support management on setting schedules for controllers. However, the HMI provides a measure of fatigue management and mitigation simply by the methods recommended in API 1165.

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COMMENT: The Wonderware SCADA system is applied here.

- Adherence to API 1165 is a crucial element to meeting this requirement, but this requirement is typically met by the owner's in-house training organization via classroom training, video training or other means.

(1) Establish shift lengths and schedule rotations that provide controllers off-duty time sufficient to achieve eight hours of continuous sleep;

(2) Educate controllers and supervisors in fatigue mitigation strategies and how off-duty activities contribute to fatigue;

(3) Train controllers and supervisors to recognize the effects of fatigue; and

(4) Establish a maximum limit on controller hours-of-service, which may provide for an emergency deviation from the maximum limit if necessary for the safe operation of a pipeline facility.

COMMENT:

- These four requirements would typically be met by the owner's in-house training organization via classroom training, video training or other means.

(e) Alarm Management. *Each operator using a SCADA system must have a written alarm management plan to provide for effective controller response to alarms. An operator's plan must include provisions to:*

COMMENT: Alarm management implies that the operator's response to alarms – and acknowledgements – appear in the HMI. But in context of this regulation, alarm management is much more. Handling alarms should be considered in the context of the entire pipeline, which means that alarm management should be managed from the control room, to the field personnel, to any interested parties, including internal management and external agencies. Therefore, alarm management must look at workflows starting at the control level and how controllers follow-through on them. Furthermore, alarm management must start with alarm rationalization, which is partly a consultancy process backed up by rich alarm software tools for gathering critical baseline data. Finally, alarm management should create a closed loop process where lessons learned are captured and can easily be retrieved for future response in emergency or abnormal conditions. So alarm management is much more than handling alarm floods, chattering alarms and the like.

COMMENT: Invensys Alarm Management software (with embedded consulting services), Wonderware SCADA and Wonderware ArchestrA Workflow are used here.

(1) Review SCADA safety-related alarm operations using a process that ensures alarms are accurate and support safe pipeline operations;

COMMENT:

- Invensys Alarm Management tools provide a means to rationalize the alarm strategy prior to creating the alarm setting and management of alarms in the real-time Wonderware SCADA environment.

(2) Identify at least once each calendar month points affecting safety that have been taken off scan in the SCADA host, have had alarms inhibited, generated false alarms, or that have had forced or manual values for periods of time exceeding that required for associated maintenance or operating activities;

COMMENT:

- The Wonderware SCADA system archives and provides alarm statistics.
- Invensys Alarm Management features create a rich environment in which to view and analyze alarms.

(3) Verify the correct safety-related alarm set-point values and alarm descriptions when associated field instruments are calibrated or changed and at least once each calendar year, but at intervals not to exceed 15 months;

COMMENT:

- Invensys Alarm Management provides an environment that captures alarm setpoints from the database of IO attributes. The alarm data can be captured as frequently as is required. A web portal is a good way to collect and store alarm data and collect alarm information.
- The integrated Web Application Framework provides a module where alarms and attributes of the tag, including setpoint values, are displayed and stored.

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(4) Review the alarm management plan required by this paragraph at least once each calendar year, but at intervals not exceeding 15 months, to determine the effectiveness of the plan;

COMMENT:

- Consultancy on Invensys Alarm Management is a key element to the plan.
- The Wonderware ArchedrA Workflow description for communications supports this element of the regulation.

(5) Monitor the content and volume of general activity being directed to and required of each controller at least once each calendar year, but at intervals not exceeding 15 months, that will assure controllers have sufficient time to analyze and react to incoming alarms; and

COMMENT:

- Wonderware SCADA audit logs and event management embedded tools provide a first stage environment for monitoring alarms and actions.
- Invensys Alarm Management software provides an extremely rich set of features for analysis.
- Wonderware ArchedrA Workflow can record workflows for later analysis. The workflows have a number of filtering tools.

(6) Address deficiencies identified through the implementation of paragraphs (e)(1) through (e)(5) of this section.

COMMENT:

- The integrated Web Application Framework has a 'lessons learned' section in which alarm information can be loaded, including documents and other attachments, for immediate review upon alarm.

(f) Change Management. Each operator must assure that changes that could affect control room operations are coordinated with the control room personnel by performing each of the following:

COMMENT:

This section discusses long-term management of change (MOC) and making sure processes are updated and working across internal groups. But MOC also includes an element of change adoption. Simply creating new processes does not guarantee they are adopted. To ensure adoption of changes directly related to the control system (or cascaded activities), process adoption must be automated. For instance, contacting emergency responders is important during an event, but the controller may be so busy with basic mitigation procedures that emergency responders are not immediately contacted. An automated method to create a channel to other members in the organization is logical. Therefore, a method to feed control information across the enterprise is needed, thus closing the MOC loop. In fact, API 1168 specifically discusses handling emergency MOCs. MOCs should also be tested prior to installation, implying an off-line environment to test newly developed MOCs.

COMMENT: Invensys Alarm Management, Wonderware Mobility Solutions (IntelaTrac), SimSci-Esscor/ESI Training and Leak Detection (through ESI, an Invensys partner) are used in this section.

(1) Implement section 7 of API RP 1168 (incorporated by reference, see §195.3 for control room management change and require coordination between control room representatives, operator's management, and associated field personnel when planning and implementing physical changes to pipeline equipment or configuration; and

COMMENT:

- API 1168 is comprehensive, but primarily addresses Management of Change. A discussion of API 1168 is included at the end of this section.
- Wonderware ArchedrA Workflow is specifically designed to coordinate actions based on tags within the Wonderware SCADA control system. By capturing the tag attributes within the Integrated Engineering Environment (IDE), users can update all workflows associated with a specific tag through the organization. As a tag attribute changes, either in real time or in the workflow section of the engineering environment, those changes cascade through the entire workflow process.
- Wonderware SCADA basic alarm functions can initiate a workflow. That alarm is integrally tied to the specific tag in the control system and IDE.
- Wonderware Mobility Solutions (IntelaTrac) satisfies the element of 'field personnel.' As workflows are created and coordination with the field is required, the IntelaTrac product receives these workflows and kicks off more detailed actions for the field operator.

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- SimSci-Esscor/ESI Training provides an environment for operators to test themselves on handling a situation in which coordination between stakeholders is mandated.
- Leak Detection is specifically called out as part of API 1168, Section 7.4, which calls for an MOC procedure to allow verbal actions for leak detection. Operators should be included in creating the plan so they understand the criticality of the change and the appropriate actions.

(2) Require its field personnel to contact the control room when emergency conditions exist and when making field changes that affect control room operations.

COMMENT:

- Wonderware ArchestrA Workflow is designed to coordinate actions based on specific tags within the Wonderware SCADA control system. It is integrally tied to specific tags and as that tag attribute changes, either in the 'real time' or in the workflow section of the engineering environment, those changes cascade through the workflow process.
- Wonderware Mobility Solutions (IntelaTrac) satisfies the element of 'field personnel.' As workflows are created and coordination with the field is required, the IntelaTrac product receives these workflows and kicks off more detailed actions for the field operator.

(g) Operating Experience. *Each operator must assure that lessons learned from its operating experience are incorporated, as appropriate, into its control room management procedures by performing each of the following:*

COMMENT: This section implies that lessons learned regarding the pipeline are collected and procedures followed. Much like Section (f) discussed MOC, it is imperative that lessons learned be considered whenever possible. An automated workflow is the way to do that for many of the items. Lessons learned may be anecdotal, but collecting real-time data for analysis at a later date should be mandated. Alarm Management software storage of all types of alarms, field response data and training scores should be considered baseline data for control management improvements.

COMMENT: Integrated Web Application Framework, Wonderware ArchestrA Workflow, SimSci-Esscor/ESI Training and Invensys Alarm Management are used in this section.

(1) Review accidents that must be reported pursuant to §195.50 and 195.52 to determine if control room actions contributed to the event and, if so, correct, where necessary, deficiencies related to:

- (i) Controller fatigue;*
- (ii) Field equipment;*
- (iii) The operation of any relief device;*
- (iv) Procedures;*
- (v) SCADA system configuration; and*
- (vi) SCADA system performance.*

COMMENT:

- The integrated Web Application Framework displays a 'Lessons Learned' section within the shift handover and data capture area, allowing users and managers to enter comments for later review.
- Invensys Alarm Management is used to baseline alarms and their statistics.
- The SimSci-Esscor/ESI Training grading processes test how controllers respond to events and the grades can be considered critical data.
- Wonderware ArchestrA Workflow provides a method to automate changes made as a result of any lessons learned.

(2) Include lessons learned from the operator's experience in the training program required by this section.

COMMENT:

- The integrated Web Application Framework displays a 'Lessons Learned' section within the shift handover and data capture area, allowing users and managers to enter comments for later review.
- SimSci-Esscor/ESI Training provides a flight simulator environment for operators to review lessons learned after training. These lessons learned can be recorded for use in future scenarios used to test other operators.

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(h) Training. Each operator must establish a controller training program and review the training program content to identify potential improvements at least once each calendar year, but at intervals not to exceed 15 months. An operator's program must provide for training each controller to carry out the roles and responsibilities defined by the operator. In addition, the training program must include the following elements:

COMMENT: This section may seem as though it is limited to operator training for the basic elements of running the pipeline and navigating the HMI. However, since this regulation is focused on safety, the training system should extend to how the controller handles emergency situations and workflows initiated by alarms and actions. Training should include workflows initiated by alarms and actions. Training can also extend to simulation in an off-line environment where controllers and engineers can fully test the workflow and SCADA system prior to release.

COMMENT: SimSci-Esscor/ESI Training, Wonderware ArchestrA Workflow, IntelTrac and Invensys Alarm Management software are used in this section.

(1) Responding to abnormal operating conditions likely to occur simultaneously or in sequence;

COMMENT:

- SimSci-Esscor/ESI Training typically teaches controllers how to handle alarms and events created by instructor scenarios to handle the process only at the HMI level. Multiple scenarios can be programmed and invoked by opening the 'file' or modifying on the fly.
- For a fully integrated response to emergency procedures, an event with simultaneous abnormal or emergency conditions can be simulated so that the controller alerts all interested parties. The operator might leverage SimSci-Esscor/ESI Training, Wonderware SCADA, Wonderware ArchestrA Workflow or IntelTrac modules. This allows the operator to test him/herself on handling workflows, alarms, basic activities and field response.

(2) Use of a computerized simulator or non-computerized (tabletop) method for training controllers to recognize abnormal operating conditions;

COMMENT:

- SimSci-Esscor/ESI Training provides a computerized instructor/operator environment to simulate the operator experience, including two way communications between the simulator and the instructor machine. That is, the SimSci-Esscor system emulates the PLC or other control devices so that as the operator makes changes, those responses are forwarded to the instructor's pipeline models and dynamic changes are made, simulating real pipeline conditions. Multiple scenarios can be programmed and called up by opening the 'scenario file' or modifying on the fly. It is mandatory that the training system emulates the real SCADA system as closely as possible. The EPA has levied significant fines for training systems that don't emulate the real SCADA system. A PLC emulation program should be employed to meet the regulation's intent.
- IntelTrac provides a desktop tool to create and validate field procedures prior to sending them to the field. The desktop tool provides field personnel with a computer simulation of the user screen.
- Wonderware Workflow, IntelTrac and Wonderware SCADA all should be employed as components in the training system to emulate real-life situations that can arise.

(3) Training controllers on their responsibilities for communication under the operator's emergency response procedures;

COMMENT:

- To test the operator on communications responsibilities in response to an emergency, they may be required to respond to a fully 'orchestrated' scenario. It can be created with SimSci-Esscor/ESI Training, Wonderware SCADA, Wonderware ArchestrA Workflow and IntelTrac and used in an instructor/operator simulated environment. This simulation and training environment tests the operator on his/her full set of responsibilities from basic manual intervention to downstream communication prompted by workflow, SCADA alarms and remote operator software in one fully integrated system.

(4) Training that will provide a controller a working knowledge of the pipeline system, especially during the development of abnormal operating conditions; and

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COMMENT:

- SimSci-Esscor/ESI Training teaches controllers how to handle alarms and events created by instructor scenarios to handle the process at the HMI level (which only partially meets the regulation). Multiple scenarios can be programmed and invoked by opening the 'file' or modifying on the fly.
- To test an operator's 'working knowledge' of the pipeline, he/she may be required to respond to a fully 'orchestrated' scenario. It can be created with SimSci-Esscor/ESI Training, Wonderware SCADA, Wonderware ArchestrA Workflow and IntelaTrac and used in an instructor/operator simulated environment. An appropriate scenario in this simulation and training environment tests the operator's knowledge of the pipeline system and can be kicked off by the workflow, SCADA alarms and remote operator software in one fully integrated system.

(5) For pipeline operating setups that are periodically, but infrequently used, providing an opportunity for controllers to review relevant procedures in advance of their application.

COMMENT:

- SimSci-Esscor/ESI Training typically teaches controllers about various conditions created by instructor scenarios to handle the process only at the HMI level. Multiple scenarios can be programmed and invoked by opening the 'file' or modifying on the fly.
- IntelaTrac provides an off-line computer simulation area that allows engineers and operators to test the creation and validation of procedures.
- For fully integrated operating setups, a scenario with simultaneous conditions can be created so that the controller responds to tasks throughout the scenario. These setups could be driven from any of several applications, including SimSci-Esscor/ESI Training, Wonderware SCADA, Wonderware ArchestrA Workflow and IntelaTrac. This allows the operator to test him/herself on handling workflows, alarms, basic activities and field response.
- The integrated Web Application Framework provides an off-line environment to review lessons learned for important procedures.

(i) Compliance Validation. *Upon request, operators must submit their procedures to PHMSA or, in the case of an intrastate pipeline facility regulated by a State, to the appropriate State agency.*

COMMENT: Procedures can be anything from configuration to testing. During a recent DOT Workshop on the regulation, DOT indicated that compliance with the regulation was 'Performance Based.' This means that compliance is a matter of individual owner procedures. If procedures are documented, recorded and quantifiable such that DOT can audit those procedures and validate compliance based on those results, then that is the litmus test. All Invensys activities relevant to this regulation are recordable for auditing purposes.

(j) Compliance and Deviations. *An operator must maintain for review during inspection:*

COMMENT: Wonderware SCADA, Wonderware ArchestrA Workflow, SimSci-Esscor/ESI Training, Wonderware Mobility Solutions and Invensys Alarm Management software are used in this section.

(1) Records that demonstrate compliance with the requirements of this section; and

COMMENT:

- The integrated Web Application Framework provides an intranet portal environment to review lessons learned for important procedures.
- SimSci-Esscor/ESI Training provides the method for evaluating and grading operators on their responses to scenarios.
- Invensys Alarm Management software includes tools to report on a variety of statistics for the alarms.
- Wonderware ArchestrA Workflow defines specific automated actions and the workflows can be saved to show compliance.
- Wonderware IntelaTrac's Auditor Plus enables management to review field personnel responses and record comments as part of a specific procedure.

(2) Documentation to demonstrate that any deviation from the procedures required by this section was necessary for the safe operation of the pipeline facility.

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COMMENT:

- The integrated Web Application Framework provides an off-line environment to review lessons learned for important procedures.
- Wonderware ArchestrA Workflow can create malfunction reports that can be viewed and approved up the management chain.
- Management must have an area available to record various components.

8. API 1168 REVIEW

API 1168: Section 5 and API 1168: Section 7 are specifically called out in 49 CFR 195.446. In general API 1168 discusses Pipeline Control Room Management. Section 1.1 states:

Purpose: The purpose of this publication is to provide operators and pipeline controllers with guidance on industry best practices on control room management to consider when developing or enhancing practices and procedures. This document is written for operators with continuous and non-continuous operations as applicable.

Section 5 Guidelines for Shift Turnover:

Establishing practices for shift turnover reduces the possibility of an incident and improves pipeline operations. Pipeline operators should establish a shift turnover process to ensure that relevant operating information is transferred. This may include overlap time between outgoing and incoming pipeline control room personnel as applicable.

5.1 Shift Turnover Procedure

COMMENT: Integrated Web Application Framework

- The integrated Web Application Framework supports control accountability during the turnover, with a permanently maintained record of the turnover activity.

5.2 Shift Turnover Meeting

COMMENT: Integrated Web Application Framework

- Checklists of tasks and completions are logged in the integrated Web Application Framework system. Those documents are electronically signed as required by various authority levels.
- The meetings will be a formal process conducted by management at each shift change.

5.3 Information to Exchange

COMMENT: Integrated Web Application Framework

- The integrated Web Application Framework provides a rich environment to log many kinds of information:
 - Number of Logbook entries related to this tagname and associated tagnames in the last week
 - Number of Alarms related to this tagname and associated tagnames in the last 24 hours
 - Number of events related to this tagname and associated tagnames in the last 24 hours
 - Number of associated tags being historized
 - Number of lessons learned
 - Number of communication failures in the last 24 hours
 - Number of Point-to-Point verifications
 - Historical Operations data web pages available in a tabular or graphic format
 - Easy queries, filtering and editing of data with web pages
 - Audit trail
 - Hardcopy reports
 - Event-based or scheduled email and reporting

5.3.1 Emergency/Abnormal Operating Conditions

COMMENT: The integrated Web Application Framework provides a rich environment in which to communicate emergency or abnormal operating conditions.

5.3.2 Daily Operation Information

COMMENT: This information can be listed for incoming shifts in the integrated Web Application Framework's rich environment.

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5.3.3 Status of Scheduled/Unscheduled Maintenance Activities

COMMENT: Wonderware Mobility Solutions (IntelaTrac); integrated Web Application Framework

- IntelaTrac provides a module for the desktop that schedules and describes maintenance activities, crew availability and status of activities.
- The integrated Web Application Framework provides an environment in which to remind the 'second shift' to review the IntelaTrac desktop system.

5.3.4 Incident Information

COMMENT: Wonderware Mobility Solutions (IntelaTrac); integrated Web Application Framework

- IntelaTrac provides a module for the desktop that schedules and describes maintenance activities, crew availability and status of activities.
- This information can be listed for incoming shifts in the integrated Web Application Framework's rich environment.
- Invensys Avantis CM can be applied for equipment availability via its work order maintenance and related reports.

5.3.5 Changes to Physical Assets, Procedures and/or Responsibilities

COMMENT: Integrated Web Application Framework provides a rich environment to log changes to physical assets.

- This information can be listed for incoming shifts in the integrated Web Application Framework's rich environment.

5.3.6 Alarm Reviews

COMMENT:

- Invensys Alarm Management provides a large number of alarm review solutions.
- Wonderware SCADA provides alarm analysis tools as part of the fundamental set of features.

5.3.7 Third-party Incidents Potentially Impacting Operations

COMMENT:

- This information can be listed for incoming shifts in the integrated Web Application Framework's rich environment.

Section 7 Pipeline Control Management of Change (MOC):

Change is a regular part of pipeline control operations that must be managed and governed by effective processes and procedures. For MOC to be effective, affected personnel should be part of the decision and implementation process.

7.1 Inclusion of Pipeline Control Room Personnel

COMMENT: It is management's responsibility to create this process.

7.2 Systems/Processes Undergoing Change *(below is specific language from API 1168 shown to note processes which lend themselves to automation)*

Pipeline operators should consider defining which systems/processes will be governed by MOC policies. Among the activities to consider are changes that include, but are not limited to:

- new or revised procedure
- operating responsibilities between pipeline controllers and field personnel or third-party operations
- field maintenance activity affecting pipeline control room operations
- control system changes
- SCADA system changes

COMMENT: Wonderware ArchestrA Workflow, Wonderware Mobility Solutions (IntelaTrac) and the integrated Web Application Framework

- Wonderware ArchestrA Workflow is updated as SCADA system tags are updated. The IDE environment allows changes to a similar process to be updated across all tags related to that process. The embedded automation provided by the IDE makes this an obvious area to include in MOC policies.
- Wonderware Mobility Solutions (IntelaTrac) will be updated when field procedures change. These changes can be in the form of a new or modified procedure. This MOC lends itself to automation because a change to a procedure can be uploaded to handheld devices and desktop applications.

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- The integrated Web Application Framework solution has a built-in utility to keep track of all (required) IO points. Its tools allow users to upload new or updated IO tables in different formats. Based on rules, the system will identify new or modified tags.

7.3 Notification and Training

COMMENT: SimSci-Esscor/ESI Training, Management Procedures

- SimSci-Esscor/ESI Training teaches operators on pipeline operations in an instructor/operator flight simulator type of environment.
- Use of other applications such as the integrated Web Application Framework and Wonderware ArchestrA Workflow is typically by the owner's in-house training organization via classroom training, video training or other means.

7.4 Emergency MOCs (Management of Change)

COMMENT: Wonderware SCADA, Leak Detection (ESI, an Invensys partner)

- With real-time events during the daily operation of the SCADA system, all information that is important for safe operation of the pipeline will be available to the operator. Critical applications should be embedded or integrated in the SCADA system to enable quick response by the operator.
- Wonderware ArchestrA Workflow gives operators instructions on how to respond to various activities as they happen. Documents and other attachments can be embedded into the workflow to augment their response.
- Leak Detection software requirements should be embedded in the document.

9. Summary

The 49 CFR 195.446 regulation requires that pipeline operators implement policies and procedures to ensure a safe and reliable system. To achieve this, the DOT has expressly discussed the entire Change Management process. In order to ensure that the procedures are put into place, operators will undergo a self-policing program that validates the processes have been changed and continue to be followed. There are two ways to accomplish that validation. First, an operator can maintain strict and up-to-date manuals and guidelines on their new procedures. This can become difficult to maintain and even more difficult to validate, regardless of the due diligence the operator took during the creation. Second, an operator can create the same procedures in a written form, but transfer them to an automated solution with applications that are driven directly from the SCADA system. An automated solution will provide visible validation since results are automatically stored, signatures are recorded and instructions are electronic.

The key questions operators should ask themselves when planning their SCADA system are the following:

- Should I solve my regulatory compliance using traditional manual tools such as notebooks, video training or procedural binders? Or, should I use automated software tools that are integrated with the SCADA system?
- How am I going to be able to implement the changes I make and be sure they are followed?
- How can I quantify the effectiveness of the changes?
- How can I assure that the controllers and the entire operation are taking advantage of lessons learned? That is, have I given my workforce a simple and automated way to capture a deficiency and associate it to an event or a device?

If these questions are asked when planning the SCADA system, operators won't find themselves on a dead-end street requiring an expensive and difficult U-turn toward a system that is reproducible, validateable and quantifiable.

To answer these questions, solve the problems presented in this White Paper and meet the requirements of the regulation, Invensys offers a fully compliant 49 CFR SCADA Pipeline Solution for Control Room Management.



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