ELECTRIC POWER RESEARCH INSTITUTE

# Interoperability Test No. 7 of the Generic Interface Definition (GID) Standards and the Common Information Model (CIM)

Executive Briefing

*Technical Report*

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**1013688**

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# PRODUCT DESCRIPTION

The EPRI Control Center Application Program Interface (CCAPI) project has produced a number of international standards, including the Common Information Model (CIM) and Generic Interface Definition (GID) specifications. This report describes a seventh set of interoperability tests that expanded GID testing, introduced testing of IEC 61968 Part 13 (CIM-based distribution exchange), and demonstrated exchange of complete, partial, and incremental power system models. Test participants were ABB, EDF, Siemens PTI (SPTI), Siemens, and SISCO.

### Results & Findings

This is an executive-level version of EPRI report 1012990, *Interoperability Test No. 7 of the Generic Interface Definition (GID) Standards and the Common Information Model (CIM).* It is intended to summarize the most noteworthy results and findings reported in that earlier document. The reader is referred to that report for full details on the test plan, results, and references.

### Challenges & Objectives

The GID and CIM standards provide the basis for model-driven information exchange both within and between control centers and other systems involved in utility operations. Previous interoperability tests validated the use and acceptance of the CIM standard translated into the eXtensible markup language (XML).

### Applications, Values & Use

CCAPI-enhanced integration architectures based on the CIM model, GID interfaces, and standard XML messages enable interdepartmental teams to access a range of needed information via open systems. Hence, in innovative applications, energy companies are planning to implement CCAPI/CIM/GID/XML outside the control center to reduce costs and improve customer service and staff productivity.

### EPRI Perspective

The changing business environment has increased the need for greater business and operating flexibility in the energy industry. CCAPI compliance offers operations center managers the flexibility to combine one or more integrated platforms and software systems to best meet their energy company's needs for system economy and reliability. This compatibility allows managers to upgrade or migrate their EMS or other operations systems incrementally, thus preserving prior utility investments in custom software and enabling use of new applications as they become available. Migration can reduce upgrade costs by 40 percent or more. EPRI continues to sponsor collaborative efforts to advance these CCAPI-based integration strategies for greater information systems integration solutions in the control center and beyond.

## Approach

EPRI spearheaded an industry-wide CCAPI effort to develop open, interoperable applications for energy management systems (EMS) in energy control centers through use of standardized interfaces (now part of the IEC 61970 series of international standards). Central to the CCAPI concept is CIM, which defines the essential data structure of a power system model. The North American Electric Reliability Council (NERC) sought the best way to exchange power system models electronically. As a result, the CCAPI project initiated an effort to map CIM into XML using Resource Description Framework (RDF) schema and syntax to organize XML. To validate XML and RDF for model exchange, EPRI planned and carried out a series of interoperability tests between products from different suppliers.


## Keywords

Application program interface
Control Center Application Program Interface
CCAPI
Common information model
CIM
Control center
Energy management systems
Generic interface definition
GID
eXtensible markup language
XML

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# 1
# INTRODUCTION

On September 27-30, 2005, software vendors serving the electric utility industry met at the California Independent System Operator (CAISO) in Folsom, California to test the capability of their software products to exchange data and correctly interpret power system data based on the Control Center Application Program Interface (CCAPI) standards. This was the seventh in a series of planned interoperability tests to demonstrate additional CCAPI capabilities and was an important milestone in the CCAPI project.

Previous testing had focused exclusively on exchanging power system network models using the CIM (Common Information Model). The fifth test, however, introduced both compliance and interoperability testing of the Generic Interface Definition (GID) standards. For the first time, the use of GID interfaces in vendor products was observed and evaluated. This seventh test built on the results of prior tests and expanded the GID interface tests. This report summarizes the results of that testing.

Both the CIM and the GID were developed by the EPRI CCAPI project. The part of the CIM used for these tests has been approved as an international standard (IEC 61970-301 CIM Base). The GID is currently being progressed as an IEC standard as well and is available as a series of draft standards. Each vendor present was required to exchange files with the other vendors and to demonstrate that their software correctly converted their proprietary representation of a power system model to/from the CIM XML format. For those that implemented the GID, a series of server conformance and client/server interoperability tests were performed.

These interoperability tests address an important industry requirement established by NERC to be able to transfer power system model data (including ICCP configuration data) between Security Coordinators. NERC has mandated the use of the Resource Description Framework (RDF) as the XML schema/syntax for the CIM, which is defined in another CCAPI standard (draft IEC 61970-501 CIM RDF Schema). These tests demonstrated the use of this draft standard for this purpose and for any other application where a standard way of representing power system models is needed, such as combining multiple, proprietary-formatted power system models into a single merged internal model for an RTO. Complete model files as well as partial models and incremental updates to existing base model files were exchanged between participants. The GID was used to provide request/reply and publish/subscribe type mechanisms for a client to access a model or data residing on a server based only on the CIM rather than the internal logical database schema where the model data is stored.

Vendors participating in these tests included ABB, Areva, Siemens PTI (SPTI), Siemens, and SISCO. One utility, EDF, participated as well. Project Consultants prepared the test procedures, witnessed the test results and prepared this test report for EPRI. Loris Arnold of LIPA assisted in witnessing the tests.

## Objectives of Interoperability Test

This set of interoperability tests focused on three major types of tests:

1. Power system model exchanges via file transfer based on CIM XML standards. These tests included complete model transfers, partial model transfers, and incremental model updates.
2. Tests of client/server pairs using interfaces based on the GID service standards. The GID provides methods for accessing data, including power system model transfers as well as complex queries and periodic high-speed data transfers. The data exchange is accomplished through a client/server interface operating over industry-standard middleware, such as Microsoft COM and MSMQ, rather than by file transfer. This provides for a much more dynamic exchange of data, even though the underlying standards for the data format are the same.
3. Distribution model exchanges via file transfer based on the CIM XML and 61968 Part 13 standards.

### *General Test Objectives*

The general objectives of the interoperability tests and demonstrations were:

- Demonstrating interoperability between different products based on the CIM and/or GID. This includes applications from EMS as well as independently developed applications from third party suppliers.
- Verifying compliance with the CIM for those CIM classes/attributes involved in the information exchanges supported by the tests.
- Demonstrating the exchange of power system models using the CIM and an RDF Schema and XML representation of the model data.
- Demonstrating message exchange between different vendor products using the services defined in the interface definition standards. This includes the GID services provided by the Common Services, HSDA and TSDA standards to provide communication interoperability.

Secondary objectives included:

- Validating the correctness and completeness of IEC draft standards, resulting in higher quality standards by removing discrepancies and clarifying ambiguities.
- Providing the basis for a more formal interoperability and compliance test suite development for CCAPI standards.

# 2 TEST PLAN

Formal test procedures were prepared and used to conduct and score the tests. These procedures were made available ahead of time, and all participants were encouraged to execute as many of the tests as possible before coming to CAISO in Folsom. The goal was to have each participant successfully complete as many tests as possible while on site. The specific criteria used to evaluate successful completion of each test were not revealed ahead of time, although the nature of the criteria was discussed.

## Participants and Their Products

The six test participants—ABB, EDF, Siemens PTI (SPTI), Siemens, and SISCO—were given the opportunity to spend four full days at the CAISO test site. Participants brought their hardware and software, and connected to a shared Ethernet LAN set up in the test room. Sample model files as well as files successfully exported by a participant's product were loaded onto a JumpDrive USB mass storage device and each participant could access those files to test their import capability. Each participant was required to use an actual product so that testing would demonstrate interoperability of real products.

Table 2-1 lists the participants and their products.

## Test Approach

Participants were given three major sets of tests, of which they could perform as many or few as desired:

1. GID interface tests conducted as both conformance tests and interoperability tests.
2. Power system model and data exchange tests based on CIM XML using file transfers.
3. Distribution model and data exchange test based on IEC 61968 Part 13.

Much more detailed descriptions of the interoperability test procedures are provided in the EPRI report, *Interoperability Test No. 7 of the Generic Interface Definition (GID) Standards and the Common Information Model (CIM)* (1013688).

**Table 2-1**
**Participants and Their Products**

| Vendor | Product Name | Tests |
|---|---|---|
| ABB | PCU400 | HSDA Interoperability Test |
| ABB | DAIS2OPC | HSDA Interoperability Test |
| Areva | e-Terra-Platform | Transmission Power System Model CIM/XML file transfer |
| EDF | CIM C++ Framework | 1.) Transmission/Distribution Power System Model CIM/XML file transfer<br>2.) Incremental file transfer |
| EDF | GEDEON | Transmission/Distribution power system model CIM/XML file transfer |
| EDF | OPC Matrikon Server/Client + Micro-Turbine Simulator | HSDA Interoperability test |
| EDF | CIM-EUROSTAG Adapter | Transmission Power Solution Test |
| Siemens PTI | HSDA Server | HSDA Interoperability |
| Siemens PTI | TSDA Client | TSDA Interoperability |
| Siemens PTI | ODMS (Operational Database Maintenance System) | 1) Transmission power system model CIM/XML file transfer<br>2) TSDA Interoperability<br>3) HSDA Interoperability |
| Siemens | Spectrum PowerCC IMM | Transmission power system model CIM/XML file transfer |
| Siemens | Spectrum PowerCC SCADA | HSDA Interoperability |
| SISCO | UIB Adapter for OPC | 1) HSDA Interoperability<br>2) TSDA Interoperability |
| SISCO | UIB PI Adapter | 1) TSDA Interoperability<br>2) HSDA Interoperability |
| SISCO | UIB Core | 1) Transmission power system model CIM/XML file transfer<br>2) Distribution Power System Model CIM/XML file transfer |

Table 2-2 lists the tests performed, while the text that follows provides brief explanations of selected test procedures.

**Table 2-2**
**Tests Performed**

| Test Procedure Step No. | Test Description |
|---|---|
| 4.2 | ***Basic Import/Export*** |
| 4.2.1 | Basic Import: Participant A demonstrate successful import of sample model file |
| 4.2.2 | Basic Export: Participant A export 100 bus model and run validator |
| 4.2.3 | Interoperation: Participant B import of Participant A exported CIM XML file. |
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| 4.4.1.3 | Import & Merge sample model containing only substation(s) |
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| 4.4.2.2 | Re-import merged model: Participant A re-imports exported merged model file |
| 4.4.2.3 | Participant B import merged model file from Participant A and validate |
| 4.4.3 | **Export Partial Model Pair and Re-Import with Merge** |
| 4.4.3.1 | Export Partial Model Pair |
| 4.4.3.2 | Re-Import Partial Model Pair and Merge |
| 4.5 | ***ICCP Configuration Data Transfer*** |
| 4.6 | ***HSDA GID Testing*** |
| 4.6.1 | **Conformance testing** |
| 4.6.2 | **Interoperability testing** |
| 4.8 | ***TSDA GID Testing*** |
| 4.8.1 | **Connectivity test** |
| 4.8.2 | **Exchange historical data test** |
| 4.8.3 | **Disconnect test** |
| 4.9 | ***61968 Part 13 Distribution Model Exchange Test*** |
| 4.9.2 | **Import Interoperation** |

### HSDA GID Interface Testing

Based upon the definitions and philosophy of the GID, testing applies primarily to the HSDA servers and to HSDA clients that are not required to meet the full OPC client specifications. That is, it should be possible to use off-the-shelf OPC clients without modification in actual implementations of the HSDA standard. As a result, testing was divided into two parts:

1. **HSDA Conformance Testing:** Dealing with the ability of the HSDA server to correctly conform to the standard. This test applies only to HSDA servers. The main focus of the GID conformance testing was to validate the new requirements imposed on HSDA due to the CIM NameSpace and related standards.
2. **Interoperability Testing:** Dealing with the ability of one participant's client ability to interoperate with another participant's server. A total of nine participant pairs were tested. The SPTI client and the Siemens server were tested using two different communication technologies. In each case the test scenario included three tests: connectivity, data exchange and disconnect.

### TSDA GID Interface Testing

TSDA tests comprised interoperability tests between the test participants' products—one acting as a TSDA client and one as a TSDA server. Since the OPC HDA specification defines several services with internal methods, test participants must declare the TSDA services/methods/events that are supported or used in the client or server application under test.

### Model, Data Exchange and Solution Tests

These tests were similar to those performed in previous interoperability tests, where three types of data transfers involving power system models were tested: full (complete) model transfers, partial model transfers, and incremental model updates.

### IEC 61968 Part 13: Full Distribution Model Exchange Test

For the first time in this series of interoperability tests, an IEC 61968 distribution model exchange test was conducted using the Common Distribution Power System Model (CDPSM) Profile. This test demonstrated the ability of a product to correctly import a CIM XML model file generated using the specifications defined in IEC 61968-Part 13.

The test used a full CIM XML distribution model provided by EDF exchange to demonstrate the ability of participants to import a distribution model. Each participant in this test was required to import the EDF CIM XML model file and correctly interpret the model data contained. Product-specific tools were used to validate the import was successful. This test was performed by SISCO using their UIB Core product.

# 3
# TEST RESULTS

This section reports highlights of the testing. More detailed descriptions are available in the full EPRI report, *Interoperability Test No. 7 of the Generic Interface Definition (GID) Standards and the Common Information Model (CIM)* (1013688).

## *Basic Import and Export*

Table 3-1 and Table 3-2 show the results of the tests on individual products to determine compliance with the final CIM version 10 XML/RDF standards, which have been approved as an International Standard IEC 61970-301 CIM Base.

The primary objective of this test was to successfully import and export a sample model file based on the NERC CPSM transmission model profile to show compliance. It should be noted that to pass the export test successfully, the exported model file had to be re-imported correctly. All participants were able to pass this test.

**Table 3-1**
**Basic Import Test of Individual Products**

| Test Procedure | 4.2.1 Basic Import | | | | | |
|---|---|---|---|---|---|---|
| Test Model Used | 100 Bus Model | 60 Bus Model | 40 Bus Model | 27 Node Model | UCTE 14 Node | EDF7 3TW Model |
| Areva | Pass | | Pass | Pass | Pass | |
| EDF CIM Framework | Pass | | Pass | Pass | Pass | |
| EDF GEDEON | Pass | | Pass | Pass | Pass | Pass |
| Siemens PTI | Pass | Pass | Pass | Pass | Pass | Pass |
| Siemens | Pass | Pass | Pass | Pass | Pass | Pass |
| SISCO UIB Store | Pass | | Pass | Pass | Pass | |

**Table 3-2**
**Basic Export Test of Individual Products**

| Test Procedure | 4.2.2 Basic Export | | | | | |
|---|---|---|---|---|---|---|
| **Test Model Used** | **100 Bus Model** | **60 Bus Model** | **40 Bus Model** | **27 Node Model** | **UCTE 14 Node** | **EDF7 3TW Model** |
| Areva | Pass | | Pass | Pass | Pass | |
| EDF CIM Framework | Pass | | Pass | Pass | Pass | |
| EDF GEDEON | Pass | | Pass | Pass | Pass | Pass |
| Siemens PTI | Pass | Pass | Pass | Pass | Pass | Pass |
| Siemens | Pass | Pass | Pass | Pass | Pass | Pass |

### *ICCP Test*

The ICCP test used the Basic Import Procedure and then directed the participant and witness to verify the existence of the ICCP point within the model after it was imported using the product tools or exported using XML inspection tools. EDF completed this test using the Siemens 100 Bus model. This model has 20 ICCP points. EDF completed the following steps:

1. Imported the Siemens 100 Bus model
2. Exported the Siemens 100 Bus model
3. Verified all 20 ICCP points were contained in the exported model.

EDF executed this test using the CIM Framework and GEDEON products. In each case the test passed.

### *Interoperability Testing*

Table 3-3 shows pairs of vendors that were able to demonstrate interoperation via the CIM XML formatted-model file. The primary objective of this test was for a participant to successfully import a power system model exported by another participant. Rows represent the results of the interoperability test for each participant. Each column represents a file available for testing. These files were previously exported as part of the Basic Export test. A “Pass” indicates that a pair of vendors successfully demonstrated the exchange of a power system model file using the CIM XML format. The specific model file exchanged is also identified.

All participants with functionality to export a file did so and then made that file available for other participants to import. Nine pairs of vendors were able to interoperate successfully by exchanging at least one sample model file.

**Table 3-3**
**Interoperation with Sample Models**

| Test Procedure | 4.2.3 Import of 4.2.2 CIM XML Exported file | | | | |
|---|---|---|---|---|---|
| **Participant Importing File** | **File Exported by Areva** | **File Exported by EDF CIM Framework** | **File Exported by Siemens PTI** | **File Exported by Siemens** | **File Exported by EDF GEDEON** |
| Areva | X | | | | |
| EDF CIM Framework | Pass – 100 Bus<br>Pass – EDF 27<br>Pass – UCTE14<br>Pass – 40 Bus | X | | | X |
| EDF GEDEON | Pass – 100 Bus<br>Pass – EDF 27<br>Pass – UCTE14<br>Pass – 40 Bus | X | | Pass – 60 Bus<br>Pass – EDF 27<br>Pass – UCTE14<br>Pass – 40 Bus | X |
| Siemens PTI | | Pass –100 Bus | X | Pass – 60 Bus<br>Pass – 40 Bus<br>Pass – EDF 27 | |
| Siemens | Pass – EDF 27 | Pass –100 Bus<br>Pass – 40 Bus | P – EDF 27 | X | Pass – UCTE14 |
| SISCO | | | | | |

X = No files were exported by this participant, so none available for import.

### *Power Flow Solution Testing*

EDF participated in these tests using the Siemens 100 bus model, the EDF 27 Node model, and the UCTE 14 Node model. Table 3-4 shows the results of each of the steps. EDF was able to successfully run a power flow solution on an imported model file and then export the file. They were also able to import and run a load flow on a model file that had been previously imported and exported by another participant.

In conclusion, the contents and format of the power system model files exchanged with the CIM XML file representation are adequate for running power flow applications. But more importantly, the running and comparison of power flow solutions is the ultimate validation of the CIM version 10 content and the adequacy of the CIM XML standards for exchanging power system model files.

**Table 3-4**
**Power Flow Solution**

| Test | 1 Import Doc-1 | 2 Run PF Sol-1 | 3 Export Doc-2 | 4 Import Doc-2 | 5a Run PF Sol-2 | 5b Compare Sol-1, Sol-2 | 6 Export Doc-3 | 7 Import Doc-3 | 8a Run PF Sol-3 | 8b Compare Sol-1, Sol-3 |
|---|---|---|---|---|---|---|---|---|---|---|
| EDF w/100 Bus Model | Pass | Pass | Pass | Pass w/SPTI export | Pass | Pass | Pass | | | |
| EDF w/EDF27 Node Model | Pass | Pass | Pass | Pass w/Siemens export | Pass | Pass | Pass | Pass w/SPTI export | Pass | Pass |
| EDF w/UCTE 14 Node Model | Pass | Pass | Pass | Pass w/Siemens export | Pass | Pass | Pass | Pass w/SPTI export | Pass | Pass |

## *Incremental Model Update*

EDF and Siemens participated in the incremental model update tests. Table 3-5 shows the results, grouped according to the type of incremental model update tested: Add, Modify, Delete, or a Combination of adds, modifies, and deletes as would most likely be found in a real-world application of this standard. The entries show the number of incremental update files of each type that were tested.

**Table 3-5**
**Incremental Model Update**

| Test Procedure | 4.3.3 Export Incremental Update | | | | 4.3.4 Import Incremental Update | | | |
|---|---|---|---|---|---|---|---|---|
| Incremental Update Type | Add | Modify | Delete | Combi-nation | Add | Modify | Delete | Combi-nation |
| EDF CIM Framework | | | | | Pass – 1 | Pass – 2 | Pass – 1 | |
| Siemens | Pass – 1 | Pass – 1 | Pass – 1 | Pass –1 | Pass – 2 | Pass – 2 | Pass – 2 | Pass – 1 |

## *Partial Model Transfer*

This section shows the results of the partial model testing. Four participants (Areva, Siemens PTI, Siemens, and EDF) took part in these tests. Table 3-6 and Table 3-7 show the results of these tests.

The first test required a participant to import a partial model and merge with a pre-existing base model. The base model had a certain substation removed as shown by the notation (e.g., “No Kincaid,” which indicates the Kincaid substation was removed from the Siemens 100 bus model before importing). Some base model files had three substations removed (e.g., “No Gannon, Oak, Derby,” which indicates the Gannon, Oak and Derby substations were removed). Among the highlights of this test:

- Areva, Siemens PTI and Siemens successfully imported and merged at least one substation model with the base model file.
- Siemens successfully imported and merged three substations.

**Table 3-6**
**Partial Model Import**

| **Test Procedure** | **4.4.1 Partial Model Import** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Test Model Used** | **Import 100 Bus Model w/o SS** | **Import 100 Bus SS Model** | **Merge 100 Bus Partial Model Pairs** | **Import 27 Node Model w/o SS** | **Import 27 Node SS Model** | **Merge 27 Node Partial Model Pairs** | **Import 60 Bus Model w/o SS** | **Import 60 Bus SS Model** | **Merge 60 Bus Partial Model Pairs** |
| Areva | | | | Pass – No N33 | Pass N33 | Pass | | | |
| Siemens PTI | | | | Pass – No N33 | Pass N33 | Pass | Pass – No Brighton | Pass – Brighton | Pass |
| Siemens | Pass – No Oak, Derby, Gannon | Pass – Oak, Derby, Gannon | Pass | | | | Pass – No Brighton | Pass Brighton | Pass |

The second test required a participant to export a merged model file and to also import a merged model file from another participant, as a way to validate the contents and format of the merged files. Highlights of this test are as follows:

- Areva, Siemens PTI and Siemens were able to export the merged model file successfully.
- Areva and EDF successfully imported merged model files exported by Siemens. Siemens and EDF successfully imported merged model files exported by Areva and Siemens PTI. These are further checks on the Areva, Siemens PTI and Siemens merged files, as well as the ability of Areva, EDF, and Siemens to interoperate with another vendor.

The third test provided an opportunity for participants to further demonstrate their product’s ability to export partial model files. In this test, Areva and Siemens successfully exported a partial model file comprising one substation.

**Table 3-7**
**Partial Model**

| Test Procedure | 4.4.2 Merged File Export & Import from Another Participant | | | 4.4.3 Export New Partial Model Files | |
|---|---|---|---|---|---|
| **Test Model Used** | **Export Merged Model** | **Re-Import Merge Model** | **Import Merged Model from Another Vendor** | **Export Partial Model Pair** | **Re-Import Partial Model Pair & Merge** |
| Areva | Pass – 27 Node | Pass – 27 Node | Pass – 27 Node from Siemens | Pass – 60 Bus with SS Brighton & 60 Bus w/o Brighton | Pass – 60 Bus with SS Brighton & 60 Bus w/o Brighton |
| EDF CIM Framework | | | Pass – 27 Node from Areva<br>Pass – 60 Bus from Areva<br>Pass – 60 Bus from SPTI | | |
| EDF GEDEON | | | Pass – 60 Bus from Areva<br>Pass – 60 Bus from Siemens<br>Pass – 60 Bus from SPTI<br>Pass – 27 Node from Areva | | |
| Siemens PTI | Pass – 27 Node<br>Pass - 60 Bus | | | | |
| Siemens | Pass - 100 Bus<br>Pass - 60 Bus | Pass - 100 Bus<br>Pass - 60 Bus | Pass - 27 Bus from SPTI<br>Pass – 60 Bus from Areva<br>Pass – 60 Bus from SPTI | Pass – 27 Bus with SS N33 & 27 Bus w/o N33 | Pass – 27 Bus with SS N33 & 27 Bus w/o N33 |

## HSDA Conformance Testing

This section shows the results of the HSDA conformance testing. SISCO was the only participant in these tests. SISCO passed all tests concerning the HSDA interface except demonstrating the Write Interface capability or the ability to obtain TC57 NameSpace Custom Properties.

### HSDA Interoperability Testing

There are four major tests involved in proving interoperability:

1. Connect an HSDA server and client
2. Exchange message data – client Read server
3. Exchange message data – client Write server
4. Disconnect the server from the client.

At least one of the data exchange tests must be completed to prove interoperability. The exchange portion of these tests are all basically the same—browse the server CIM namespace and select a measurement to read/write—although the messaging technology for each test may be different. For example, one set of tests used DCOM and the other set of tests used the SISCO message bus to demonstrate the MoM technology. All tests used the Siemens 100 bus, the ABB 40 bus or the EDF Small model and the measurements contained therein. The exact model used is presented in the results table below.

Five companies participated in these tests: ABB, EDF, Siemens PTI, Siemens, and SISCO. Eight client/server pairs successfully demonstrated the capability to connect, read data, and disconnect (Table 3-8). Four different messaging technologies were used to complete the tests.

**Table 3-8**
**Passing Client/Server Pairs**

| Client | Server |
|---|---|
| ABB | Siemens |
| EDF OPC DA (Matrikon Client) | Siemens |
| EDF OPC DA (Matrikon Client) | SISCO OPC DA |
| Siemens PTI | SISCO OPC DA |
| Siemens PTI | ABB |
| Siemens PTI | EDF OPC DA (Matrikon Server) |
| Siemens PTI | Siemens |
| SISCO OPC DA | EDF OPC DA (Matrikon Server) |

### TSDA Testing

All TSDA interoperability testing used the Siemens 100 bus and the measurements contained therein. SISCO and Siemens PTI participated in these tests and used the UIB Message Bus as the middleware technology. Among the highlights of these tests:

- The SPTI TSDA client and the SISCO TSDA server were able to connect and the SPTI TSDA client was able to request historical data from the SISCO TSDA server

- The TSDA client and server utilized three of the TSDA services (ReadAtTime, GetItemHandles & GetHistorianStatus) to effect the transfer
- The TSDA client subscribed to the requested data using the full CIM pathname

This test validated that a TSDA client was able to subscribe to a TSDA server and correctly read the historical data using the TSDA services. In other words, the test exercised and validated correct operation of the methods specified.

### *61968-13 Distribution Model Exchange Test*

EDF prepared two sample model files based on the IEC 61968 Part 13 Distribution Model Exchange standard (the CDPSM Profile). EDF and SISCO demonstrated a successful import of the AigueV2 model and interoperation.

# 4 CONCLUSIONS

Each of the six participants was able to successfully import at least one power system model, correctly converting from the CIM XML format to their internal proprietary format. Eight pairs of vendors also were able to interoperate successfully by exchanging at least one sample model file.

EDF was able to successfully run a power flow solution on an imported transmission model file and then export the file, providing further validation of the content and correct translation between proprietary formats and CIM.

Incremental model update testing verifies correct update of a base model with incremental updates using the XML difference file format. Both EDF and Siemens successfully imported multiple incremental model update files and merged them into an existing base model.

Partial model transfer verifies correct import and merge of a partial model with an existing base model. Areva, SPTI, and Siemens successfully imported at least one partial model, merged it with the base model file, and exported the merged model. EDF imported merged models generated via partial model operations from Areva, Siemens PTI, and Siemens. Partial model pairs were provided by Areva, EDF, and Siemens.

Distribution model exchange testing verifies compliance of a CIM-based XML distribution model as defined in the IEC 61968 Part 13 standard. This test required a participant to import the distribution model provided by EDF. SISCO, the only participant in this test, successfully imported the distribution model.

An important result of the testing effort was the identification of issues that affect interoperability, either in the CIM documents themselves, in the sample model files, or in the test procedures. A working session was initiated to provide a more formal review of issues, which will be forwarded to the appropriate industry group or standards committee.

In the future, project organizers will create an IOP/CPSM/CDPSM issue list, which will allow us to specifically identify instance file issues, CPSM profile issues and CDPSM profile issues. This document will be maintained and referred to for future interoperability tests.

## Future Directions

Good progress was made during Interoperability Test No. 7 on several fronts. However, additional testing is needed to validate the many resolutions reached as a result of testing and vendor consultations to reach agreement. Future interoperability tests should concentrate on the following areas:

- Power Flow Solutions: Have more participants and test files in order to improve CPSM and CDPSM profiles.
- Create a European profile based on the CPSM profile and validate it during the interoperability tests.
- Partial model transfers: Validate resolutions on contents of partial model files.
- Incremental model updates: Validate resolutions on how to do deletions and pre-condition statements
- GDA: In addition to complete power system model access, need to test more vendors for partial model access, incremental model update, event notification, and add new data access scenarios to retrieve/write other types of data as a formal part of the test. Much of this testing was begun during IOP 6 but this time no GDA tests were perform. Also need to include more vendors.
- HSDA testing was quite inclusive and comprehensive during this IOP. All that is needed for this area of testing is to include more participants and exercise the various communication technologies to ensure all areas are included.
- GES: Test the use of publish/subscribe services provided by the GES specification.
- TSDA: Include more vendors, test more services and possibly add more communication technologies.
- A more complex demonstration and interoperability tests involving multiple GID interfaces on multiple vendor products operating simultaneously should be staged. One possibility is to demonstrate a virtual data warehouse concept.
- Continue compliance testing of the IEC 61968 XML message standards defined by IEC TC57 WG14. More participants testing additional message types are needed.
- Start true interoperability testing of the IEC 61968 XML standard messages involving pairs of participants.
- Continue the testing of distribution model exchange (IEC 61968-Part 13) begun this time by EDF and SISCO.

Hopefully, future testing will also be possible off-line using a conformance test suite (yet to be developed) with official observation, evaluation, and documentation of results.

Future interoperability tests will, of course, still include opportunities for new participants to complete the tests used for this interoperability test or previous tests.

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