Topological Database Business Case

General

Project Name: Topological Database
Project Number: 2006-XX
Project Manager: Brian Nolan
Date Submitted: November 17, 2006

Executive Summary

It is proposed that the underlying data contained in the Multiregional Modeling Working Group (MMWG) base cases be migrated to a web based Common Information Model (CIM) compliant topological database. It is also proposed that the existing System Dynamic Database (SDDB) be integrated with the topological database.

The technology for developing and implementing a base case topological database exists and utilizes many commercial off the shelf database product to run the backend system.

The motivations for transforming the current base case modeling data and dynamics data into a web based database comes from recommendation 14 in the NERC Final Blackout Report dated July 13, 2004 and recommendation 4 in the Blackout Technical Report dated June 1, 2005 and are presented in this document. Also, the options are identified, analyzed, and support for the proposed requirement is developed.

Overview

This business case provides a proposal for the development of a Power Flow and Dynamics Database (PDDB) which can be used to house all power flows and dynamic data currently handled by the MMWG.

The intention is that the database developed will be designed in such a way as to facilitate and expedite the model building process.

This business case addresses two issues which the NERC MMWG has been considering,

1. Develop a topological power flow database.
2. Provide web-based access to the current SDDWG dynamics database.

The proposed solution is a single database which contains both the dynamics data (and which has all the functionality of the existing dynamics database) and the annual series of power flow cases. To improve the security of the data and to facilitate model building, the proposed database would reside on a server at a single location and would be accessed via the web. This would eliminate the need to distribute the database as is currently the practice with the existing Access database.

This business case proposes to develop the database as a single project; however, if preferred, the database can be constructed in two phases with the development of a topological power flow database in the first phase and development of web-based access to the dynamic data being added in a second phase.
The Business Case

Purpose of the Business Case

The members of the NERC MMWG believe that it is imperative to review the manner by which data is collected, corrected, stored and distributed in relation to base case development and dynamics simulation for the following reasons:

1. From Recommendation 14: Improve System Modeling Data and Data Exchange Practices.

   Recommendation 14: The regional reliability councils shall within one year establish and begin implementing criteria and procedures for validating data used in power flow models and dynamic simulations by benchmarking model data with actual system performance. Validated modeling data shall be exchanged on an inter-regional basis as needed for reliable system planning and operation.

2. From Blackout Technical Report, Recommendation TR–4:

   TR-4a – The MMWG should reinvestigate the feasibility of a power flow creation database that is CIM capable. This would help eliminate ongoing topology modeling problems, including consistency in equipment ratings, impedance, and connectivity.

Sponsor

The NERC Multiregional Modeling Working Group (MMWG) is sponsoring this project.

Stakeholders

- MMWG
- NERC Regional Councils
- Regional Council Members
- Distribution Factor Working Group (DFWG) - Secondary
- Interchange Distribution Calculator Working Group (IDCWG) - Secondary
- System Data eXchange Self Directed Work Team (SDX SDWT) - Secondary

Options

Two options were reviewed by the members of MMWG. These options are:

1. Implementation of a Topological Database for power flow and dynamics data
2. Maintain the current system

Assumptions, Issues, and Constraints

General

- A suitable vendor or vendors can be found
- Regional members will be diligent in populating the database with as accurate a data as they have
- Regional members will make all necessary corrections to their data
- Regional members will utilize the data in the database when creating new models
- Regional members will only make incremental changes to the database for items such as: load, generation dispatch, interchange schedules, and projects
Analysis of Options

Identification of Options

Option 1 – Implementation of a Topological Database
Option 2 – Maintain the current system

Discussion of Options

Option 1

The implementation of a topological database will address TR-4 and part of recommendation 14 of the Blackout recommendations pertaining to system modeling data improvements. By developing and utilizing a centralized CIM compliant topological database, errors or omissions in data can be corrected once and distributed everywhere. Once the data in the database is corrected, all users of the database will have access to the most recent and most accurate data for system modeling and simulation, thus ensuring that all users have consistent topological information. As the system matures, users will feel more confident that the topological data is correct, since the implementation works off of the continuous improvement of the underlying data.

Another benefit to utilizing a web base topological database is that there is no need to distribute discrete executable databases as is currently done with the MMWG's System Dynamics Database (SDDB). The centralization of the data will ensure that all users of the system will have the most recent data as of the time the data is downloaded.

Since both the power flow and dynamics data would be housed in one central location with continuously improving data, users of the system would not have to wait for the annual model creation to generate the underlying data for a model needed for a study.

Other Reliability Enhancements

- Easier report generation
- Minimize annual update effort
- Easier modifications of loads
- Easier handling of projects and possible in service date changes

By utilizing a centralized database, there will be eventual reduction in cost related to the creation of base case models. The majority of this savings will be in the form of minimizing data corrections. Once the correct data related to a given model element is submitted and correct, there should be no need to change it in the future. Also, many of the common data errors would be "trapped" when the data is loaded into the database and validated, thus further reducing the workload and cost of the power flow coordinator.

Similar to the cost reduction in base case development, there would be a reduction in the cost of developing system dynamic simulations. The majority of these savings will come in the form of consistent data from the topological database and a better mapping of dynamics data to the base case elements.

It is estimated that the expected database cost vs. coordinators' savings will achieve a break point in approximately five to seven years. This estimate comes from discussions with the two current MMWG vendors and what they estimate the time cost of incorrect data is from their prior work on the MMWG models.

Similarly, it is estimated that during the first year or two of utilizing a centralized topological database the Regional Coordinator level of effort will increase by 25%. After the initial
population and cleansing of the data, it is also estimated that the Regional Coordinators level of effort to maintain the system and develop the MMWG models will reduce by 50% from their current level of effort.

**Option 2**

Maintain the current system option would leave the model development process as is.

**Summary of Option Pro's and Con's**

<table>
<thead>
<tr>
<th>Option</th>
<th>Pro's</th>
<th>Con's</th>
</tr>
</thead>
</table>
| Option 1 – Implementation of a Topological Database | • Responds to the Blackout recommendations  
• Consistent topological information  
• Centralized storage of information  
• Reduction in cost of annual updates to models and data  
• Report generation  
• Easy to develop cases outside of MMWG work | • Initial time requirements to get the database populated with correct data  
• Initial cost of development |
| Option 2 – Maintain the current system       | • Does not change the current process                               | • Does not respond to the Blackout recommendations  
• Continuation of current level of effort  
• Does not allow for easy expansion of the number of base cases developed |

**Recommended Option**

MMWG propose that NERC develop a Request for Proposal to solicit bids for the creations of a web based topological database and interface for the dynamics data, Option 1.

This proposed solution will address the two issues noted in the Blackout Recommendations and Blackout Technical Report. The implementation of this database will require all Eastern Interconnection Regional entities to populate the database with the most recent and accurate data available to them, and to continue to maintain this data.

The implementation of this system can be staged with the development of the web based topological database in the first phase and the migration of the dynamics data with the second phase.

MMWG recommend the conversion to a web based data storage and retrieval system within 18 months after the Board approval.

**NERC Direct Costs**

If the Topological Database Business Case is approved, the below incremental costs will be passed on to the Eastern Interconnection Regional Councils based on the NEL allocation. The annual base case and dynamics simulation cost will be about the same as the current cost during the initial years of implementation, but after that the annual cost are expected to be reduced.

**Project Direct Cost** – The expected cost for development of a web based topological and dynamics database is about $200,000.

**Summary**
<table>
<thead>
<tr>
<th></th>
<th>Year One</th>
<th>Year Two</th>
<th>Year Three</th>
<th>Year Four</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Cost</td>
<td>$200,000</td>
<td>$200,000</td>
<td></td>
<td></td>
<td>$200,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$200,000</td>
<td></td>
<td></td>
<td></td>
<td>$200,000</td>
</tr>
</tbody>
</table>

**Implementation Strategy**

MMWG will work with NERC to coordinate the implementation of the Topological database.

**Related Projects**

NERC has projects/initiatives that are related to this project. These are:

- MMWG Base Case development
- MMWG Dynamic Simulations

**Work Plan**

- This business case will be presented to the NERC Planning Committee or designated group for their review and vote: Tentative December 2006 meeting.
- Pending approval of the business case a project plan will be developed with periodic status reports by MMWG to the NERC Planning Committee or designated group. The periodic reports will address:
  - Development of Functional Requirements and Project Plan
  - Issuance of a Request for Proposal
  - Reviewing responses
  - Presentation of the final Project Plan and vendor(s) select
- The final Project Plan and vendor(s) select will be presented to the NERC Planning Committee or designated group for their review and vote.
- Pending NERC Planning Committee or designated group approval, the Project Plan and vendor(s) select will be presented to the Board for their final review and vote.
- A Topological Database will be implemented by MMWG within 18 months after the Boards final approval.

**Approvals**

<table>
<thead>
<tr>
<th>Date</th>
<th>Group</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Multiregional Model Working Group</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NERC Planning Committee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Board of Trustees</td>
<td></td>
</tr>
</tbody>
</table>