PSS® ODMS
Product Overview

Answers for infrastructure and cities.
Contents

This document contains the PSS®ODMS product overview that details features and functions, licensing options, and information outlining the pre and post deployment offering.

Information in this document and any software described herein is confidential and subject to change without prior notice.

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PSS®ODMS Overview

1.1 Introduction
PSS®ODMS is a multi-purpose software product used by power transmission system planners, operations engineers, and operations planners to create, maintain, analyze, and exchange network model data quickly and easily for use in long term planning studies, near-term operational planning, and real-time system operation.

- **For Transmission Planners**
PSS®ODMS simplifies the entire planning project workflow from conception to operation. It boosts the efficiency and ease of your modeling workflows, improves model reliability/accuracy, simplifies model exchange, and helps you achieve ongoing regulatory compliance.

- **For Operations Engineers**
PSS®ODMS provides a more efficient and reliable way of managing and exchanging operational data & models in a way that’s compliant with current regulations. It also provides Transmission System Operators (TSOs) with solutions for operator training and compliance with regulations around situational awareness and audit trails.

- **For Operations Planners**
PSS®ODMS automates the creation of accurate and reliable operational planning cases that are compliant with regulations, and easily exchanged with other entities.

With its flexibility, lightweight deployment, ease of use, CIM (IEC 61970) compatibility, open architecture, public APIs, and seamless integration with planning tools like PSS®E, PSS®ODMS can benefit power companies of various sizes and functions, including TSOs, ISOs, RTOs, balancing authorities, reliability coordinators, and integrated utilities. Benefits include:

- Greater efficiency in your model exchange workflows / business processes
- Higher degree of accuracy in your power system studies, models, and simulations
- Increased power system reliability/security
- Fewer regulatory violations/fines
- Turnkey compliance with key regulatory requirements around model accuracy, audit trails, network analysis, and model exchange, and network model/data formats.

1.1.1 PSS®ODMS for Transmission Planners

<table>
<thead>
<tr>
<th>Market Problem</th>
<th>PSS®ODMS Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Validation</strong></td>
<td><strong>Model Validator</strong></td>
</tr>
<tr>
<td><em>How can I ensure that my planning projects/models are valid and that they’ll solve as intended?</em></td>
<td><em>Ensure that your planning projects are valid and solve as you intend.</em></td>
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</table>

<p>| <strong>Model Exchange and Data Conversion</strong> | <strong>Model Exchanger and Data Converter</strong> |
| <em>How can we improve the efficiency and accuracy of our model exchange processes, while also achieving compliance with data format regulations?</em> | <em>Provides a simpler, more reliable, interoperable, and regulatory-compliant way of exchanging projects/model information with external entities.</em> |
| - How can we reduce paper shuffling, and improve the simplicity, reliability, and efficiency of model synchronization and sharing of model changes with other planners, with operations, and with external entities such as neighboring TSOs and ISOs? | |
| - We need a simpler way to do automatic data conversion between different data formats (such as PSS®E and | |</p>
<table>
<thead>
<tr>
<th>Market Problem</th>
<th>PSS®ODMS Capabilities</th>
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<tbody>
<tr>
<td><strong>Market Problem</strong></td>
<td>CIM/XML in order to exchange planning models/projects with external and internal entities in a more interoperable way – and in some cases, to comply with regulations.</td>
</tr>
<tr>
<td>• We need a simpler, more reliable, and compliant way of exchanging projects/model information with external entities (such as our ISO/RTO, and neighboring TSOs).</td>
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<tr>
<td><strong>Model Management</strong></td>
<td>Model Manager</td>
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<tr>
<td>How can we have a more automated, efficient, reliable way to manage lifecycle of planning projects from inception to absorption in EMS operational model?</td>
<td>Manage the complete modeling workflow – from project creation to electrification – in a more reliable, accurate, efficient, and streamlined way.</td>
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<tr>
<td>• How can we make sure our baseline planning models are always in sync with the current operational model / EMS snapshot?</td>
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<td>• How can we maintain a persistent CIM model with consistent rdf:IDs / MRIDs across planning and operations?</td>
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<td>• How can we better manage project dependencies (i.e. when a planning project changes, how do we identify and manage the impact/propagation of those changes to other planning projects)?</td>
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<td>• How can we minimize mistakes in our planning projects/models?</td>
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<tr>
<td>• We need a more automated, streamlined process/tool to manage the complete lifecycle of planning projects from inception to construction to absorption into the operational EMS model.</td>
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<tr>
<td>• We need an easier way to organize/manage model changes across multiple planning engineers.</td>
<td></td>
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<tr>
<td>• How can we update content and timing of a planned project, and make sure the appropriate people are automatically notified, and make sure that the models that other planners are working on are updated accordingly?</td>
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</tr>
<tr>
<td><strong>Audits and Model History</strong></td>
<td>Model Historian</td>
</tr>
<tr>
<td>How can we have more automated tracking of model changes, and the ability to roll back to any past model?</td>
<td>Automatically indexes the complete lifecycle of your planning models/projects in regulatory-ready detail, and makes the information available to you in a customizable, intuitive way.</td>
</tr>
<tr>
<td>• We need a more automated and detailed audit trail of the entire lifecycle of a planning project/model - from first conception to construction and absorption into the operational EMS model?</td>
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<tr>
<td>• We need an easier way to pull planning models from any point in time (past/present/future), and view detailed information about the model, such as: (1) who was involved in creating the model; (2) which projects/phases are included in the model; and (3) what the status is of the model changes (e.g. approval status, construction status, was the operational model updated properly, etc.).</td>
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### 1.1.2 PSS®ODMS for Operations Engineers

<table>
<thead>
<tr>
<th>Market Problem</th>
<th>PSS®ODMS Capabilities</th>
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</thead>
<tbody>
<tr>
<td><strong>Validation</strong> Are new incoming projects valid? Will they solve under state estimation?</td>
<td><strong>Model Validator</strong> Ensures incoming projects from planning will solve before integrating into your operational environment.</td>
</tr>
<tr>
<td><strong>Model Exchange</strong> We need a simple, reliable, compliant way of exchanging model information with external entities?</td>
<td><strong>Model Exchanger and Data Converter</strong> Provides a simpler, more reliable, interoperable, and regulatory-compliant way of exchanging operational data/model information with external entities. Includes built-in data converters for different formats.</td>
</tr>
<tr>
<td><strong>Model Management</strong> The management of our operational EMS model is inefficient and prone to errors.</td>
<td><strong>Model Manager</strong> Manage operational data models - including the end-to-end lifecycle of data flowing into and out of the operational environment – in a more reliable, efficient, and accurate way.</td>
</tr>
<tr>
<td><strong>Operator Training</strong> How can we create/synchronize training simulation models based on the actual EMS model?</td>
<td><strong>Operator Training Toolkit</strong> Simplify the training process. Helps with simulation model creation and analysis in a lightweight, portable environment.</td>
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</table>

We have too many “out of date” external models in our EMS.

- How can we have a simple, reliable, and regulatory-compliant way of exchanging model information with external entities (such as neighboring TSOs, ISOs, balancing authorities, reliability coordinators, etc.)? For example: (1) Updating our ISO when we have a new EMS/operational base model; or (2) Receiving operational model updates from our ISO.

Our EMS model isn’t always updated with the latest/correct outage information.

- It takes too long for us to update our EMS model. We’d like to do an EMS model update more often, but it takes too long.

- How can we maintain a persistent CIM model with consistent rdf:IDs / MRIDs across planning and operations?

- How can we simplify the process of merging incoming planning projects into our operational environment?

- We need a better way to ensure accuracy of our operational model – ensuring the right changes are applied and the wrong changes are corrected or not applied.

- We need better communication with planning and other departments to let them know when we have updated our operational model.

- Our EMS model occasionally needs a future view – how can we easily and accurately update it to reflect future projects from planning?
### Market Problem

**Situational Awareness**

*My company is too small for a fancy EMS, but as a TSO, regulation requires us to maintain a state-estimator and network analysis suite.*

- How can we automatically generate a complete, regulatory-ready audit trail of changes to the operational model/baseline – from any point in the past until the current moment in time?
- We don’t have a fancy EMS/SCADA – how can we still ensure that we comply with the latest regulatory requirements/standards for maintaining a state-estimator and suite of network analysis functions?
- How can we ensure compliance with the latest regulatory standards around historical event re-creation and audit trails?

### PSS®ODMS Capabilities

**Network Analysis and Compliance Kit**

*Provides TSOs with a vendor-backed solution for complying with key regulatory requirements involving audit trails, model history/roll-back, and situational awareness.*

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### 1.1.3 PSS®ODMS for Operations Planners

### Market Problem

**Validation**

*How can I ensure that my operational cases are valid, and will solve as I intend/expect them to?*

**Case Creation**

*How can I simplify the creation of accurate, reliable, and compliant cases?*

- How can I simplify the creation of accurate/reliable operational planning cases that are compliant with regulations?
- How can I ensure that my operational planning cases are properly synchronized with the current operational model / EMS snapshot?
- I wish it was easier to automate the creation of our operational planning cases.
- How can I ensure that I have the right base models and model instantiation parameters when I’m building our operational planning cases?

**Model Exchange and Data Conversion**

*How can we improve the efficiency and accuracy of our case exchange processes, while also achieving compliance with data format regulations?*

- How can I ensure that my operational planning cases can be easily exchanged with other people and analysis applications?
- How can I easily and reliably convert my operational planning cases to a different format (for example, to CGMES-compliant CIM/XML) so I comply with interoperability needs and regulation requirements?

### PSS®ODMS Capabilities

**Case Validator**

*Ensure that your operational planning cases are valid and solve as you intend.*

**Case Creator**

*Automates the creation of accurate and reliable operational planning cases.*

**Case Exchanger and Data Converter**

*Facilitates exchange with other entities and converts operational planning cases to the format that’s mandated by your organization or regulatory authority.*

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1.1.4 Summary Product Capabilities

<table>
<thead>
<tr>
<th>PSS®ODMS Capabilities</th>
<th>Transmission Planners</th>
<th>Operations (EMS) Engineers</th>
<th>Operations Planners</th>
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<tbody>
<tr>
<td>Model/Case Validator</td>
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<tr>
<td>Model/Case Exchanger and Data Converter</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Model Manager</td>
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<tr>
<td>Model Historian</td>
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<tr>
<td>Operator Training Toolkit</td>
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<td>Network Analysis and Compliance Kit</td>
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<td>Case Manager</td>
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1.2 PSS®ODMS Capabilities Overview

1.2.1 Model/Case Validator

PSS®ODMS includes various validation functions to make it easy for transmission planners, operations engineers, and operations planners ensure the validity of their projects, models and cases.

- **For Transmission Planners**
  PSS®ODMS Model Validator ensures that your planning projects are valid and solve as you intend

- **For Operations Engineers**
  PSS®ODMS Model Validator ensures incoming projects from Transmission Planning will solve before integrating into your operational environment

- **For Operations Planners**
  PSS®ODMS Model Validator ensures that your operational planning cases are valid, and solve as you intend
Features

PSS®ODMS provides various layers of model validation:

- **Standard Data Format Consistency Checking**
  Assures that your data is compliant with the desired CIM specification

- **Connectivity / Topology Processor**
  Allows you to check connectivity specifications, check for disconnected network resources, and create bus-branch models to check bus naming. This module converts a node-breaker (operations) model to bus-branch (planning) format based on explicit switch statuses (whether from real-time or historical measurements, defaults, contingencies or manually modified). It identifies the complete set of electrical buses and islands in the network and determines the in-service/out-of-service status of each device. This facilitates exporting the case to PSS®E format for subsequent analysis.

- **Intuitive graphical and text-based presentation of results**
  Makes it easy to visually inspect models and debug cases
• **Power Flow**
  This module calculates the flows and voltages across the entire network and provides the capability to adjust operational network settings such as device status, load and generation values, regulated voltages and transformer tap positions, observe the results and create operational schedules. The Power Flow supports a fully coupled Newton-Raphson algorithm in addition to a fast decoupled algorithm. Several control options are also available, such as VAR Limiting, Area Interchange, Phase Shifting MW Control, Tap Adjustment, and Shunt Switching.

![Power Flow in PSS®ODMS](image)

• **State Estimation**
  Validate models under state estimation in a totally vendor-neutral environment that’s independent of your EMS environment. The PSS®ODMS State Estimator has an option to run in “Study Mode”, which provides the user with control over all of the operational values of the case to allow for analysis of the system under different possible conditions. This provides EMS engineers assurance of the accuracy and robustness of the model and associated operating conditions prior to exporting it for use in other applications.

1.2.2 **Model Exchanger and Data Converter**
The PSS®ODMS Model Exchanger and Data Converter provides a simpler, more reliable, interoperable, and regulatory-compliant way of exchanging projects, cases, and model information with other entities. It converts proprietary network model data (including PSS®E and various EMS formats) into the industry-standard International Electrotechnical Commission (IEC) Common Information Model (CIM / IEC 61970) format and can import and export data in CIM/XML. The product has more than a decade-long history of participation in official CIM interoperability tests in which it has been certified as fully compliant with both the NERC CPSM (Common Power System Modeling) and ENTSO-E CIM (CGMES) profiles.

**Features**
• Bidirectional data conversion (import/export) between different network data formats. PSS®ODMS has built-in functions for the following data formats:
  • CIM/XML (import and export)
  • Planning Tools (including PSS®E RAW and SEQ (import and export), and PSS®E ECDI (export))
  • Geographic Information Systems (various GIS formats)
  • Historians (OSIsoft PI, Instep, plus others)
• Energy Management Systems (including Siemens SPECTRUM 3 (import and export), GE EMS (import), Areva EMS (import))
• PSS®ODMS also provides a public API (CIMdbNET) which allows the creation of custom data importers and exporters for any network data format.
• Model changes/projects can be applied in “bulk” or “incremental” modes – depending on the preferred business processes and workflows. Applying model changes in increments saves from having to create an entirely new model when there is a model update, and also helps to preserve RDFIDs.

• PSS®ODMS includes the ability to convert graphical data between different formats:
  • a Siemens PTI binary SLD file (import and export)
  • Siemens SPECTRUM 3 GML file (export)
  • SNC DAT file (export)
  • AutoCad DXF file (export)
  • Google Earth KML file (export)
  • Standard raster image files (import and export)
  • Supported generic image file types: BMP, JPEG, GIF, PNG, TIFF
• Preserves model fidelity and equipment identifiers
• Bus Mapping – PSS®ODMS includes standard functions to import and export a complete bus mapping data table in a defined CSV format. These functions can be used to conveniently add critical PSS®E bus identifiers to a model imported from a non-PSS®E source (such as EMS-produced CIM/XML).
• Accept model information from external entities and apply changes locally in either “incremental” or “bulk” mode
• Export model changes to neighboring TSOs, balancing authorities, reliability coordinators, ISOs, etc. in a common format
• Build study cases, solve power flow, visualize results and export directly to PSS®E
• Exchange network models with other entities in CIM/XML format
• Create scripts to automate data conversion processes via powerful and easy to use Python™ APIs

1.2.3 Model Manager
The PSS®ODMS Model Manager provides a common CIM-based network modeling platform for planning and operations. Deployment of this solution helps ensure that both departments share a common data model that is reliable and current.

• For Transmission Planners
PSS®ODMS Model Manager allows you to manage the complete planning/modeling workflow – from project creation to construction to absorption into the EMS operational model – in a more reliable, accurate, efficient, and streamlined way.

• For Operations Engineers
PSS®ODMS Model Manager allows you to manage your operational data models – including the end-to-end lifecycle of data flowing into (e.g. from planning) and out of the operational environment – in a more reliable, efficient, and accurate way.
Features

Model Functions

- Uses Oracle or SQL database technology to centrally maintain a single source model across operations and planning.
- Engineers across operations and planning can check-out, change, and apply model changes in a coordinated way based on roles, responsibilities, context, and permissions. Model content, format, and detail level (e.g., bus-branch vs. node-breaker) is automatically adjusted according to context and user role.
- Models can be accessed and managed across all time domains (past, present, and future) across multiple concurrent users.
- Model changes/projects can be applied in “bulk” or “incremental” modes – depending on your preferred business processes and workflows.

- Model synchronization engine automatically ensures that planning projects always maintain the desired alignment with the operational EMS model and vice versa.
- Project dependency checking.
- Automatic notifications ensure right people are aware of changes to project content, status, or timing.
- Edit, compare, duplicate, merge, backup, and restore models.
- Automatic case build.
The PSS®ODMS Model Manager includes a Project Modeling function that allows users to interactively record, manage and analyze planned model changes in advance of commissioning. It can save hours, days or weeks of troubleshooting later on. Future model changes can be organized into multi-phase projects, with each project phase having a specific, editable commissioning date. Recorded model changes do not impact the base model until they are explicitly committed to the model.

Scenarios may be auto-generated based on a selected timeframe (date/time) and/or customized to include or exclude specific project phases. Any Scenario can be activated for previewing at any time. When a Scenario has been activated, its associated model changes are “virtually” applied and visible throughout the user interface (including all hierarchical and one-line displays), allowing the user to preview the entire future model - as planned.

Multiple Scenarios provide the ability to easily switch between alternate future versions of the model. A study case can be built based on the active Scenario, solved and validated directly within PSS®ODMS, and exported to PSS®E for further analysis. Project modeling data is contained in the PSS®ODMS Data Repository and shared by all users. Scenarios may be shared or designated exclusively to a particular user group. Project modeling functions can be restricted on a per-user basis by configuring user roles and privileges in the database.

For example, if the user is planning to commission a substation 6 months in the future, the user can instantiate a “project” containing the substation components. Any system modification can be input as a project. Then should the user desire to look at the performance of the model at some time beyond 6 months, the user can specify a date of interest and the Scenario analyzer will include any project that would be commissioned by the target date. This project-based approach allows organizations to easily manage and study alternate potential future models as actual transmission grid development plans change.

**User Interface and Graphics**

- Graphical and text-based model editor lets you create and edit planning project content, timing, and status in an intuitive way
- Graphical model editor supports zooming, layering, panning, point-and-click, drag-and-drop, and copy/paste equipment
- Drill-down into equipment on diagram or tree view

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• Automatic generation and export of schematics, one-line diagrams, and world map graphics at any time in the project lifecycle
• Simultaneous graphical and model data editing

The PSS®ODMS graphical diagramming interface, OneLine, was designed with particular focus on ease of use. In addition to serving as a normal graphics package with layering, zooming, panning and other standard graphical capabilities, it is also an automatic schematic diagram and world map graphics generator that creates accurate one-line displays based solely on the network data provided in the underlying CIM-compliant database. It also functions as an interactive graphical model editor. This module helps prevent potential errors in the database, reducing model maintenance efforts by orders of magnitude while virtually eliminating connectivity and topology errors when compared to legacy batch editing methods. OneLine is:

• A graphical model editor employing intuitive (point-and-click, drag-and-drop, etc.) user events including Copy/Paste of network elements. The power of this function is not only depicted in the graphical representation and ease-of-use of the substation one-line diagrams, but in the database topology/connectivity that is automatically built in the CIM schema when the substations one-line diagrams are created. In other words, as the engineer draws the one-line diagrams for any given substation, the database connectivity associated with that substation is simultaneously being built and the network topology is automatically propagated through the CIM hierarchy, a unique feature typically not available in traditional EMS modeling tools.

• An automatic one-line diagram builder capable of automatically generating the complete-and-accurate substation one-line from the underlying network model hierarchy and connectivity data. The user only needs to rearrange the layout of the initially generated display as desired, rather than building the display entirely from scratch.

• A semi-automated map board diagram builder. Map board displays in this context refer to the entire grid, a subset of the grid or just a few substations of the grid. Instead of building connectivity maps, the user can naturally “grow” the map diagram simply by expanding individual substations whose layouts have already been generated and saved. Map board displays provide a powerful results visualization and navigation tool for on-line analysis.

Integration
• .NET API's and Python scripting provide automation and integration with other systems
• Integrates with PSS®E through data exchange and scripting

1.2.4 Model Historian
PSS®ODMS Model Historian automatically indexes the complete lifecycle of your planning models/projects in regulatory-ready detail, and makes the information available to you in a customizable, intuitive way.

Features
• Audit trail automatically captures entire project lifecycle - including timestamps and people responsible – from project conception to electrification. In regulatory-ready detail level.

• Pull planning models from any point in time (past/present/future), and view detailed information about the model, including: (1) who created the model; (2) which projects/phases are included in the model; (3) who changed the model; (4) model/project status

• Configurable/customizable reports and presentation of model information and audit trails

1.2.5 Training Tools
The PSS®ODMS Operator Training Toolkit (OTT) simplifies the operator training process for new operations engineers. It helps with simulation model creation and analysis – all in a lightweight, portable environment. The PSS®ODMS OTT is configurable as either an independent single-user simulator or shared multi-user simulation environment. It provides a flexible and low-maintenance tool for training on customer-specific network models. Unlike traditional approaches, which may require months of model building, configuration and tuning to deploy, the PSS®ODMS OTT can be configured quickly and efficiently. It can be easily deployed – even at off-site and portable/mobile locations.
Features

- Simulation capabilities:
  - System outages
  - Voltage collapse
  - Cascade scenarios
  - Black start sequencing
  - Safe switching procedures
  - What-if scenarios
  - Load shedding
- Real-time feedback and instant realization of an operator’s actions
- Incorporate real historical event data
- CIM-based environment and open data exchange architecture
- Lightweight, portable training tools that can run outside the operational environment
- Easily creates/synchronizes training models with actual operational models

Scenarios can be set up utilizing the PSS®ODMS model building and data import features to replicate the system in any area. The friendly user interface, using single line diagram representations, provides a familiar environment for operator navigation and enhances the training experience.

Training scenarios can be built to test system operators on a wide variety of operational procedures, and have the ability to incorporate real historical event data as part of the simulation. The CIM environment and open data exchange architecture enables the PSS®ODMS OTT to be easily populated with multiple scenarios. Operator interaction with the OTT simulator, and the analytical capabilities of the OTT, provide real-time feedback and instant realization of an operator’s actions.

Visualization of contingencies in PSS®ODMS using color contouring
1.2.6 TSO Network Analysis and Compliance Kit

The PSS®ODMS Network Analysis and Compliance Kit (NACK) provide TSOs with a solution for complying with key regulatory requirements involving audit trails, network analysis, and situational awareness.

Features

Model History, Audit Trails, and Event Reconstruction

- Model Change Tracking – Automatically tracks and generates a complete, regulatory-ready audit trail of changes to the operational model/baseline – from any point in the past until the current moment in time.
- Pull models from any point in time (past/present/future), and view detailed information about the model, including: (1) who created the model; (2) which projects/phases are included in the model; (3) who changed the model; (4) model/project status
- Configurable/customizable reports and presentation of model information and audit trails
- Historical Case Builder – assembles an accurate operational snapshot case from previous system conditions. The model change tracking feature of PSS®ODMS provides an audit trail of network model changes which can be used to automatically “roll back” the model to a selected past date. Then, a complete snapshot of measurement values can be obtained from a third-party historian (such as OSIsoft PI Historian or Instep Historian) providing an OPC HDA server interface. In this situation, the OPCSsync utility provides the OPC client interface and PSS®ODMS receives the historical measurements via OPCSsync. Next, PSS®ODMS runs a State Estimator/Power Flow solution to solve the historical case. Finally, the solved case can be analyzed internally within PSS®ODMS or exported to PSS®E for further study.

Network Analysis

The PSS®ODMS NACK provides a simple, low-cost, vendor-neutral State Estimation and Network Analytics package for smaller TSOs who don’t have an elaborate EMS/SCADA. It provides the advanced analytical features of a powerful EMS in a standalone lightweight package that includes contingency analysis, state estimation, power flow, short circuit analysis, and topology processing. These functions help operators evaluate system operating conditions in real-time, anticipate issues before they occur, and determine the best course of action in response to potential operational problems. By deploying the PSS®ODMS NACK, Transmission System Operators have the ability to assess and mitigate operational issues, resolve reliability concerns, and perform system analysis.

The analytical functions of PSS®ODMS are specially designed to supplement or replace a traditional EMS Network Applications package. Therefore, PSS®ODMS can be used as a low-cost alternative to a conventional EMS. Also, the PSS®ODMS Network Applications solution offers vendor-neutral compatibility, so it can be used with existing SCADA systems.

The PSS®ODMS Network Applications algorithms are fast-performing, robust and accurate, leveraging more than 40 years of Siemens PTI’s industry experience.

PSS®ODMS offers the following analytical modules. Since these tools can be used with real-time SCADA data or a historical snapshot, they provide users with a powerful facility for studying operating strategies.

- **Topology Analysis**
  This module converts a node-breaker (operations) model to bus-branch (planning) format based on explicit switch statuses (whether from real-time or historical measurements, defaults, contingencies or manually modified). It identifies the complete set of electrical buses and islands in the network and determines the in-service/out-of-service status of each device. This facilitates exporting the case to PSS®E format for subsequent analysis.
• **Power Flow**
  This module calculates the flows and voltages across the entire network and provides the capability to adjust operational network settings such as device status, load and generation values, regulated voltages and transformer tap positions, observe the results and create operational schedules. The Power Flow supports a fully coupled Newton-Raphson algorithm in addition to a fast decoupled algorithm. Several control options are also available, such as VAR Limiting, Area Interchange, Phase Shifting MW Control, Tap Adjustment, and Shunt Switching.

• **State Estimator**
  This module processes telemetered (observable) areas of the power system and estimates the operating values and system conditions (including transformer tap positions, phase shifter values, bus voltages, line flows, etc.) in the non-telemetered parts of the network. The State Estimator can be used in a real-time mode or study (simulated) mode. The State Estimator accepts the following input measurements: switch statuses; branch MW, MVAR or AMP flows; bus section voltage magnitudes; load, shunt and generator MW and MVAR injections and transformer tap positions.

  The PSS®ODMS state estimator algorithm identifies critical measurements and bad measurements and provides optional switch status correction. A measurement is considered critical if its removal results in unobservable buses in the vicinity of the measurement. The solution is fast, taking less than 5 seconds on an average sized model. In addition, State Estimator solution results can be published to any OPC server interface for advanced integration (such as SCADA display).

  The State Estimator has an extremely high convergence rate and includes self-tuning features that make it much easier to maintain than that of a traditional EMS. It also calculates accurate results for non-
telemetered sub-transmission areas based on the scheduled load data. The Historical Case Builder feature uses a combination of historical model reconstruction and off-line State Estimator and Power Flow solutions to reconstruct an accurate solved historical snapshot case for study. This level of automation for assembling an accurate historical study case is unprecedented.

- **Contingency Analysis**
  Contingency Analysis simulates individual (N-1) or simultaneous multiple equipment outages and calculates the resulting flow and/or voltage violations across the entire system or selected areas of interest. Single-outage contingencies can be automatically generated by the Outage Ranking function, which additionally serves as a contingency screening mechanism. User-defined multiple-outage contingencies are modeled as Python scripts and can be conveniently recorded through the PSS®ODMS user interface. Fully integrated simulation of special protection schemes is also supported. Protection schemes are also modeled in Python to accommodate complex logic, using the powerful pssoPy public API, which provides full access to the underlying network model, operational settings, calculation functions and results.

Contingency Analysis can be run in both on-line and off-line (study) modes. Each contingency is solved via full AC power flow calculation to produce the most accurate results. In on-line mode, the Outage Ranking function use real-time system conditions with a fast DC power flow calculation to preselect which contingencies to run based on their potential resulting violations.

The Contingency Analysis function produces pre-filtered and pre-sorted tabular output summary reports designed for fast recognition in an operational control room setting. For additional off-line-study, the results of individual contingencies can be comprehensively visualized – both with and without any associated special protection scheme – with the click of a button. The violations caused by individual contingencies can be easily visualized in one-line diagrams (supported by color contouring) and within tabular alarm views. This approach can be used to evaluate the effectiveness of existing protection schemes, helping to increase system security and reliability.

All of these features provide essential situational awareness to the system operators and planning engineers, enabling them to be more effective in developing system operating alternatives during heavily stressed conditions.
• **Short Circuit Analysis**
  This module applies a user-configurable fault (including type, distance from bus and impedance) to all buses and/or lines within user-selected areas, and calculates the resulting voltage and injection magnitudes and angles, which are displayed in tabular format. Supported fault types include:
  - Single line-to-ground
  - Line-to-line
  - Double line-to-ground
  - Triple line-to-ground
  - Remote single line-to-ground
  - Remote line-to-line
  - Remote double line-to-ground
  - Single phase open
  - Double phase open

**Study Mode vs. Real-Time Mode**

The analytical functions of PSS®ODMS NACK operate in the context of one of two possible states: Study mode or Realtime mode. Study mode provides the user with control over all of the operational values of the case to allow for analysis of the system under different possible conditions. Study mode is effectively an “off-line” mode, with no measurement updates being received.

In Realtime mode, PSS®ODMS subscribes to and receives measurement updates (switch status, line flows, generation, load, etc) as they become available and automatically executes a solution sequence on a timed basis (typically every 5 minutes or less). This updates the in-memory snapshot case, with all one-line diagram and tabular displays accordingly updated. For security purposes, operational values are non editable in Real time mode.

Study mode is the default mode of operation. The user can toggle the application between Study and Realtime mode via a single toolbar button click.

**Real-Time Measurement Integration**

PSS®ODMS is designed to receive measurement updates from SCADA and/or ICCP via an OLE Process Control Data Access (OPC DA) client-server interface. PSS®ODMS communicates with the Siemens PTI OPCsync utility, a DCOM service. OPCsync provides the OPC client interface. The OPC server interface is typically provided by a third-party tool, SISCO’s AX-S4 ICCP product; however, any alternate OPC server interface may be substituted as needed.

The connection between PSS®ODMS and OPCsync is opened when Realtime mode is activated and closed when Study mode is activated. In Realtime mode, PSS®ODMS subscribes to continuous measurement updates from OPCsync (which broadcasts all measurement updates virtually simultaneously to all connected PSS®ODMS instances).

**Measurement Mapping**

Measurement mapping Comma Separated Value (CSV) file formats support PSS®E identifiers to specify the exact locations of measurements within the network. This greatly facilitates the process of developing a detailed operational model from an initially imported planning model. The following measurement mapping formats are supported:
  - NERC ISN (exported from ICCP Gateway)
  - Analog measurement CSV
  - Switch measurement CSV
  - Result measurement CSV
1.2.7 Case Creator

PSS®ODMS Case Creator automates the creation of accurate and reliable operational planning cases that are compliant with regulations and model exchange standards.

Features

- Open APIs (based on Python and .NET) allow you to script/automate the generation of operational planning cases, including the integration of case parameters from external sources (e.g. outage schedules, load forecasts, etc.)
- Model synchronization engine ensures that your operational planning cases are based on the current operational model / EMS snapshot
- Assemble an accurate operational snapshot case from previous system conditions

1.2.7 Case Manager

The PSS®ODMS Case Manager manages the end-to-end lifecycle of operational planning cases, ensuring efficiency, reliability, and regulatory compliance.

Features

- Audit trail that captures all case assembly steps, including timestamps and people responsible
- Easy-to-use Graphical User Interface lets you view/change model data and case parameters
- Coordination of equipment identifiers across operations/EMS, planning applications, and outage scheduling

1.3 System Requirements

PSS®ODMS Client Workstation

<table>
<thead>
<tr>
<th>Feature</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Microsoft® Windows XP (SP3), Microsoft® Windows 7 or Microsoft® Windows Server 2008 (32 or 64 bit)</td>
</tr>
<tr>
<td>CPU</td>
<td>minimum 2.1 GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>minimum 3 GB RAM</td>
</tr>
<tr>
<td>Hard Disk</td>
<td>minimum 60 GB</td>
</tr>
<tr>
<td>Graphics Card Resolution</td>
<td>minimum 1024x768</td>
</tr>
</tbody>
</table>

PSS®ODMS Database Server

<table>
<thead>
<tr>
<th>Feature</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Any OS compatible with a supported database platform (typically a Microsoft® Windows, UNIX or LINUX operating system).</td>
</tr>
<tr>
<td>CPU</td>
<td>minimum 2.1 GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>minimum 3 GB RAM</td>
</tr>
<tr>
<td>Hard Disk</td>
<td>minimum 120 GB</td>
</tr>
<tr>
<td>Database Software</td>
<td>SQL Server 2012, SQL Server 2008 R2, Oracle 12c, Oracle 11g</td>
</tr>
</tbody>
</table>

Note: The database server typically has a Microsoft® Windows, UNIX or LINUX operating system.

Note: If the database server is running a Microsoft® Windows operating system, the PSS®ODMS application can be installed on the server itself so that certain functions such as model backup and recovery can be conveniently accessed on the server.
1.4 Licensing Options and Pricing
PSS®ODMS is available in several licensing configurations, including: Single User, Standard Edition, and Enterprise Edition. For product pricing, and help with selecting the licensing option that best suits your organization, please contact Siemens PTI via telephone at +1-518-395-5000, email at pti-software-sales.ptd@siemens.com or contact your local Siemens PTI account manager.

1.5 Professional Services Offered
Siemens PTI offers a world-class blend of project management and technical/industry expertise to support you in every stage of your deployment:

- **Pre-Deployment**
  - Engineering consulting
  - Business process consulting / change management

- **Deployment**
  - System installation/setup
  - Model assembly/creation
  - Architectural design
  - System integration
  - Formal acceptance testing
  - Project management
  - Data conversion

- **Post-Deployment**
  - Training: How to prepare your organization for the switch to PSS®ODMS
  - Training: How to squeeze the most benefit out of PSS®ODMS
  - End-user training
  - System administrator training

1.6 How to get started
Where do you go for more information?

- Phone: +1 518 395 5000
- World Wide Web: [www.siemens.com/pss-odms](http://www.siemens.com/pss-odms)
- Email: pti-software-sales.ptd@siemens.com
- Or contact your local Siemens PTI account manager.