In 2003, the North East Blackout plunged an estimated 45 million people into the dark and triggered the creation of the Energy Policy Act of 2005. This act resulted in the appointment (via FERC) of NERC (the North American Electric Reliability Corporation) as the “Electric Reliability Organization” (ERO) and made NERC’s policies enforceable by law with penalties up to $1 million per day per violation. This White Paper explores how a conceptual j5 NERC Compliance application could manage these regulations efficiently and effectively.
Introduction

In 2003, the North East Blackout plunged an estimated 45 million people into the dark and triggered the creation of the Energy Policy Act of 2005.

This act resulted in the appointment (via FERC) of NERC (North American Electric Reliability Corporation) as the “Electric Reliability Organization” (ERO) and made NERC’s policies enforceable by law with penalties up to $1 million per day per violation.

The NERC standards are designed to “ensure the reliability of the North American bulk power system”. In all, more than 500 different Power Companies in the USA, Canada and Mexico are now required by law to abide by these mandatory standards.

The NERC Standards are complex, numerous and cover a wide variety of areas including: Resource and Demand Balancing, Communications, Critical Infrastructure Protection, Emergency Preparedness, Facilities Design and others. Each standard comprises numerous, complex requirements to which the corporation must comply. Because of the legal and technical aspects of the standards, they are complex and difficult to read. Additionally, in many cases, the notification to the authorities of changes in the status must be carried out within a very short time period to maintain compliance.

The complexity of the standards, the magnitude of the penalties, and the time pressure to react to disturbances place added pressure on the responsible site personnel. In cases where the company has many sites often using completely different fuel types (for example Wind, Coal, Gas, Geo-Thermal and Hydro), the management of the compliance processes can be extremely difficult, time consuming and stressful with the high possibility of incurring extremely costly slip-ups.

The Conceptual j5 NERC Compliance Application

1. Could be designed to assist responsible personnel to manage the Compliance processes efficiently, effectively and within the time imposed by the regulations
2. Could manage the processes in multi-site utilities and where the corporation has many different fuel types
3. Could manage the Compliance requirement of the local jurisdictions and integrate these with the NERC Compliance requirements
The conceptual j5 NERC Compliance application would have a single integrated framework that achieves this management and control through:

1. A pre-configured rules engine that would constantly monitor many hundreds of inputs to detect Compliance events
2. Providing a set of NERC templates for each NERC rule that defines what data needs to be captured and what procedures must be carried out
3. Providing a set of NERC (and local jurisdiction) Dashboards and monitoring facilities that provide a comprehensive overview of the NERC Compliance
4. Providing a set of tools that enable users and engineers to quickly adapt the system to meet the local requirements and new regulations coming out of NERC

Benefits

Using the conceptual j5 NERC Compliance application, corporations could:

1. Bring the level of Compliance Management from pseudo manual up to “best of breed” level
2. Get immediate visibility and notification of events identified at the operations level
3. Substantially reduce the amount of time spent collecting, analysing and reporting on the different Compliance requirements
4. Avoid significant penalties / embarrassment of slip-ups and by reacting quickly and effectively to potential non-compliances
5. Maintain “best of breed” standard by continually updating and synchronizing the processes as the regulations change
6. Maintain a clear overview and detailed visibility of all the processes using the on-line dashboard

NERC Management System Requirements

The table below shows the key NERC requirements and provides comments on the resulting expectations that would be required from any NERC Management System:
<table>
<thead>
<tr>
<th>NERC Requirement</th>
<th>NERC Management System Expected Functionality</th>
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| Time-critical response to many hundreds of (often complex) requirements across many different departments | • The system should continuously scan the various sources of potential non-conformance and immediately report (to the right person) when a potential non-conformance is detected  
• It should warn that the situation is at risk of a non-compliance and guide the users through the correct procedures of handling the situation  
• Such an event scanner must be pre-configured to detect the NERC requirements  
• Each NERC event may require additional data to be reported to avoid a non-compliance occurrence | • The system should come pre-configured with data entry forms that will enable non-skilled operators to enter the critical additional data at the time of the NERC nominated event  
• Each NERC nominated event may require a controlled workflow to be carried out that is specific to the NERC requirement and the workflow must be audited and may involve multiple different personnel in different roles | • The system should come pre-configured with a workflow engine that will make sure that non-skilled operators carry out the precise tasks required for the active NERC events  
• The system should also co-ordinate the “passing of the baton” between the different stakeholders as the workflow progresses  
• A complete auditing function for each workflow must be integrated into the system  
• The Facility Process Owner must correlate the NERC event with the specific NERC Requirement and the Process Owner must also define actions to mitigate the effect of the NERC event | • The system should route all Compliance events to the Facility Process Owner where validation and rule correlation can occur  
• The system should hold all requirements and the required workflows in pick lists to easily correlate the events to the requirements  
• Once the respective rule had been identified, the system must enforce the required data entry and workflow  
• The system must also allow the user to create Actions that will be used to mitigate the effects of the event  
• Corporate Compliance Users should validate the NERC events for the stipulated time and create the necessary Self-Certification Reports and Mitigation Actions should also be managed and where necessary expedited | • The system should automatically collect (where possible) the nominated NERC Events and populate the Report Forms to simplify the Compliance User Workload and avoid omissions  
• The system should provide a framework for the management and control of the mitigation actions  
• The system should provide a framework for the self-certification processes and maintain the information in a non-volatile format  
• Reports should be issued to the correct regulating authority on-time and in the required format and where data is to be stored, this should be done in a non-volatile format which will allow easy access to regulators and assessors  
• Responsible Managers must have a clear view of the status of the compliance always | • The system should maintain the correct templates for the reporting functionality  
• The system should provide the distribution capabilities to automatically distribute the reports to the correct authority  
• Reports should be stored in electronic format and there should be an easy way to retrieve them | • The system should provide a live and historic view of all Compliance events in an easy to understand intuitive form (preferably an interactive dashboard)  
• The regulations are constantly evolving with new and modified requirements and the company must remain in synchronism with these changing requirements | • The system must provide a logical, expandable framework of facilities that can be easily modified and configured to stay abreast of the changing set of NERC Standards  
• The ability to quickly configure the scanning engine, the required data, the required workflow and the required reports for each change must be inherent in the system and achievable by end users or Systems Integrators  
• Corporations must be able to facilitate the gathering of Compliance data from the operations representatives | • The system must provide active support for the scheduling, data collection, communication and reporting functionality associated with the NERC self-certification process |
j5 NERC Compliance Application Concept

j5 NERC Compliance is a conceptual application that could support, assist, control and provide visualization of the Compliance processes by multiple personnel from Compliance event detection right through to the scheduled event reporting to the regulating authorities and self-certification activities. The conceptual j5 NERC Compliance application could support all five levels of the Modified Deming Operations (MDO) categorization. (Modified Plan, Do, Check, Act) because it would:

1. Provide Comprehensive Logging of the Compliance Events
2. Provide Multi-Discipline Procedural Identification and Management of Events (Do)
3. Provide High Level Operational Management Visualization of the Compliance Information (Check)
4. Provide Procedural Planning and Design Support (Plan, Act)
5. Provide Multi-Department Support

Essentially, the conceptual j5 NERC Compliance application could:

1. Scan the sources of information for any of the possible hundreds of potential Compliance events
2. Identify and route these (and other jurisdiction and internal) events to the first level of processing
3. Assist in the further identification and categorization of the event by ensuring that the correct procedures are provided to the operations users when the event occurs
4. Pass the information on to the Facility Process Owner (the site Compliance-trained user)
5. Assist the Facility Process Owner by automatically identifying the appropriate NERC Standard(s) and affected Requirement(s) (in some cases, a single event may trigger multiple NERC Standards and Requirements)
6. Ensure the Process Owner carries out the correct procedure
7. Where necessary, facilitate the procedure for processing a non-compliant violation by guiding the user through the Self Reporting and Mitigation Plan procedures
8. Automatically create the necessary reports and Tie Off procedures for the regular corporate reports to be collated and validated by the Corporate Compliance User
9. In parallel, provide context information in Dashboard format of the system in near-real time
10. Finally, provide the necessary tools to tailor and enhance all the procedures so that they align with the constantly evolving set of NERC standards and requirements

**Typical j5 NERC Compliance Workflow**

The swim lane diagram below shows how the j5 NERC Management application could manage a typical workflow for the management of NERC events. Each of the functions in the Swim Lane Diagram is discussed in more detail in the sections below. Note that the diagram below is just one example of the workflow. The precise workflow will differ depending on the Rule that has been activated:
To maintain Compliance, the conceptual j5 NERC Compliance application could ensure that all NERC related events are reported on time, with the correct data and according to the required workflow. The diagram above shows how the conceptual j5 NERC Compliance could provide continuous support in virtually every aspect of the process from Event Occurrence to final reporting and dashboard updating. Such support enables an efficient, consistent level of Compliance Management with far less chance of slip-ups and the corresponding high penalties associated with them.

**Summary of NERC Compliance Activities**

This section summarizes the broad activities carried out by the individual stakeholders and the possible interaction with the conceptual j5 NERC Compliance application. A more detailed description of these activities is provided later in this document.

With the conceptual j5 NERC Management application, *the Compliance User could quickly Design and Maintain a Compliance Strategy by*:  

- **Creating a Compliance watch-list** in the rules-engine that monitors the status of multiple areas like Operations Logbook Entries, Incidents, Environmental Data, Audits, Certificates and so on
- **Defining graphical Workflows, Forms and Documents** for the expected NERC events
- **Associating the relevant regulations** and reporting characteristics to the watch list entries
- **Linking external events**, for example from the real-time historian and maintenance systems, into the watch-list
- **Easily creating custom reports and dashboards** to efficiently and rigorously monitor all the key events and notifications on time and within the regulations
The Compliance User could efficiently and rigorously monitor hundreds of Compliance points by:

- **Receiving immediate notifications** of any Compliance excursions or warnings in a single, easy-to-understand, summary view
- Quickly **drilling down to get details** of a non-compliance or a Compliance warning
- **Initiating actions** to mitigate NERC events and avoiding non-compliances and delegating responsible parties to carry out these actions
- **Tracking the status** of actions and escalating overdue actions using the Dashboards so that the user has complete control of the rectifying procedure
- Receiving **Compliance reports** that are generated automatically, regularly or linked to an event
- **Precisely tracking all the events** of the system through the automatically generated audit logs
- **Tracking Compliance warnings and notices against NERC and other regulatory categories**
- Viewing and **approving the automatically generated regulatory reports** before they are sent out
- **Monitoring the overall Compliance status** through the Customizable Compliance Dashboards
- **Drilling down** to specific Compliance events or aspects directly from the Dashboard

**NERC Compliance Key Personnel**

For a typical NERC Event, there are several key personnel involved (as shown in the diagram on the right). The key personnel include:

**Operators** – This is usually the first group to see an event. They are generally not skilled in managing NERC events. The system guides them through a classification of the event (sometimes asking them for more information).

**Process Owners** - The Process Owners are trained to manage the classified events detected by the Rules Engine. They are generally located at the Facility and are required to correlate the events to the NERC Requirements. Often the workflow requires a quick turnaround to maintain Compliance.

**Compliance Users** - The Compliance User normally has corporate responsibilities. They will for example be required to provide follow-up reports on NERC events, provide monthly reports, expedite mitigation actions, update the self-compliance results etc.
**Other Users** - During the workflow, other users may be required to contribute to the NERC Compliance Process as defined by the relevant workflow.

**Conceptual j5 NERC Compliance Input / Output Summary**

The diagram on the right shows the principal input sources and output reports and visualizations of the conceptual j5 NERC Compliance application. In essence, the I/O comprises of:

- The Design and Configuration Sections
- The Sources of potential non-Compliances
- The Dashboards and Reports Sections which are viewed by the active stakeholders

The sections below describe these conceptual modules in more detail.

**Design and Configuration Sections**

A Compliance Department receives NERC Requirements from both the Regulatory Bodies as well as Internal Corporate Departments. The Compliance Department would configure the conceptual j5 NERC Compliance application to:

- Scan and detect potential events
- Route events to the correct user
- Define the data that is to be collected
- Configure the workflow
- Create Reports and Dashboards

The conceptual j5 NERC Compliance application would come with:

- A set of templates to achieve these functions
- The configuration tools needed to fine tune and add to the basic templates
NERC Nominated Events

The j5 Framework could scan any number of information sources for changes that could signal a NERC nominated event (for example, an Event that must be reported to avoid Non-Compliance), typically, these information sources include:

- The Data Historian for alarms or trips or non-availability of resources
- The Operations Logbook where operations personnel enter information relating to various plant conditions
- The CMMS where information on Work Orders and so on are kept
- The LIMS system results falling outside the allowable norms
- Other registers and database tables where information such as inspections, qualifications and so on may be kept

Note that, at any time, new rules and registers could be added to the system to create new data sources.

Reports, Dashboards and Other Applications

The conceptual j5 NERC Compliance application could create many visual outputs which would be used for monitoring and managing the system, these outputs include:

1. Various general and NERC specific Reports
2. Various Dashboards which would be interactive and could be drilled down
3. Data which could be written to various applications that will act as repositories for the information
4. Various Reports and documents that could be written to the Document Management System
5. Various custom reports and Dashboards that could be created for specific local requirements

j5 NERC Compliance System Users

The information in the Dashboards, Reports and j5 Applications could be viewed by any authorized user. These users could comprise of both local on-site users as well as (if authorized by the Corporate Compliance User) the users in the regulatory agencies and third-party users. To view the information, the user would require the correct authentication attributes which are issued by the conceptual j5 NERC Compliance application. The user would also require a j5 supported browser.
Functional Description

This section shows how the various internal processing sections within the conceptual j5 NERC Compliance application could meet the needs for NERC Compliance Reporting. The diagram below shows how a raw, uncategorized NERC event could:

- Appear in the Operations Logbook
- Be identified and processed by an operator
- Be automatically routed to the facility (site) trained Process Owner for Identification and Processing
- Be automatically collected at the end of the NERC nominated period for the self-compliancy reports
- Be validated by the Corporate Compliance User (probably creating Reports and Dashboard updates)

It also shows how the system could be categorized and configured (covered in the next section):

Raw Event Collection

NERC Compliance events could originate from many different sources of information. The sources of information are discussed in the section above. Generally, all the NERC event notifications would arrive in the Operations Logbook for categorization, identification and processing, note that these events could be:

1. Generated automatically by the j5 Framework
   a. By the Data Historian or DCS (events are generated by the j5 Event Manager)
   b. By the manual data collection for specific conditions
   c. By monitoring various registers for specific conditions
2. Manually entered by an operator or other authorized person and this would usually occur while the operator is monitoring the Dashboards or DCS system or by simply noticing something on the site 

**Event Classification**

Operators are generally not trained to identify all the NERC Compliance Requirements. The conceptual j5 NERC Compliance application could therefore break the identification down into two distinct steps:

1. Operations Logbook Event Classification and Identification (carried out by the operators)
2. Rule Classification and Processing (carried out by the NERC trained Facility Process Owner)

The conceptual j5 NERC Compliance application could assist operators in identifying the events using a structured classification tree. To identify an event, an operator could simply select the category, sub category and event. As an example, the operator could choose Safety, Security and Potential Sabotage options. Once trained, operators would find it easy to classify these events and it is also simple to upgrade the hierarchy tree. Note that operators could also assign the event to an area (using a similar tree structure for specifying the location information).

**Operations Logbook Workflow**

The management and sequencing of data entry in the Operations Logbook would be determined by the Operations Logbook Workflow. The diagram on the right shows the top level of the Operations Logbook Workflow, please note that:

- This Operations Logbook Workflow is tightly tuned to NERC and other Compliance requirements
- The diagram only shows the top level of the workflow, each block in the diagram represents a (hidden) additional workflow
- The workflow carries out the logic that a highly skilled operator would have to remember to achieve the correct Compliance activities
- The workflow is created using BPMN, which is a graphical workflow application that is standard in the industry and this means that the process could proceed largely without any programming (coding) so as to tailor the application to local conditions and to add new requirements when they are issued by
the regulating authorities (it also means the workflow is easy to understand since it is graphical view of the workflow)

**Event Identification (with Additional Data Entry and Workflow)**

When an operator classifies an event, the conceptual j5 NERC Compliance application workflow could automatically:

1. Recognize the classification
2. Show a form with additional data that is required for that category of event
3. Show a sequence of steps (workflow) for the operator to complete (the workflow may include multiple nominated stakeholders who will be required to contribute to the event record)
4. Show specific documentation for that category (as defined in the rules engine)

**Checklists**

A Checklist could be assigned to the processing of each event type. A Checklist could be used to ensure that every requirement is satisfied and signed off before the next step in the workflow could be started. Checklist templates could be easily added and could be easily maintained by the Authorized Person. The Checklists would also be kept as a permanent record with the Event Record.

**Event Routing to the Process Owner Screen**

Once an event has been correctly classified and recorded, it needs to be sent to the Process Owner for correlation with the NERC or local regulation rule(s). This task could be carried out by the j5 Framework by:

1. Scanning many registers and applications for events that match the configured criterion (filter)
2. When a match is achieved, a Compliance event could be identified and inputted into the
Compliance Management repository (configured workflows could notify responsible personnel and facilitate appropriate follow-up action)

3. A notification template (form) that is specific to that recognized event could be attached
4. Relevant documentation could also be attached
5. The originating log could be attached so that the Process Owner could understand all the details of the originating event

**Pop-up Notifications**

Since many of the Compliance Notifications are time critical, it is important to warn the Process Owner or Compliance User in a timely manner. The conceptual j5 NERC Compliance application could do this through a Pop-up Notification system. Pop-up notifications could appear on the Process Owner or Compliance User desktop to signal that a time-critical action needs to be carried out.

**Compliance Rule Identification and Processing**

If a Non-Compliance or Potential Non-Compliance Notification is received on a Process Owner’s Notification Screen, the conceptual j5 NERC Compliance application could also identify (via the Rule Engine) the NERC or Local Authority Requirement and the required workflow to follow for that Rule. The identification of the rule and following of the workflow could be made considerably easier since all the data is attached to the record, in front of the Facility Process Owner. Please note that:

- The Process Owner could choose one or more Standards or Requirements to be associated with an event
- The Standard (or Standards) could determine the workflow and the content of the record
- There could be a workflow in the record which assists the users in making the right sequence of steps
- There could be placeholders for Actions to be carried out (see the relevant section below), Stakeholders (the people who will play a part in this Event) and an Audit Log which records every step in the progress of the workflow
- The information entered into the log could also be represented in a Dashboard (see the section below)
- The conceptual j5 NERC Compliance application could allow for Self-Reporting and Mitigation Plan processes in the case of non-compliances
**Requirement Identification and Processing Workflow**

Like the Event Identification and Processing carried out by the Operator, there is could also be a Workflow associated with the Requirement Identification and processing, please note the following:

- The workflow could cater for each of the NERC and Local Regulations’ requirements
- The diagram only shows the top level of the potential workflow (each block in the diagram represents a - hidden - additional workflow)
- The workflow could assist the Facility Process Owner - and other stakeholders - in following the many complicated - but essential - steps in meeting the Compliance Requirements
- The workflow could be created using BPMN, which is a graphical workflow application that is standard in the industry, again, no programming (coding) (with the possibility of scripts in special cases) is required to tailor the application to local conditions and to add new requirements when they are issued by the regulating authorities

**Action Management**

When processing the Non-Compliances and the potential Non-Compliances, the Facility Process Owner or Corporate Compliance User will often need to assign actions to be carried out by other parties. The conceptual j5 NERC Compliance application could include a complete Action Management system that uses a built-in Workflow. There could be many Actions associated with a single Compliance Event. Overdue Actions could also be highlighted in the Dashboards and Reports.

**Audit Logs**

An Audit Log could be attached to each Notification and could be viewed at any time. The Audit Log would report on every action that has taken place on the record, who carried out the action and when that action occurred. This enables a tight control of the processes involved with the correct management of Compliance Events.
**Dashboards**

With the sheer quantity of information required to be monitored by the conceptual j5 NERC Compliance application, for the Compliance Manager, Dashboards are almost essential, particularly if there are multiple sites or multiple fuel types.

With the conceptual j5 NERC Compliance Dashboard, the Compliance Manager or any Authorized User could:

- View **large amounts of information** in an easy to understand format
- **View aggregate data** (for non-compliance events per unit or per category) to quickly pick up trends
- Use hotspots within the Dashboard to **drill down to more detailed** Dashboards, Reports or to records in the conceptual j5 NERC Compliance application
- View **Process Trends** from multiple disparate data sources
- View **KPI's and leading and lagging indicators**
- View **Bad Actors** and drill down to see trends of the causes
- **Create-custom Dashboards** using the in-built drag and drop report builder

There are would be several pre-formatted Dashboards associated with conceptual j5 NERC Compliance application to simplify the route to full NERC Compliance.

**Reports**

To adequately manage all aspects of Health, Safety and Environment, the Compliance Personnel require a comprehensive repertoire of reports. With j5 Reports, the Compliance Personnel could:

- **Choose from a range of standard Compliance specific reports**
- **Create custom reports** using the in-built simple drag and drop report builder
- **Insert charts, trends** and other easy-to-understand widgets into their reports
- **Schedule the reports** or instruct the system to create the reports on an event
• **Link in real-time information** for analysis
• **Activate reports from within the Compliance modules**
• **Insert hotspots** in the reports to drill down to more detailed reports
• Access the report repository to **view reports that have run previously**
• Instruct the system to **email reports** to nominated personnel in the operations

**Audits, HAZOPs, Legislative and Inspection Management**

The conceptual j5 NERC Compliance application could provide a register repository function which could be used to efficiently store specific information relating to the Compliance needs. These registers could typically be used to store information (for example) Audits, HAZOPs, Legislative, Training and Inspection Management. With the Register Capability, Compliance Personnel could:

- Have a **single source of information** to track many kinds of information
- Quickly **set up warning triggers** to automatically provide notifications of non-compliance or impending non-compliance
- **Import the information** from 3rd party applications
- Assign actions to any of the registers to **prevent non-compliance or to rectify non-compliance**
- **See an overview of the information** in Reports or in the Dashboards

**Lab Information**

To meet Compliance requirements, a Compliance Manager often requires an integrated laboratory data management system. With a j5 Lab Data interface / application, the Compliance Personnel could:

- Have **access to all Lab data** whether it is collected in a standalone LIMS or entered directly into a custom j5 Lab Data application
- View **summary information** or drill down to see **detailed information** for each of the samples taken
- **Schedule the collection of samples** and track whether the samples have been collected on time as required
- **View Trends** of the Lab Data to identify problems before the limits or specifications are exceeded
- Setup **Non-Compliance and Warning Triggers** that will issue notifications if the limits are exceeded
- Setup input screens to initiate a sample collection manually
- Create Lab Data Reports (to be used internally or sent to the regulatory authorities) and Dashboards to provide an overview of the lab data
Managing documents efficiently and securely is one of the essential tasks of Compliance Management. With the j5 Framework, Compliance Personnel could:

- **Attach any number of documents to any of the logs** (for example Graphics, Excel and PDF files)
- **Review the contents of these documents** by simply clicking the link in the log
- **Retrieve and replace documents** with a new version directly from the logs (and retrieve old versions if required)
- **Search through all the documents** to find document meta-data (for example to find all documents that are due to be revised)

The **document controller** could:

- Decide on the **required revision control workflow**
- Manage the different documents in the database using **standard database tool facilities**
This conceptual White Paper was written in 2014 and there have been significant enhancements to the j5 Framework, which make it even easier to create an application like j5 NERC Compliance. In 2016, j5 International (Part of Hexagon) introduced IndustraForm® technology. In the past, industries have used word processor and spreadsheet documents to record vital operational information. The number of these files tend grow rapidly creating a management nightmare, but industries have had very little alternative since the existing enterprise options are not only hugely expensive, but also hard to configure and maintain.

**What IndustraForm® offers:**

The j5 system now offers IndustraForm® technology to quickly and simply upgrade spreadsheet and word processor information into enterprise level forms that support many operational requirements like workflow and real-time updates. Additionally, it enables organizations to easily add new applications and forms to the j5 Framework that meet special site requirements. This is possible because an IndustraForm® is rich in industry-based capabilities and they are intuitively spreadsheet-like in structure. In fact, spreadsheets can be directly imported into the j5 Integrated Development Environment (IDE).

**How this resolves a problem:**

IndustraForm® technology allows companies to consolidate all their paper and electronic forms into a single enterprise system. These could be, for example include NERC Compliance, Risk Assessment, Shift Handover and Incident Management forms. It also provides a clear and simple approach to adding new industry rich forms to meet specific industry requirements.