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## Announcing a New PSCAD® Release!

*Manitoba HVDC Research Centre Inc.*

### **The Manitoba HVDC Research Centre is pleased to announce the release of PSCAD® X4!**

Our software development team has successfully achieved a significant leap forward in the evolution of the PSCAD® software architecture. At the same time, we have worked carefully to ensure that the user interface environment remains familiar to users by keeping the outward appearance of the software similar to the latest released version; though functionality has been enhanced to deliver the powerful new features made possible by the modern architecture. The result is branded X4, and it is the most powerful version of the PSCAD® software to date.

During the past decade, a trend has emerged toward the use of compatible software working off of common sets of data, eliminating the need to manually manipulate or translate results from multiple incompatible tools. It is this philosophy that has driven the changes to the internal architecture of PSCAD®. We have elected to consider the simulation as data centered rather than computational engine centred as in the past. PSCAD® is now operating fully on a centralized database, meaning that it reads and writes all of the bookkeeping information required to keep the project organized, from a single source. This architectural change is absolutely essential to facilitate communication between different programs, and to design a common information bank for results data. This also greatly simplifies and stabilizes both the usage and the development of the software, which in turn reduces operational difficulties, making PSCAD® even more enjoyable to work with.

In addition, the new architecture will make possible a new efficiency in feature implementation and future innovations of PSCAD® from this point forward. For example, X4 includes an advanced copy and paste for entire page modules, including pages within pages, graphs, controls, etc. The ability to copy and paste page modules comes with a new responsibility that rests primarily on the shoulders of the user. The PSCAD® X4 user must now rethink how a project is designed from the very beginning of the process in order to make the most efficient use of this feature. The multiple instance modules feature is meant to exploit repetitiveness in systems. In other words, identify first what combinations of components are replicated at the lowest level (a string of thyristors for example), and incorporate them into a page module. From here, move upward until you reach the top, all the while exploiting duplication. The main reason for this is that although a page module can be copied and pasted many times, only unique page module definitions need be compiled. So, the more duplication is taken advantage of, the more efficient the compilation of your project will become.



In addition to the computational efficiency, there is also improved efficiency in the preparation of simulation cases. Exploiting the duplication in a case reduces the time required to create a case, as well as reducing the opportunity for error in needing to manually prepare each individual copy.

The many new structural and feature changes to PSCAD® X4 have enabled abilities that have long been sought after by PSCAD® users. X4 is the first step in a new development direction for PSCAD®. Moving forward, you will be able to readily import PSCAD® version 4.1.x or 4.2.x project files into X4.

Of course, the features discussed above are not the only highlights of PSCAD® X4. Here are a few more of the major advancements in this release<sup>1</sup>:

**Multiple Instance Modules (MIM)** The new architecture has enabled us to treat page module components the same as regular components. Page modules may be copied and pasted, either as an instance of itself, or uniquely with new definitions and links. In addition, page modules may now possess input parameters, which may be used in concert with graphical connection ports to transfer data onto the page module canvas.

**EMTDC™ Memory Management** A major change was made to the manner in which EMTDC™ uses memory in large networks with subsystems. EMTDC™ now dynamically allocates the memory needed based on the requirement of individual subsystems, instead of relying on dimensions of the largest subsystem. This can mean huge savings in system memory, especially for systems containing many subsystems (i.e. networks separated by transmission lines or cables).

### **Fortran 77 Compatibility No Longer Required**

The old free compiler supplied with PSCAD®, which is Fortran 77 based, has been replaced by its modern equivalent: The GFortran 95 compiler. This means that users no longer need to maintain model code in Fortran 77 when working in PSCAD® X4.

**New Master Library Models** Many new models have been added to the master library, in addition to numerous updates and improvements to existing models. Some of the more important new models are:

- New Multiple Run component allows for additional data recording
- Discrete Wavelet Transform (DWT)
- Saturable Reactor
- Spark Gap
- Two New Auto Transformer Models

### **Line Constants Program Improvements**

Line constants program developments include some of the following major enhancements:

- *DC Correction* Two unique DC correction algorithms have been added, which assure accurate DC parameters for time domain simulations.
- *Unique Ground Wires in Overhead Towers* If there are two ground wires in a tower, they may now be entered with unique parameters.
- *Specific Conductor Layer Elimination in Cables* Users may now select which conductors are to be eliminated (not just the outer layer).

Our technical support team has played a key role in the success of PSCAD® and would be pleased to assist you should you need advice. Please contact [support@pscad.com](mailto:support@pscad.com) for more information.

<sup>1</sup> For a complete list of new features, please refer to the PSCAD® help documents.

# Sheath Overvoltage Study for a Transposed 380kV XLPE Cable System

Ismail A. Hamza, IEEE, GCC-CIGRE Member, Saudi Arabia, [ihamza@ieee.org](mailto:ihamza@ieee.org)

**The Saudi Electricity Company in the Western Region (SEC-WR) in the Kingdom of Saudi Arabia has recorded an excessive load increase in the past few years.** As a result, the overhead transmission lines, underground cables and transformers became fully loaded, especially in the Jeddah area. In case of system faults, the nature of load mainly composed of air conditioners during high load season (summer) causes very severe low-voltage and slow-voltage recovery. This may lead to brownouts and blackouts. It was necessary to set up an emergency automatic under-voltage load shedding scheme.

Using PSCAD®, a study involving transposed cable system was performed to simulate the fault and also compared with field measurements.

**SEC-WR Existing Power System** The Saudi Electricity Company in the Western Region (SEC-WR) is the main power supply utility responsible for generation, transmission and distribution in the region.

The SEC-WR generation capacity (in 2005) at peak load is 8727 MW including 1028 MW from Saline

Water Conversion Corporation (SWCC). The peak load recorded is 8559 MW. This load includes network losses and auxiliary power plant loads.

The existing SEC-WR 380 kV network is connected with Makkah Al-Mukarramah, Jeddah, including SWCC Jeddah, Rabigh Plant, Al-Madinah Al-Munawwarah, including SWCC Yanbu and Yanbu Area. The sub-transmission 110kV network in Jeddah is divided into seven electrical islands radially fed from the 380kV primary transmission. In Makkah Al-Mukarramah, the 110kV network is divided into three islands including Taif network. The 110kV network in the other cities of the area is synchronized as one island.

The SEC-WR power network is comprised of five main power plants, three main SWCC power plants, fourteen 380/110kV substations, over 150 110/33 and 110/13.8kV substations, more than 5000 kms of 380kV and 110kV over-head transmission lines and underground cables and a distribution network of mainly underground 33kV and 13.8kV cables [1]. The Marafiq power system in Yanbu Industrial City is interconnected with SEC-WR System.

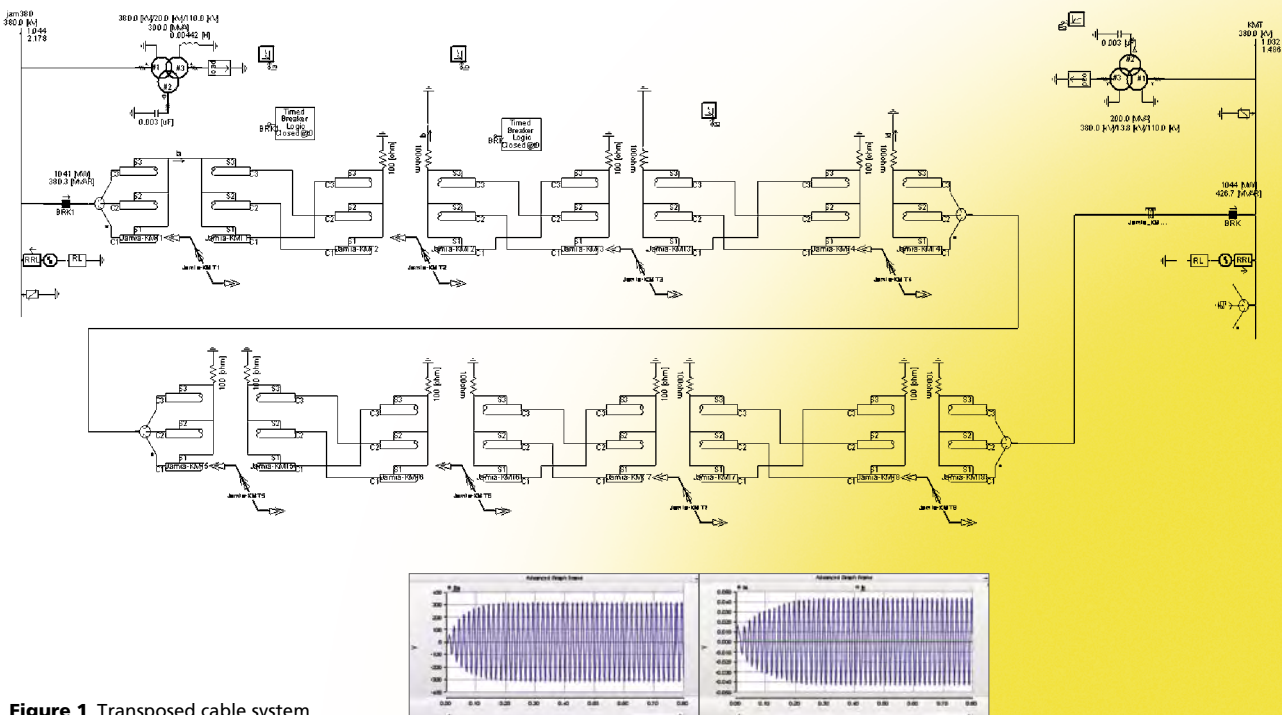


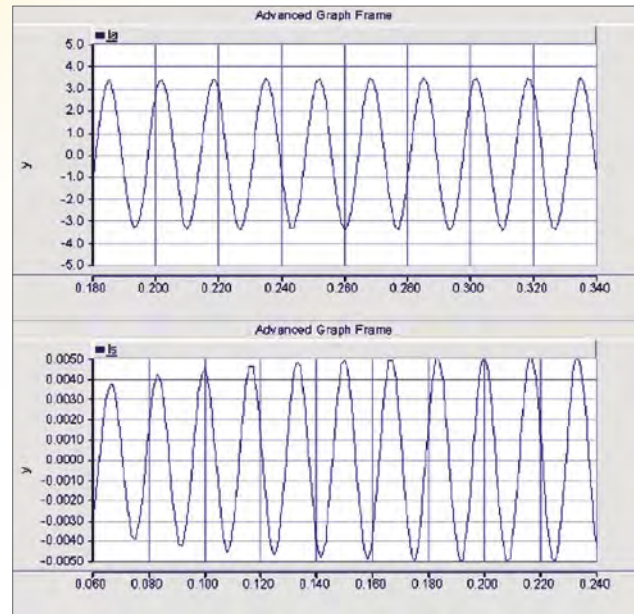
Figure 1 Transposed cable system

The 12 km long KMT-JAM circuit consists of a 5 km section of XLPE cable (2500 mm<sup>2</sup>) from the JAM-end and a 7.2 km overhead section at the KMT-end. The circuit was manufactured and installed by the Japanese manufacturer Fujikura (now known as Viscas) and was commissioned in May 2001. It is one of the first two 380kV XLPE cables (2500 mm<sup>2</sup>) installed in the WOA system. The link boxes are located below ground and buried to avoid exposure to the damage. The purpose of a link box is for the bonding and grounding of the metallic sheath of high voltage cables at predetermined locations. This is to ensure that the induced sheath voltage will not exceed the specified sheath maximum voltage and to prevent sheath circulating currents, which would result in overheating and consequent reduction in cable capacity [3]. There are a total of eight link boxes associated with this cable. The first and second link boxes from JAM-end were completely damaged.

**Cable Fault Incident** On 30th August 2005, it was found that the linkboxes at joint-7 and joint-8 of KMT-JAM circuit were damaged. After replacing these link boxes, the cable was put in operation on 1st September. After several days (12th September), the fault occurred on y-phase cable at transposing point near JB7. As a result of this fault, a dip in voltage caused under-voltage load shedding to operate. It is important to understand the reasons for the failures.

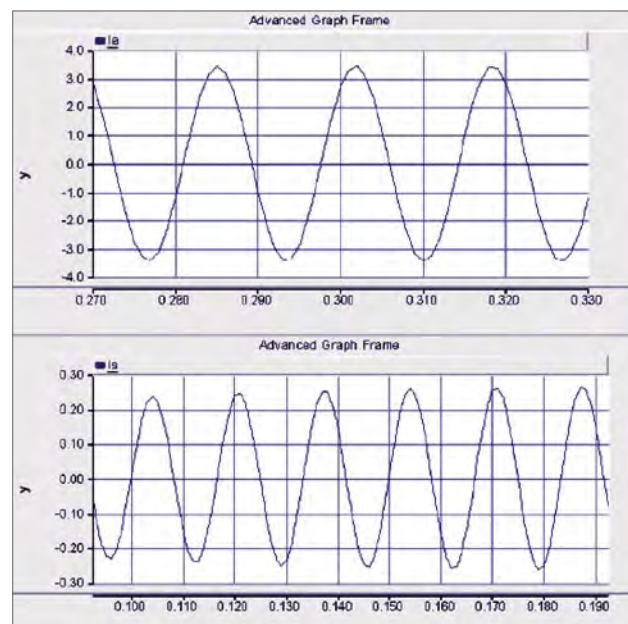
### Simulation Studies

**Case 1 Normal Cross-bonded Cable System (with transposition of phase conductors)** A simulation study was performed using PSCAD<sup>®</sup> for the transposed cable system. Figure 1 shows a transposed cable. One end of the cable was energized with a three phase supply. The sheath currents in the cable are almost symmetrical. Figure 2 shows the conductor currents ( $I_A$ ) and the total sheath current ( $I_S$ ).



**Figure 2** Case 1 conductor currents  $I_A$  and the total sheath current  $I_S$ .

**Case 2 Cross-bonded Cable Shortened at JB (with transposition of phase conductors)** Compared with the first case, a high sheath current was observed from the time domain simulation (see Figure 3).



**Figure 3** Case 2 Conductor current  $I_A$  and the total sheath current  $I_S$ .

**Excessive circulating currents in cable sheaths are potentially harmful to the cable and should be avoided.**

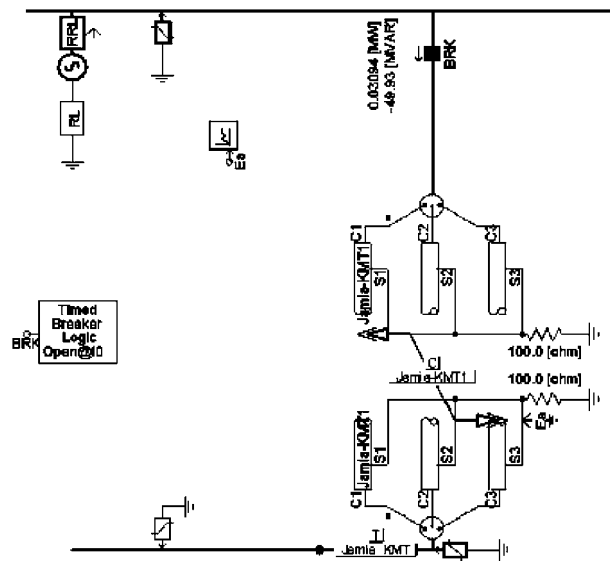
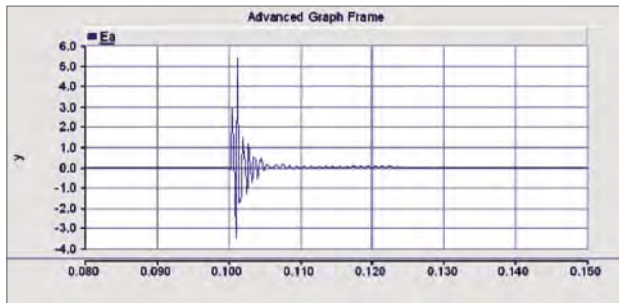


Figure 4 PSCAD® model

**Switching Study** The cable system (without transposition) used in the simulation is shown in Figure 4. It was observed that the sheath voltages are 4.86kV with reactor and 6kV without reactor. SVL sheath voltage limiter rating is 5kV.

**Conclusion**

- (1) The PSCAD® results are in agreement with the field measurement report from Viscas company.
- (2) Switching overvoltages did not damage the SVL.
- (3) For this example, there is no significant difference between transposed cable and non-transposed cable in the switching study.
- (4) Link boxes should be tested every year and should be accessible.

**References**

- [1] SEC-WR Annual Report 2005.
- [2] "EWR Under Voltage Load Shedding Scheme;" J. Deuse, J.Dubios, R. Fann & I. Hamzah
- [3] Jeddah incident Aug-Sep 2005 Final Report
- [4] "Field Measurements and Investigation;" Report by Viscas 2005
- [5] "Jeddah Cable Switching Study 2004;" ABB.

**Note**

Ismail A. Hamza served as Vice President of Transmission for North, West and South Regions at Saudi Electric Company from 2003–2006. Mr. Hamza is also a member of IEEE & GCC CIGRE.

If anyone would like to discuss the article further, please feel free to contact the author:

Ismail A. Hamza  
 ihamza@ieee.org

# A Fresh Approach to Managing Transmission Lines and Cables in PSCAD® X4

John E. Nordstrom, Manitoba HVDC Research Centre Inc.

**There are two new and exciting features involving the use of transmission lines and cables in PSCAD® X4.** Referred to as *Multiple Instance Modules (MIM)* and *Mutual Coupling (MC)*, these features may be used separately or combined to greatly enhance the management and solution of systems containing transmission lines and cables (especially in larger projects).

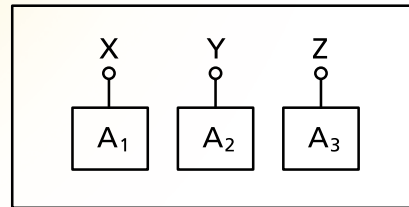
## Multiple Instances of Transmission Segments

From the perspective of the application, transmission segments (i.e. transmission lines and cables) are not unlike module components; they possess a canvas, input parameters, and a definition. As such, it would seem that transmission segments can also be multiple instanced, like their module component counterparts. This is indeed possible, however, there are some subtle differences between modules and transmission segments that should be considered, so as to optimize the efficiency and speed of your simulation.

When a project is compiled, each unique module component is compiled only once, no matter how many times the component has been instantiated in the project. In other words, it is only the definition of the module that is compiled (a *FORTTRAN* file and *Data* file are created for each unique definition). Both connection ports and input parameters are included in the defining *FORTTRAN* file as subroutine arguments, thereby allowing the module component to be connected in different parts of the circuit, as well as to possess unique input parameter values. Instantiating a module component is analogous to adding a call to its defining subroutine in the generated *FORTTRAN* for the project.

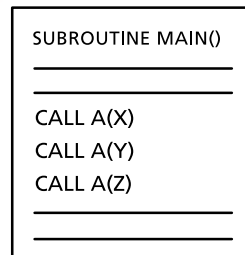
For example, if a project contains three instances of a module *A* on its *Main* page, then there exist two, unique module definitions (and therefore two unique sets of *FORTTRAN* and *Data* files). Module *A* is called thrice within the *FORTTRAN* file for *Main*.

Main Circuit Canvas

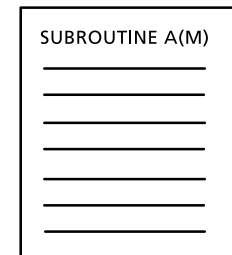


**Figure 1** Main canvas with three instances of A including connection ports

Main.f

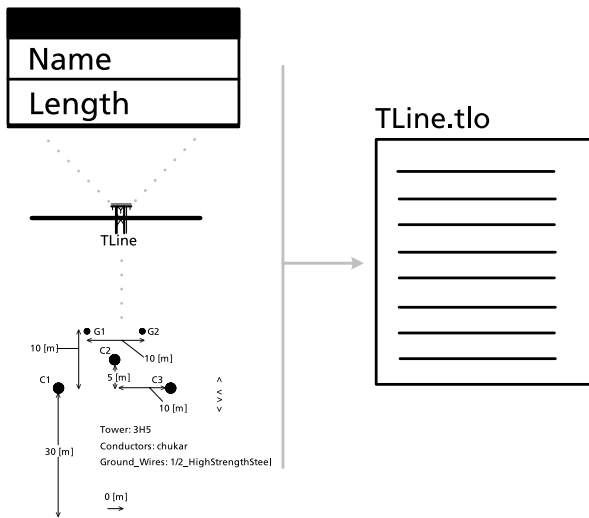


A.f



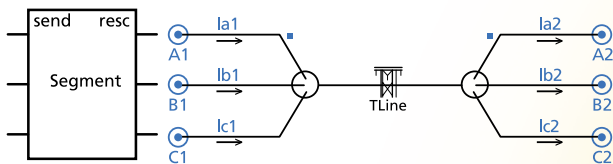
**Figure 2** *FORTTRAN* file for main showing calls to Module A with different arguments

Transmission segments are also compiled in the same manner. Each unique segment is solved separately, resulting in a *Transmission Line (\*.tlo)* or *Cable (\*.clo)* results file, which defines the time domain interface to the electric network. The major difference between segments and modules is that the results file for transmission segments is based on a combination of both instance and definition information. Transmission segment input parameters include, among other things, the segment length. The overall segment properties are highly dependent on its length, and so a change in length results in a completely new results file. This means that each transmission line or cable segment instance must be solved separately, even if they are based on the same definition.



**Figure 3** Both instance and definition information combine to create a unique segment results file

This does not mean however, that identical transmission segments must be solved separately. If your project includes multiple segments that are identical, in both length and cross-sectional configuration, then all that is required is to create a module component, and place an instance of the segment in the module (i.e. on its canvas). This is similar to 'wrapping' the segment within a module. This essentially makes the transmission segment part of the definition of module component. The module component, not the transmission segment, may then be instanced many times, and since a module definition is only compiled once, so shall it be for the transmission segment.

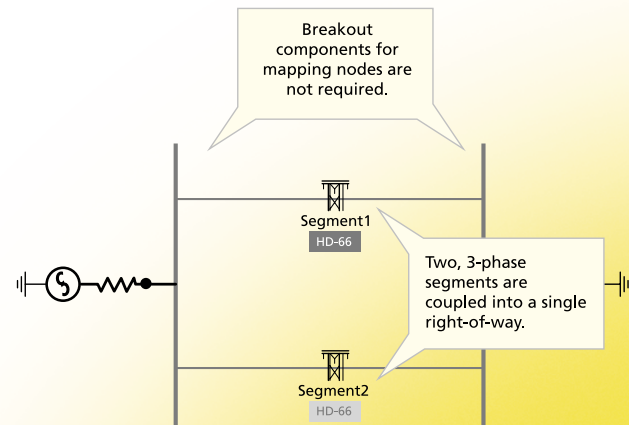


**Figure 4** Module component and module canvas including transmission line segment

This feature has the potential to drastically reduce both the compile time, and the management of transmission segments in a project, especially in cases where a lot of duplication exists. If this method is used, even if a segment appears 1000 times, it will only be solved once. Also, if a change to the configuration of the line is required, it only need be made once, and all instances will be modified automatically.

### Coupling Transmission Segments

This new feature enables the user to mutually couple (or parallel) multiple transmission segments together, provided that their lengths are all identical. In the past, this was possible only by manually combining two or more separate systems of towers (or cable cross-sections) into the same transmission segment. Now PSCAD® can be programmed to perform this task automatically, and even toggle between coupled and non-coupled states, all the while maintaining the individuality of each segment.



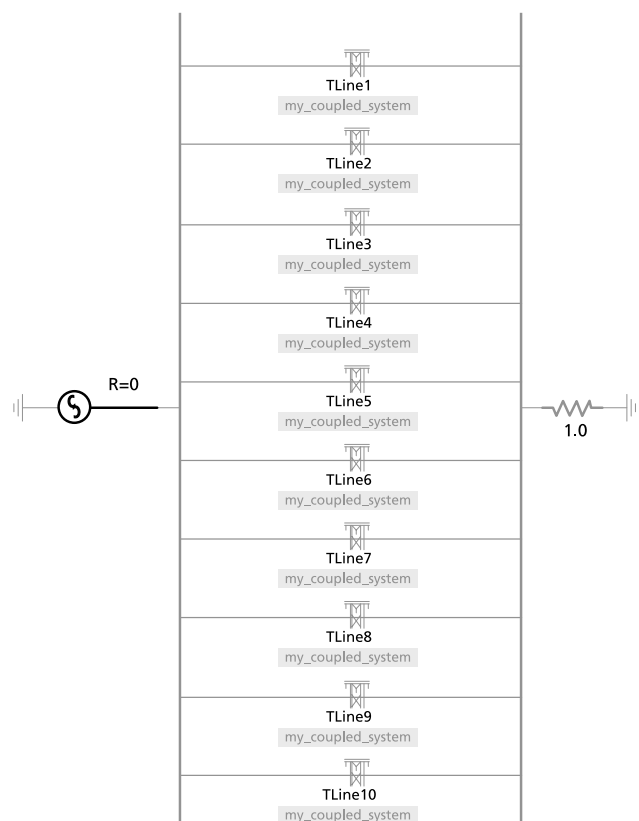
**Figure 5** Two transmission segments mutually coupled into a 6-phase system

The coupling of the transmission line and cable segments is performed completely behind the scenes. This includes node mapping subsystem allocation considerations, as well as the merging of the two separate lines into a single, coupled entity.

When a project is compiled, a unique segment input file is generated for every transmission segment in the project. The *Line Constants Program (LCP)* is called once for every input file, and in doing so produces a unique segment results file for every segment. Each input file contains information that defines the transmission segment; including conductor positions, resistance, circuits, ground properties, etc. The mutual coupling algorithm simply merges all towers (or cable cross-sections) from all segments in the coupled system into a single segment input file, which assumes the name of the coupled system. Using only the horizontal translation distance between coupled segments, conductor position and numbering can be made relative to the entire coupled system.

This algorithm essentially ‘fools’ the simulation engine into thinking there is only a single line, when there are actually many combined together. This provides the huge benefit of avoiding having to use *Breakout* components to map its endpoint nodes. For example, in versions previous to X4, only 6-conductor systems were allowed as a maximum in *Direct Connection* mode. Now using mutual coupling, you may parallel up to ten, 3-phase transmission segments between two buses (i.e. 30 conductor maximum per segment), with all node mapping performed for you. Mutually coupling also makes it possible to keep all transmission systems in your project in terms of 3-phase circuits, with the ability to toggle coupling on and off as needed.

For more information on these PSCAD® X4 features, please refer to the online help provided with the product, or contact the PSCAD® Support Desk at: [support@pscad.com](mailto:support@pscad.com)



**Figure 6** Ten, 3-phase transmission segments mutually coupled (a total of only 6 nodes!)



# Preparation of Figures Generated in PSCAD® for Technical Publication

Ali Mehrizi-Sani, University of Toronto

**Producing scalable graphics from PSCAD® graphs with print quality requires a number of intermediate steps. This guide explains how to generate the raw data for the figures in PSCAD® and import them in a graphing program of choice.** The plots generated by PSCAD®, although suitable for on-screen display, lack the flexibility and ability to customize for inclusion in the scientific publications because of, for example, (i) limited control of colors and line styles, (ii) possible inconsistency in the fonts, (iii) limited control on the titles and axes names, (iv) non-standard legend, and (v) the gray border of the figures.

It is, however, possible to use the data points for each output channel in PSCAD® and import them in the software of choice to generate high quality, vector graphics suitable for printing and publication. This step-by-step guide explains how to combine PSCAD® and MATLAB to generate vector graphics acceptable for IEEE publications, for example.

PSCAD® can store the data points in a text file. The process involves instructing PSCAD® to generate such output files and then importing them into the plotting software of interest. PSCAD® also generates a helper file that defines the corresponding output of each channel.

## Procedure

Right click on the simulation case, then set Save Channels to Disk to Yes in Project Settings | Runtime. In the same dialog box, you can also increase the "Channel plot step" so that fewer data points are written to the output files, resulting in smaller files.

Files will be stored in a folder named as the simulation case itself but with an .emt extension. There will be an .inf file and several .out files named serially as name\_01.out, name\_02.out, etc.

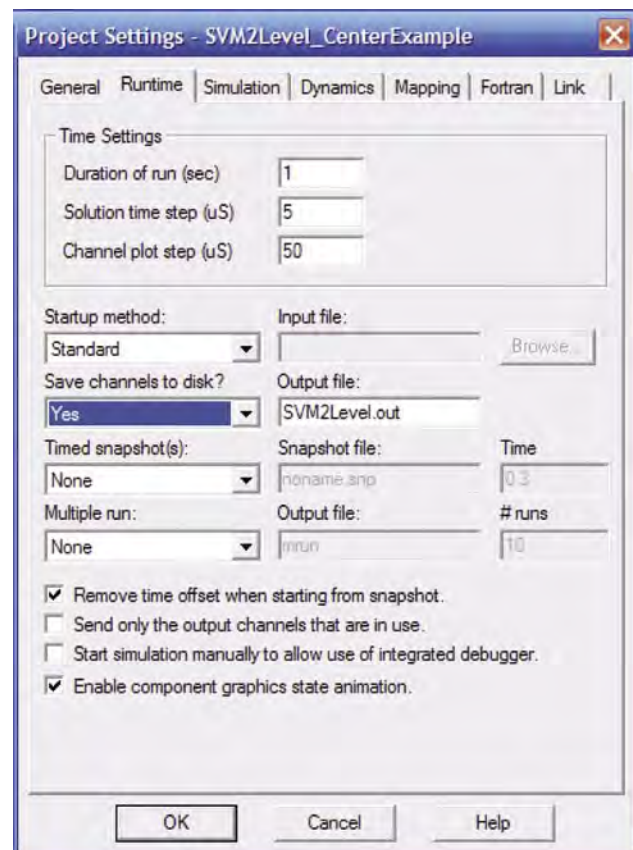


Figure 1 Case Project Settings

Each .out file has exactly 11 columns (except the last one, which might have less). The first column is always time (in seconds), and the rest of the columns correspond to the data points of the respective channel. Therefore, file name\_01.out contains channels 1 to 10 in columns 2 to 11, name\_02.out contains channels 11 to 20 in columns 2 to 11, and so on. For example, channel 44 is in file name\_05.out. To find out which data column corresponds to which channel, you need to check the .inf file. Consider the following snippet of an .inf file.

```
PGB (1) Output Desc="V:1" Group="Main" Max=2.0 Min=-2.0 Units=""
PGB (2) Output Desc="V:2" Group="Main" Max=2.0 Min=-2.0 Units=""
PGB (3) Output Desc="V:3" Group="Main" Max=2.0 Min=-2.0 Units=""
PGB (4) Output Desc="angle" Group="Main" Max=2.0 Min=-2.0 Units=""
```

The first column shows the channel number. The third column shows the description of the channel which is entered in PSCAD® as its “title.” As shown, the elements of an array are placed next to each other in the .inf file. Note that if you change the PSCAD® simulation case, the channel numbers may change, and you need to use the new .inf file. A MATLAB function is provided to help determine the column and file number from the channel number.

**In MATLAB** The following code is an example of using MATLAB to process and generate the plots. A number of optimizations are considered in the code, which are explained below:

1. To use less memory, only the data points within the time window of interest [tstart, tend] are stored. If n shows the indices of the data points:  
`n = find( (t >= tstart) & (t <= tend) );`  
 You can also use `n = n(1:10:end)` to sample the data points.

2. The time offset can be removed by setting:  
`t = t(n) - t(n(1));`

3. The figure can be exported in Encapsulated PostScript (EPS) format using the MATLAB print command: `print -depsc2. “c”` means in color.

4. The size of the figure can be preserved as shown on screen using:  
`set(gcf, 'PaperPositionMode', 'auto');`  
 The size can be set as: `set(gcf, 'Position', [left bottom width height])`. For five plots, an appropriate selection is width = 600 and h = 800.

5. For multi-plot figures, each plot needs to have the letter designator. The bottommost one should have the letter designator plus the title of the x-axis title (mostly “time (s)”). This can be done using:  
`xlabel(['(f)', repmat(' ', 1, 42), 'Time (s)'])` and `set(get(gca, 'XLabel'), 'Position'-[0.2,0.01,0]);`

```
% Load data
clear all
dsData06 = load('FoDGdecIslanded_06.out');
dsData12 = load('FoDGdecIslanded_12.out');

% Process data
t = dsData06(:, 1);
n = find( (0.48 <= t) & (t <= 0.68) ); % Choose only a short period
n = n(1:1:end); % Make n sparse
t = t(n) - t(n(1)); % Start t from zero

% Import data
Vbase = 0.094; %kV peak ln
Ibase = 0.071; %kA peak
v1_s = eval( pscadEvalText( 59) ) / Vbase; % pu
i2_td = eval( pscadEvalText( 112) ) / Ibase; % pu
i2_tq = eval( pscadEvalText( 109) ) / Ibase; % pu

% Plot the graphs
fontSize = 12; graphWidth = 1.5; axisWidth=1; XLims = [0 0.2];

hp1 = subplot(2,1,1);
h1 = plot(t, v1_s, '--k');
hold on
x1 = xlabel('a');
y1 = ylabel('v_s (pu)');
set(gca, 'YLim', [0.6 1.1], 'XLim', XLims);
legend('v1_s');

hp2 = subplot(2,2,1);
h2 = plot(t, i2_td, '--k');
hold on
plot(t, i2_tq, ':k', 'LineWidth', 2);
x2 = xlabel('b');
y2 = ylabel('i2_{t} (pu)');
set(gca, 'YLim', [0 1.1], 'XLim', XLims);
legend('i2_{td}', 'i2_{tq}');

set([hp1, hp2, x1, x2, y1, y2],...
    'FontSize', fontSize,...
    'LineWidth', axisWidth,...
    'FontName', 'Times New Roman',...
    'FontSize', 12);

set(gcf, 'Position', [300, 100, 600, 800*2/5],... % [left, bottom, width, height]
    'PaperPositionMode', 'auto');

xlabh = get(gca, 'XLabel'); % Move the xlabel of the latest axis
set(xlabh, 'Position', get(xlabh, 'Position') + [.05 -0.01 0]);

print -depsc2 II_4dgWithGridVoltageStep
```

The MATLAB function `pscadEvalText` gets the channel number and generates the required command to import the corresponding data points.

```
function e = pscadEvalText(chNum)

dsNum = ceil(chNum / 10);
subNum = (dsNum - 1) * 10;

dsText = num2str(dsNum);
if length(dsText) < 2
    dsText = ['0' dsText];
end

e = ([ 'dsData', dsText, '{n, ', ...
    num2str(chNum-subNum+1), '}' ] );

end
```

## We've Moved...



**The Manitoba HVDC Research Centre has moved to a new custom built facility in March 2010**

We welcome you to visit us at:  
211 Commerce Drive  
Winnipeg, Manitoba R3P 1A3  
Canada



## Our Services...

**The Manitoba HVDC Research Centre can help provide expertise and labor to guide or perform engineering consulting work for you.** We provide a comprehensive array of engineering services. Contrary to our name, the services we provide are for much more than just HVDC and include:

- AC and HVDC planning and feasibility studies
- Equipment specifications, operations and commissioning consulting services
- Load flow and fault analysis, transient stability studies, harmonic analysis
- Detailed electro-magnetic transient studies and custom models (emt)
- Power quality monitoring service and real time testing of devices
- Risk/reliability analysis
- Project management

## Expanding Knowledge

The following courses are available, as well as **custom training courses** – please contact [sales@pscad.com](mailto:sales@pscad.com) for more information.

### **Introduction to PSCAD® and Applications**

Includes discussion of AC transients, fault and protection, transformer saturation, wind energy, FACTS, distributed generation, and power quality with practical examples. *Duration: 3 Days*

### **Advanced Topics in PSCAD® Simulation Training**

Includes custom component design, analysis of specific simulation models, HVDC/FACTS, distributed generation, machines, power quality, etc. *Duration: 2–4 Days*

### **HVDC Theory & Controls**

Fundamentals of HVDC Technology and applications including controls, modeling and advanced topics. *Duration: 4–5 Days*

### **AC Switching Study Applications in PSCAD®**

Fundamentals of switching transients, modeling issues of power system equipment, stray capacitances/inductances, surge arrester energy requirements, batch mode processing and relevant standards, direct conversion of PSS/E files to PSCAD®. *Duration: 2–3 Days*

### **Distributed Generation & Power Quality**

Includes wind energy system modeling, integration to the grid, power quality issues, and other DG methods such as solar PV, small diesel plants, fuel cells. *Duration: 3 Days*

### **Wind Power Modeling and Simulation using PSCAD®**

Includes wind models, aero-dynamic models, machines, soft starting and doubly fed connections, crowbar protection, low voltage ride through capability. *Duration: 3 Days*

### **Lightning Coordination & Fast Front Studies**

Substation modeling for a fast front study, representing station equipment, stray capacitances, relevant standards, transmission tower model for flash-over studies, surge arrester representation and data. *Duration: 2 Days*

### **Modeling and Application of FACTS Devices**

Fundamentals of solid-state FACTS systems. System modeling, control system modeling, converter modeling, and system impact studies. *Duration: 2–3 Days*

## Connect with Us!

May 23–26, 2010

### **Wind Conference and Exhibition**

[www.windpowerexpo.org/2010](http://www.windpowerexpo.org/2010)

Dallas, Texas, USA

July 25–29, 2010

### **IEEE PES General Meeting**

[www.ewh.ieee.org/conf/pesgm10](http://www.ewh.ieee.org/conf/pesgm10)

Minneapolis, Minnesota, USA

August 22–27, 2010

### **Cigre Session 43 and Technical Exhibition**

[www.cigre.org/bg/events/session.asp](http://www.cigre.org/bg/events/session.asp)

Paris, France

More events are planned! Please see [www.pscad.com](http://www.pscad.com) for more information.

## **PSCAD® Training Sessions**

We regularly schedule training courses at the Manitoba HVDC Research Centre, Winnipeg, Manitoba, Canada, so please see [www.pscad.com](http://www.pscad.com) for more information about course availability.

June 22–24, 2010

### **Introduction to PSCAD® and Applications**

September 21–23, 2010

### **Wind Power Modeling Simulation using PSCAD®**

November 23–25, 2010

### **Introduction to PSCAD® and Applications**

All training courses mentioned above are held at the Manitoba HVDC Research Centre Inc. Winnipeg, Manitoba, Canada  
[sales@pscad.com](mailto:sales@pscad.com) [www.pscad.com](http://www.pscad.com)

Please visit Nayak Corporation's website [www.nayakcorp.com](http://www.nayakcorp.com) for courses in the USA.

## **For more information on dates, contact [info@pscad.com](mailto:info@pscad.com) today!**

If you have interesting experiences and would like to share with the PSCAD® community in future issues of the *Pulse*, please send in your article to [info@pscad.com](mailto:info@pscad.com)

