



## **SWAT SC Working Group Meeting Thursday, April 20, 2006**

**Location:** Salt River Project Pera Club, Centennial Conference Room

**Time:** 9:30AM-2:00PM

**Notes:** Paul Dux, WAPA  
A copy of the agenda, a list of attendees, and the presentation is attached to the end of these notes.

### **1) Introductions, Approval of Previous Meeting Minutes, and Update on Action Items**

Tom Field opened the meeting by stating that the purpose of this meeting would be to start the short circuit case development. Tom stated that he would like determine the format of the files to use, determine the information to put in the cases, determine the cases to use, and determine how to combine the cases at this meeting.

Tom asked if Paul Dux would volunteer to take notes. Paul stated that he would take the notes.

There were 11 participants at the meeting and 4 participants on the teleconference. One of the SCWG members, TEP, could not participate. It was stated that TEP had been told that they could read over the minutes and if they did not agree with a group decision, they could bring up the issue for additional discussion when the minutes of the meeting are covered in the next meeting. The list of participants is attached at the end of these minutes.

The agenda was shown next and is attached at the end of these minutes.

The list of members on the website was shown and it was noted that Bill Middaugh is now represented as the CCPG Liaison instead of the Tri-State representative. Tom F. stated that he contacted Tom Barnish with Platte River Power Authority and verified that Bill Middaugh would be the official CCPG SCWG liaison to the SWAT SCWG.

The first slide of a presentation on formation of a SCWG to be made at the STEP meeting in May was shown next. Tom stated that when Joe T. obtained the DPV2 information from SCE, SCE expressed an interest in participating in the SWAT SCWG. Tom stated

that he replied with a statement that suggested STEP form a SCWG and copied Rob K. and Ron M. on the email. Rob K. contacted STEP and had a positive response from STEP on forming a SCWG. Ron M. volunteered to give a presentation on forming a SCWG at the next STEP meeting. Tom stated that if STEP forms a SCWG, then the list of liaisons should grow to include STEP. Tom stated that after this is done, NTAC would be contacted to suggest they form a SCWG as well.

The link to the previous meeting minutes on the website was shown next. Tom F. asked if anyone had any changes they would like to see in the meeting minutes. Tom stated they had been emailed to everyone for review prior to the meeting. There were no requests for changes. The group agreed that the March 2006 meetings should be shown as approved. As an action item, Tom F. stated that he would update the website to show the March 2006 meeting minutes as approved.

Tom asked Ron O. with APS if APS did not agree with anything from the previous meeting minutes. Ron stated that they would like to defer this until the next meeting due to their recent workload.

The action items from the previous meeting were covered next.

Tom stated that Joe T. had obtained the DPV2 SCWG information in electronic form and that he posted it on the website. Tom stated that he sent an email back to NPC stating that if the email from SCE was not a release to distribute the information to the SWAT SCWG, to respond. Tom stated there was no response, so the information from SCE was posted on the website in encrypted form for the SWAT SCWG members to access. Tom stated that the same password used for the impedance maps and other information was used for the DPV2 SCWG information. The link on the website for the cases was shown. Tom stated there were 4 cases in the SCE information which had some updates since the DPV2 SCWG came out with the original cases.

Tom went through some of the information in the DPV2 report that accompanied the cases. He pointed out that 4 of the members of the DPV2 SCWG are members of the SWAT SCWG and may have some information that could be helpful. He pointed out that the list shows that the SWAT members use ASPEN and CAPE. He pointed out that several of the STEP members use PTI. He stated that if STEP forms a SCWG, they may be using PTI for their program, so the SWAT SCWG would have to work out all of the bugs with conversion from PTI to ASPEN and CAPE.

The next action item was for Tom F. to discuss the maps and other issues with IID on March 17. Tom stated that IID was concerned about who would have access to the information. He stated that he referenced the minutes from the first meeting where Rob K. helped to define this. He stated that IID had not updated their maps yet. Robert Sanders with IID stated that they were working on the maps and would send the maps to be posted when they are done.

The next two action items were for the group to decide the minimum size of motors to be included in the case and to determine what parameters to include for those motors. Tom F. asked if anyone had any information from their company on the size of motor to include. It was stated that the motor size depends on the voltage level and the transformations between the voltage levels. Ron O. stated that there was a facility with several motors that made a significant difference. Tom F. stated that it might be good to perform some sensitivity studies for various motor sizes and transformations to make this determination. Everyone agreed to wait until after the breaker duty study methodology was finished before looking into motor sizes and motor parameters to include.

The next action item was for the group to decide whether to show a symbol to indicate motors that have a converter front end that are above the chosen threshold. As an action item, Steve C. with PNM stated that he would look into the information that the IEEE PSRC had on this, as well as research other information on these applications to fault current, and report to the working group when he finished his research.

The next action item was for Steve C. to look into the converter symbol to use on the maps. Steve stated that for a back-to-back converter station, a set of diodes joined at the cathode should be used. He stated that the symbol used on the WECC maps should be used for converter stations on DC Lines. He stated that he would verify that a single diode is used for this symbol with the anode on the AC side and the cathode on the DC side. As an action item, Steve C. will report on his verification of these symbols in the WECC maps at the next meeting.

The next action item was for Tom F. to contact SWAT and inform them of the group's decision to make a combined set of maps and request that SWAT discuss the requirements with WestConnect. Tom showed a letter that was sent to SWAT on 3/24/06 with the information from the group and stated that it would be attached to the minutes of the meeting. He stated that there was a positive response from SWAT and showed a response from SWAT on 4/16/06. He stated that there are other discussions going on, but it seems like this is something that will be done by WestConnect. He stated that WestConnect is probably going to ask the SCWG for a detailed proposal as shown in the response on 4/16/06. Tom stated that when WestConnect sends a formal request for the information they need, he will bring it up with the SWAT SCWG to develop and return to WestConnect.

The last action item was for Maria R. to supply the information for the meeting to Tom F. for distribution to the group. Tom stated that Maria did a great job in setting up the meeting and that he wanted to thank her for all of her hard work.

Tom stated that he had gone through the minutes of the previous meetings and generated a list of the items the group agreed to place on the maps. He handed out this list and showed where it was located on the website near the top of the map links. Tom stated that there are a few things not listed. He stated that the three winding transformer winding designations as HXY or PST had not been decided. Steve C. stated that ASPEN uses PST

on the input data field and suggested this be used. Everyone agreed to use PST to represent the transformers.

Tom stated that ownership labels had not been decided. He stated that Ron O. used color codes to designate ownership and others used labels. Robert S. stated that color codes should be used for voltage levels. Some participants stated that the maps should be in black and white because many people print them in black and white. It was stated that the voltage levels would be shown on each winding of the transformers, so there was no need for color coding of the voltage levels. Everyone agreed that the maps would be in black and white. Everyone agreed that a dashed line should be used to show ownership of the boundaries. Everyone agreed that each owner should be shown on each side of the boundary. Everyone agreed that the person that has the bus in their operating area identified like the WECC load flow cases should be the one that the ownership is shown for even if there are multiple owners or different owners and operators. It was stated that whoever is shown as ownership is the company responsible for updating that part of the short circuit case annually.

Tom stated that even though we decided not to show line charging capacitance at the last meeting, we may want to reconsider it at some point in time. He showed a spreadsheet comparison of fault currents for some substations with and without line charging capacitance. He stated for the substations show, he placed line charging capacitance on all of the lines into the station one bus back from the station. The spreadsheet showed that the differences in fault current with and without line charging capacitance went as high as 2.55%. He stated that when there are long lines with no local generation or generation with a few transformations to the voltage level being faulted, the fault current is lowered more than when substations have short lines or local generation with a stiffer source impedance. He stated that the Western breaker margin for replacement is 5% and this showed that neglecting line charging capacitance on just one line would take over half of their margin. He stated that with all of the line charging capacitance added, the values would drop even lower. He stated that unlike shunt capacitors which can be switched, worst case scenarios should include the line charging capacitance which is always in if the line is in. He stated that based on these findings, Paul D. is now generating line constants for all of the DSW lines and will be putting them in the case. He stated that they currently do not have line charging capacitance on their lines. He stated that the capacitance used for the spreadsheet was just the positive sequence C from the WECC PSLF case, but Paul would be putting in positive and zero sequence capacitance in the ASPEN case. He suggested that others may want to consider doing the same or at least look at some of their higher voltage stations with long lines.

Tom asked if there were any other items from the old business that anyone wanted to bring up before proceeding with the short circuit case development. There were no responses.

## **2) Short Circuit Case Development**

The meeting continued on to the Short Circuit Case Development after covering old items. Tom stated that the format of the files, the identification of participant's information, bus numbers and names, equivalents, cases to use, and any other issues would be discussed first.

## **I. Format of Files**

Tom stated that under format of files, data conversion, programs used by everyone, outside cases, a check of the format conversions, the case to use for the checks, and other items would be covered.

### **a) Data Conversion**

Tom stated that if STEP forms a SCWG, they will probably be using PTI. He stated that other groups, such as the Devers-Palo Verde 2 SCWG also use PTI. Therefore, we will have to check the PTI conversion. Tom stated that all of the SWAT SCWG members use either ASPEN or CAPE, so the conversion between CAPE and ASPEN will also have to be checked. Therefore, we have to be able to convert from PTI to ASPEN, possibly from PTI to CAPE, from ASPEN to CAPE, and from CAPE to ASPEN.

Tom stated that he had converted the 06 DPV2 case from PTI to ASPEN. He stated that there were 623 of 1481 buses with a difference of 10 A or more when a fault was placed on every bus in PSS/E and in ASPEN. He stated that he used a Flat Start for both programs. He stated that ASPEN pointed out that he had to ignore shunts, loads, and line charging capacitance to get the same results. Tom stated that he found that he also had to ignore phase shift as well as set Transformers and LTCs to unity. When this was done there were only 442 of 1481 buses with a 10A or higher difference. A portion of a spreadsheet was shown with a comparison sorted by the highest differences (the run with 442 buses with a 10 A or higher difference was used). Tom stated that he was tracking down what the differences were due to.

Tom stated that even though there were no islands requested in the PTI export to .raw and .seq files and no islands requested in the import and run of ASPEN, there was 1 island that made it through. He said this consisted of 2 buses connected through a transformer with nothing connected to the buses. He said he was not sure how an island made it through, but one did.

He stated that many of the differences are due to the SLG fault and not the 3 phase. He said that he found that most of the differences were due to generators not having a GSU in PTI, but having one put in ASPEN during the conversion. He said some of the other major differences were also due to lines in PTI with no transformer, but a transformer put in ASPEN during the conversion. He said that a few of the major differences are due to type 2 buses regulating in PTI and a Flat Start in ASPEN without regulation. As an action item, Tom stated he would put the converted ASPEN case and the comparison spreadsheet on the website.

Tom showed a slide with a line in PTI with no GSU. He stated that what he had to do was isolate the bus with the fault to the branches that did not match and then narrow it down to one branch that did not match. He said this is how he was finding the cause of the differences. He showed the converted PTI line with a transformer in ASPEN. He showed the impedance of the machine and line in PTI and the impedance of the machine and transformer in ASPEN. He pointed out that the only impedance difference he could find was the  $9999.+j9999$ . zero sequence impedance for the machine in ASPEN that was not in PTI. There was some discussion about the base MVA and the rated MVA of the transformer and the branch, but it appeared they were correctly converted.

Tom showed another transformer from 230 to 500 kV which was represented in PTI as just a line from 230 kV to 500 kV. He stated that this was another example of the conversion which resulted in a significant fault current difference. He showed the impedance in ASPEN and PTI which appeared to match. He stated this was another example of a significant difference where PTI did not have a transformer and ASPEN did.

Finally, Tom showed that the type 2 buses in PTI are not running a Flat Start, but appear to be regulating. He showed an example which was due to Westwing having a type 2 bus. He stated that when he opened the line between Westwing and Perkins, they both had matching fault current, but when he put it in, they didn't match. He showed the output comparison and the Flat Start screens in PTI and ASPEN selected. He showed that when he changed the bus to a type 1 bus, the outputs came much closer. He said that based on this change, it appears that the Flat Start options in PTI do not use the Flat Start method in ASPEN and type 2 buses are not used as 1 pu buses pre-fault.

Tom stated that there were a few members of the SWAT SCWG that were on the DPV2 SCWG. He asked if they ever converted the case in ASPEN and checked the differences. Nobody stated that this had been done. Johnny H. with SRP stated that they did see about a 5 kA difference at Westwing between their case and the DPV2 case initially. Tom asked Kevin S. of NPC if they had any information from Teshmont about bugs in the conversion when they converted the PTI case to ASPEN. Kevin stated they did not have any information on this.

## **b) Access of Participants**

A list of participants and the programs they have was shown. Robert S with IID stated they also have PTI, but they use ASPEN for all of their short circuit cases. Based on this list, APS is the only participant with CAPE and they do not have ASPEN or PTI for conversions. WAPA is the only participant using PTI for short circuit work and they also have ASPEN for conversions.

## **c) Outside Cases**

Tom showed some outside cases which have different formats. Everyone agreed that the SWAT SCWG should check PTI to ASPEN conversion, the ASPEN to CAPE Conversion, and the CAPE to ASPEN Conversion.

#### **d) Check Format Conversions**

A slide was shown that listed the ASPEN conversion programs. From this list, the PSS/E to ASPEN and Electrocon (CAPE) to ASPEN conversion programs would be the ones investigated for converting to ASPEN. A slide was shown for the export of ASPEN to various formats. The ASPEN to PTI PSS/E conversion was the only one that would be investigated on this list because there is no ASPEN to CAPE conversion routine.

#### **e) Case to Use for Checks**

The cases to use for checks were shown. Everyone agreed that the DPV2 case converted to ASPEN would be used for the checks. Tom asked for volunteers to check the data. As an action item, Ron O. with APS volunteered to check the CAPE to ASPEN and ASPEN to CAPE conversion. Everyone agreed that ASPEN would be used for converting to and from PTI. As an action item, Tom F. stated that he would continue with his check of the PTI conversion to and from ASPEN. As an action item, Ted Stanton with SRP volunteered to check the CAPE to ASPEN and the ASPEN to CAPE conversion in conjunction with Ron. They agreed that Ron would take the DPV2 case in ASPEN format and convert it to CAPE. He would then send both of those cases to Ted. Ron would run a fault on every bus in CAPE using a flat start. Ted would run a fault on every bus in ASPEN using a flat start on the original ASPEN case and the CAPE case converted back to ASPEN. Both Ted and Ron would compare every bus in a spreadsheet similar to the one Tom showed earlier to sort the differences and find the problems in the conversion. Ron and Ted would report back to the SCWG their findings and if bugs were found in the conversion, the software vendors with the bugs would be contacted to fix them. Tom would report back to the SCWG on his findings and if bugs were found in the conversion, the software vendors with the bugs would be contacted to fix them.

#### **f) Other Items**

Tom asked if everyone was using version 10.6 of ASPEN. Everyone agreed that version 10.6 of ASPEN would be used. Ron stated that he was using the latest version of CAPE and would provide the build date for the CAPE version being used. Ron stated that there is a problem with conversion of series compensation between CAPE and ASPEN. Tom stated that he is checking the conversion of PTI with version 29 of PSS/E. He stated that he also has version 30.2.0, but they gave the same results when checked for faults on the DPV2 case.

Tom asked if anyone had any other issues related to file formats. There were no other issues brought up.

## **II. Identification of Participants Information**

The next item covered was identification of participant's information. Tom stated that there should be some way of identifying the data that each person is responsible for updating in the case. Tom stated that identification of a participant's information could be done with zones and areas.

**a) Zones**

**b) Areas**

Some ASPEN screens were shown with options to hide or show an area or zone, assign an area and zone to a bus, delete all in an area or zone, and export areas and zones. Tom stated that the SWAT SCWG may want to use the WECC area numbers that are currently in the WECC loadflow case and use one of the zones each member has in the WECC case for a zone to represent their information in the short circuit case. Kevin S. with NPC stated that they use several zones in their ASPEN case and they do not match the WECC zones. Tom stated that they could use any zones they wish as long as they are unique from the other SWAT SCWG members. He stated that the WECC zones may be better to use because of problems we could have when combining the case later with CCPG and STEP if they use some of our zones. He stated that if we used the WECC zones we currently have, there should be no problems. Ron O. with APS stated they do not have zones in their case, but could put them in. Ted S. with SRP stated that they have been putting in different zones, but would try to change the way zones are put in the case. As an action item, Tom Field will generate a list of zones and areas currently used by the members in the latest WECC case and send them out. As an action item, everyone will respond with the zones and areas they want to use for their data.

**c) In Service Dates**

The in service dates in CAPE were discussed, but APS stated they are not using them. ASPEN does not have this capability, so in service dates will not be discussed further.

**d) Others in Participant Area**

Tom F. stated that each participant may want to assign another zone to the equivalents that they are responsible for. Tom S. with SWTC stated that they will probably have multiple zones for different COOPS that are connected to their system. Tom F. stated that members may want to make a separate zone for each of the other entities in their area that they are responsible for putting in the case.

**e) Other Items**

There were no other items brought up for identification of participant areas.

The meeting adjourned for lunch at this point which was approximately 11:45. The meeting resumed at 12:30.



Tom F. asked everyone in the room to introduce themselves while waiting for the teleconference participants to rejoin the meeting.

### **III. Bus Numbers and Names**

Bus Numbers and Names were not covered at this meeting.

### **IV. Equivalents**

The next item covered was equivalents. Tom F. stated that we have to look at the different methods of calculating equivalents and compare them. He stated that we need to determine the number of buses to equivalence back. He stated that we also need to look at transfer impedances.

#### **a) Methods**

Tom stated that there are 2 different methods of calculating equivalents in CAPE and one method in ASPEN. He stated that other programs, such as PTI, use other methods. The screens for generating equivalents in ASPEN were shown for the 3 options in ASPEN.

#### **b) Check Methods**

Tom asked for a volunteer to check the equivalents in ASPEN against the equivalents in CAPE. As an action item, Steve C. with PNM volunteered to check the equivalents in ASPEN. As an action item, Ron O. with APS volunteered to check the equivalents in CAPE. Both Steve and Ron will work together to compare the equivalents.

#### **c) Number of Buses**

Tom asked how many buses back everyone felt we should equivalence back. Some participants wanted to just go back 1 bus to make it simple. Others stated that you should go back at least 2 buses to get the correct impedance for setting relays. Everyone agreed that we would go back 1 or 2 buses, but 2 buses would be encouraged.

#### **d) Transfer Impedances**

Tom asked Ron O. to talk about transfer impedances. Ron stated that putting in the transfer impedances would make a big difference in the results in some areas. It was stated that both ASPEN and CAPE can generate the transfer impedances.

#### **e) Others**

Everyone agreed that the comparison of equivalents would not be performed until the conversion comparison was finished because Ron has to perform both the conversion comparison and the equivalence comparison in CAPE.

There were no other items brought up for equivalents.

## **V. Cases to Use**

The next item was the case to use for comparing equivalents. It was decided that the DPV2 case in ASPEN format and CAPE format would also be used for the equivalents check in areas that give nearly identical results. There may be another case used that does give identical results in CAPE and ASPEN. Steve and Ron will determine this. This will be determined after the conversion check is finished.

The cases to use for the combined case were discussed next. Tom F. asked Kevin S. with NPC if the DPV2 case was put into their operating case. Kevin was not sure. As an action item, Kevin S. will check to see if the DPV2 case was input correctly in the NPC operating case. Everyone agreed to use their one operating case that they use today for the combined case.

### **3) Determine Plan of Work**

The plan of work was discussed next. Tom F. stated that the group needs to determine how to combine the cases, a date for submitting the cases, and the formats for the combined case.

## **I. Determine How to Combine Cases**

Tom stated that for combining the cases, the work could be done by one person or multiple people.

### **a) Individual Person**

Tom stated that there is a lot of time required for one person to combine all of the cases. Tom asked if anyone would like to volunteer to combine all of the cases. There were no volunteers.

### **b) Multiple People**

Tom stated that the work could be distributed in a way that 7 of the 9 SWAT SCWG member companies would have to combine only 2 cases each to get a complete combined case. Tom asked if everyone wanted to use the multiple person method and everyone agreed to combine the cases with multiple people.

A plan to put together the case with SRP and APS in one combination, TEP and SWTC in one combination, EPE and PNM in one comparison, and NPC, WAPA, and IID in one combination was shown. Tom asked if everyone agreed with the pairing based on geographic locations. Everyone agreed to these combinations. Tom asked for a volunteer to combine the APS and SRP cases into case 1. As an action item, Ron O. of APS volunteered to create case 1. Tom asked for a volunteer to combine the TEP and SWTC

cases into case 2. As an action item, Tom S. of SWTC volunteered to create case 2. Tom asked for a volunteer to combine the EPE and PNM cases into case 3. As an action item, Dave G. of EPE volunteered to create case 3. Tom asked for a volunteer to combine the NPC, WAPA, and IID cases into case 4. Robert S. with IID stated that IID did not have the resources to do this. Kevin S. with NPC stated NPC does not have the resources to do this. As an action item, Tom F. of WAPA volunteered to create case 4. Tom asked for a volunteer to combine case 1 and case 2 to form case 5. As an action item, Ted S. of SRP volunteered to create case 5. Tom asked for a volunteer to combine case 3 and case 4 to form case 6. As an action item, Steve C. of PNM volunteered to create case 6. Tom asked for a volunteer that had not already volunteered to combine a case to combine case 5 and case 6 to form case 7. The only member that hadn't volunteered already to combine a pair of cases or stated that they did not have resources to combine a pair of cases was TEP. Since TEP was not present, Gary T. with TEP was volunteered to create case 7 contingent upon his acceptance of this action item. If Gary does not agree by the next meeting to do this, then the group will determine who will combine cases 5 and 6 to form the final case 7.

### **c) Single Contacts of Participants**

Tom asked for a single point of contact for the case combining. He stated it should be the people performing the work. The people that volunteered to combine the cases will be the single points of contact. Ted S. of SRP said that he would not be doing the work, but would be the single point of contact for someone working under him that would do the work. The rest of the people that volunteered to combine the cases would be the points of contact. There was no response from IID or NPC for a point of contact for technical questions that the people combining the cases may have. This will be asked for at the next meeting. Since TEP was not present, they will also be asked to provide their technical point of contact for combining the cases.

### **d) Others**

The checking of the results was not discussed yet because the cases cannot be combined at this point in time. When the case combining starts, there will be some checks specified.

## **II. Date for Submitting Cases**

The date for submitting the cases to be combined was discussed. It was stated that the cases cannot be combined until the conversion checks are complete and the equivalent checks are complete. Everyone agreed that this date will be determined when the conversion and equivalent checks are complete.

## **III. Formats for Combined Case**

The formats for the combined cases were discussed. Everyone agreed that if the conversions work without problems, then the case will be put in PTI, CAPE, and ASPEN

format. If there are problems with the conversion, then the case will only be put in CAPE and ASPEN format.

#### **4) Determine Location of Next Meeting**

The date for the next meeting was discussed next. Tom stated that at the February 2006 meeting, Mark E. had volunteered to make arrangements for the May 2006 meeting in Casa Grande. Mark stated that he could still have the meeting in Casa Grande. As an action item, Mark E. will supply information on the meeting location to Tom F. for distribution to the group in the next agenda. Tom asked if anyone had any suggestions for a different time for the next meeting. Everyone agreed that the time should be from 9:30 AM to 4:00 PM Arizona time on May 18, 2006.

Tom stated that the SWAT SCWG has held a meeting on the Western edge of SWAT, in Phoenix, in Tucson, and will have one in Casa Grande. He stated that Dave with EPE has a lot of work that would make setting up a meeting right now difficult. He asked Steve if PNM could host the June meeting. As an action item, Steve C. stated that he would look into the possibility of having the June 2006 meeting at PNM in New Mexico.

The meeting was adjourned at approximately 2:00 pm.

**Note: Tom Field did not ask for permission to publish contact information in the meeting minutes on the website, so only the contact information from those that gave consent at the first meeting to publish their contact information on the website is published in the list from the April meeting.**



# SWAT SC Working Group

**April 20, 2006**

**9:30AM to 4:00PM Arizona Time**

**Location: Salt River Project Pera Club  
Centennial Conference Room (Board Room)  
1 E. Continental Drive  
Tempe, AZ 85281-1053**

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**Meeting called by:** SWAT SC Working Group

**Purpose:** SWAT SC Working Group meeting to review short circuit items of mutual interest for the SWAT system.

## ----- Agenda Topics -----

1. **Introductions, Approval of Previous Meeting Minutes, and Update on Action Items**
2. **Short Circuit Case Development**
  - Format of Files
    - a. Data Conversion
    - b. Access of Participants
    - c. Outside Cases
    - d. Check Format Conversions
    - e. Case to Use for Checks
    - f. Other Items
  - Identification of Participants Information
    - a. Zones
    - b. Areas
    - c. In Service Dates
    - d. Others in Participant Area
    - e. Other Items
  - Bus Numbers and Names
    - a. Duplicate Names
    - b. Duplicate Numbers
    - c. Others

- Equivalents
    - a. Methods
    - b. Check Methods
    - c. Number of Buses
    - d. Transfer Impedances
    - e. Others
  - Cases to Use
    - a. DPV2 Case
    - b. Internal Cases
    - c. Year
    - d. Others
3. **Determine Plan of Work**
- Determine How to Combine Cases
    - a. Individual Person
    - b. Multiple People
    - c. Single Contacts of Participants
    - d. Others
  - Date for Submitting Cases
  - Formats for Combined Case

**4. Determine Location of Next Meeting**

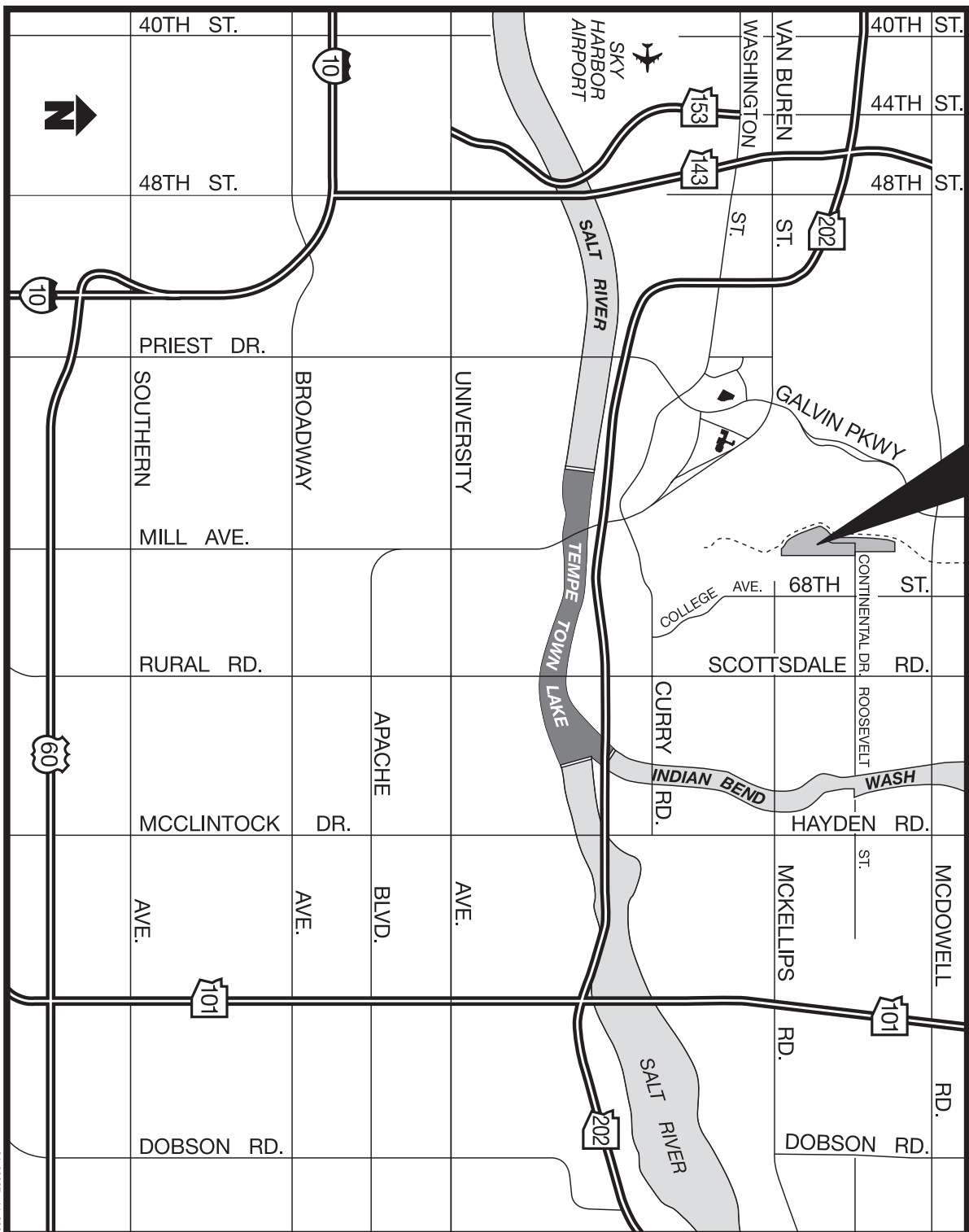
Meeting Location Instructions:

There is no security issue with entering the facility.

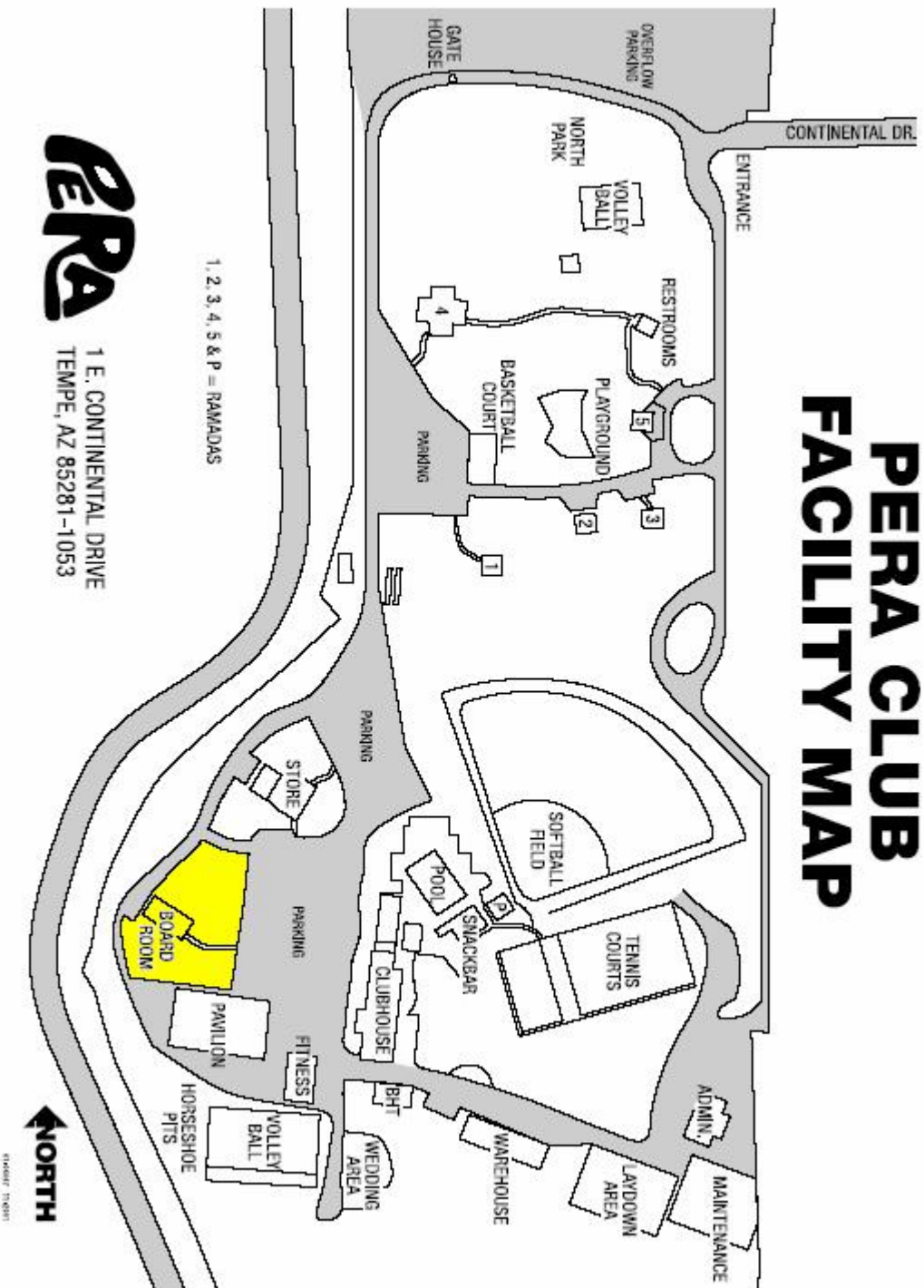
Lunch will be brought in at 11:30 and the meeting will resume at 12:00.

# PERA CLUB

1 E. CONTINENTAL DRIVE  
TEMPE, AZ 85281-1053



# PERA CLUB FACILITY MAP



1, 2, 3, 4, 5 & P = RAMADAS

**PERA**

1 E. CONTINENTAL DRIVE  
TEMPE, AZ 85281-1053



# SWAT SC Working Group

April 20, 2006

9:30AM to 4:00PM

Location: Salt River Project Pera Club  
Centennial Conference Room (Board Room)

1 E. Continental Drive  
Tempe, AZ

Name	Company	Phone	Email
STEVE PHEGLEY	APS	(602) 371-6534	steven.phegley@aps.com
Ronald P. Orate	APS	(602) 371-7754	ronald.orate@aps.com
María Ramirez	SRP		
Ted Stanton	SRP		
John Hernández	SRP		
David Gutierrez	EPE		
Tom SPENCE	SWTC	520-586-5144	tspace@swtransco.coop
Paul Dux	WAPA	602-605-2784	pdux@wapa.gov
Steve Casero	PUM	505 241 2642	scasero@pum.com
Mark Thornton	ED3/KPSA	602-809-0707	mef@kpsa.nwe.com
Thomas Field	WAPA	602-605-2517	field@wapa.gov
Robert Sanders (teleconference)	IID		
Javier (teleconference)	IID		
Kevin Salisbury (teleconference)	NPC		
Robert DerAshodian (teleconference)	NPC		

# SWAT SCWG

April 20, 2006 Meeting



# Short Circuit Case Development Issues

- Determine format of files
- Determine information to put in cases
- Determine cases to use
- Determine how to combine cases



# Agenda

## **1. Introductions, Approval of Previous Meeting Minutes, and Update on Action Items**

## **2. Short Circuit Case Development**

- Format of Files
  - a. Data Conversion
  - b. Access of Participants
  - c. Outside Cases
  - d. Check Format Conversions
  - e. Case to Use for Checks
  - f. Other Items
- Identification of Participants Information
  - a. Zones
  - b. Areas
  - c. In Service Dates
  - d. Others in Participant Area
  - e. Other Items
- Bus Numbers and Names
  - a. Duplicate Names
  - b. Duplicate Numbers
  - c. Others

# Agenda

- Equivalents
  - a. Methods
  - b. Check Methods
  - c. Number of Buses
  - d. Transfer Impedances
  - e. Others
- Cases to Use
  - a. DPV2 Case
  - b. Internal Cases
  - c. Year
  - d. Others

### 3. **Determine Plan of Work**

- Determine How to Combine Cases
  - a. Individual Person
  - b. Multiple People
  - c. Single Contacts of Participants
  - d. Others
- Date for Submitting Cases
- Formats for Combined Case

### 4. **Determine Location of Next Meeting**

# Introductions

## SWAT SCWG Members

[Tom Field](#) WAPA

[Don Bryce](#) USBR

[Mark Etherton](#) SWRTA Class Two Consultant

[Steve Phegley](#) APS

[Maria Ramirez](#) SRP

[Gary Trent](#) TEP/Unisource

[Tom Spence](#) SWTC

[Steve Conrad](#) PNM

[David Barajas](#) IID

[Jorge Barrientos](#) IID alternate

[David Gutierrez](#) EPE

[Joe Trantino](#) - NPC/SPPC

[Bill Middaugh](#) - [CCPG](#) Liaison

# STEP SCWG Proposal

## STEP SCWG Presentation

May 5, 2006

San Diego, California

# Approval of March 2006 Meeting Minutes

## SWAT SCWG Meetings

January 2006 Meeting Notes

February 2006 Meeting Notes

March 2006 Meeting Notes (unapproved)

April 2006 Agenda (draft)





# Update on Action Items

- **Person:** Joe Tarantino
- **Action Item:** Contact Gary Chin and try to get the information from the DPV2 SCWG in electronic form and get permission from Gary to distribute it to the SWAT SCWG



# DPV2 SCWG Information

## SWAT SCWG Cases

(All cases are password protected)

2006 Operating Case

Updated DPV2 Case

APS Case

SRP Case

WAPA DSW Case

TEP/Unisource Case

SWTC Case

IID Case

EPE Case

PNM Case

NPC/SPPC Case

# Update on Action Items

- **Person:** Tom Field
- **Action Item:** Discuss the map issues and other issues/concerns IID has on March 17 with Jorge.
- **Person:** Entire Group
- **Action Item:** Discuss motor size with their company and be prepared for a vote on what the size of a significant motor to represent will be at the next meeting.
- **Person:** Entire Group
- **Action Item:** Discuss motor parameters with their company and be prepared for a vote on the parameters to use to represent motors including resistance at the next meeting.



# What Size Motors to Model

- <http://www.amsuper.com/products/library/001-SysLoadAS.pdf>

Step 3 - motor model guidelines on page 4



# IEEE C37.010 Motor Data

- Section 6.4 – Symbols for Motor Variables used in Fault Calculations



# Update on Action Items

- **Person:** Entire Group
- **Action Item:** Look into the issue of non-linear loads and be prepared for a vote at the next meeting on whether to show motors connected to a converter with some identification of this connection for motors above the threshold decided to use for large motors that can have a significant contribution to fault current at the next meeting.



# Non-linear load

- [http://services.eng.uts.edu.au/~joe/subjects/eet/eet\\_ch6.pdf](http://services.eng.uts.edu.au/~joe/subjects/eet/eet_ch6.pdf)
- 6 Pulse Converter connected to motor in figures on page 28



# Update on Action Items

- **Person:** Steve Conrad
- **Action Item:** Look into the converter station symbol to use.
- **Person:** Tom Field
- **Action Item:** Contact SWAT and inform them of the group's decision to make a combined set of maps as well as request that SWAT discuss the requirements with WestConnect.





# SWAT Letter – 3/24/06

At the March 16 SWAT SCWG meeting in Las Vegas, the details of the Map portion of the SCWG work was completed. The group developed a plan of action to implement the map generation. This plan of action included an action item for me to report to SWAT the decision of the group. This decision, was as follows:

- 1) Report to the SWAT Committee that the Map plan had been finished.
- 2) Request that the SWAT Committee request funding from WestConnect for the development of the maps.
- 3) The 2 members of WestConnect that are not members of SWAT do not wish to participate in the map development or participate in funding it through WestConnect. The reason is that they (Xcel and Tri State) are involved in the CCPG SCWG effort. Bill Middaugh had stated that he would like to participate in the SWAT SCWG as a liaison for CCPG and not as a representative of Tri State.
- 4) The SWAT SCWG would prefer to have WestConnect fund a SWAT member utility to develop the maps because it would be cheaper and quicker if a member utility has the resources in terms of manpower. If this is not possible, then the SWAT SCWG would like to have WestConnect hire a consultant or other company to perform the work.
- 5) The SWAT SCWG would like to ask the SWAT Committee to obtain the procedure from WestConnect that would be used for hiring a consultant, SWAT member utility, or other company to develop the maps.
- 6) The SWAT SCWG would like to ask the SWAT Committee to obtain the information that WestConnect will require from the SWAT SCWG for the hiring procedure.

There are other details of the plan of action discussed in the draft of the March 16 meeting minutes that will be placed on the SWAT SCWG website by the end of today. These details are in section 3) entitled "Determine Plan of Work" in the meeting minutes.

The website address is:

<http://www.oatioasis.com/WALC/WALCdocs/page1.htm>

If you need any additional information, please let me know. Thanks

# SWAT Response – 4/16/06

Re: Short Circuit Work Group Proposal for Funding from WestConnect

Good news. I spoke with Cary Deise on Wednesday regarding the referenced subject. Cary is supportive of the proposal to WestConnect as we outlined it to him. He agreed that if we develop a proposal for funding that we will allow us to present it to the steering committee and will work with us to obtain funding.



# Update on Action Items

- **Person:** Maria Ramirez
- **Action Item:** Supply information on the meeting location to Tom F. for distribution to the group in the next agenda.



# Maps Items

## SWAT SCWG Impedance Maps

(All impedance maps are password protected)

2006 Combined Maps

Map Items [List](#) (draft)

APS Impedance [Maps](#)

SRP Impedance [Maps](#)

WAPA DSW Impedance [Maps](#)

TEP/Unisource Impedance [Maps](#)

SWTC Impedance [Maps](#)

IID Impedance Maps

EPE Impedance [Maps](#)

PNM Impedance [Maps](#)

NPC/SPPC Impedance [Maps](#)

# Items not voted on

- HXY or PST on transformers
- Ownership labels
- Action items for motors and DC terminals determined in action items earlier today



# Items in List – Line Charging Capacitance

pinnacle peak	345 kV		%lower		mead		345 kV		%lower
no caps	slg	16681			no caps		slg	10862	
	3p	16994					3p	12243	
circuit 1 cap to flag	slg	16503	1.07		all mead line caps		slg	10834	0.26
	3p	16779	1.27				3p	12207	0.29
circuit 1 and 2 cap to flag	slg	16323	2.15						
	3p	16560	2.55		mead		500 kV		
					no caps		slg	18646	
westwing	230 kV						3p	22814	
no caps	slg	48503			all mead line caps		slg	18411	1.26
	3p	50520					3p	22615	0.87
230 kV line caps	slg	48452	0.11						
	3p	50465	0.11		Gila		161		
					no caps		slg	5290	
mead n.	230 kV						3p	5460	
no caps	slg	42339			all mead line caps		slg	5270	0.38
	3p	43623					3p	5439	0.38
all mead line caps	slg	42100	0.56						
	3p	43353	0.62						
mead s.	230 kV								
no caps	slg	52799							
	3p	53541							
all mead line caps	slg	52439	0.68						
	3p	53155	0.72						

# Short Circuit Case Development

- Format of Files
- Identification of Participant's Information
- Bus Numbers and Names
- Equivalents
- Cases to Use
- Others



# Format of Files

- Data Conversion
- Access of Participants
- Outside Cases
- Check Format Conversions
- Case to Use for Checks
- Other Items





# Data Conversion

- PTI to Aspen
- PTI to Cape
- Aspen to Cape
- Cape to Aspen



# DPV2 case PTI-Aspen Conversion

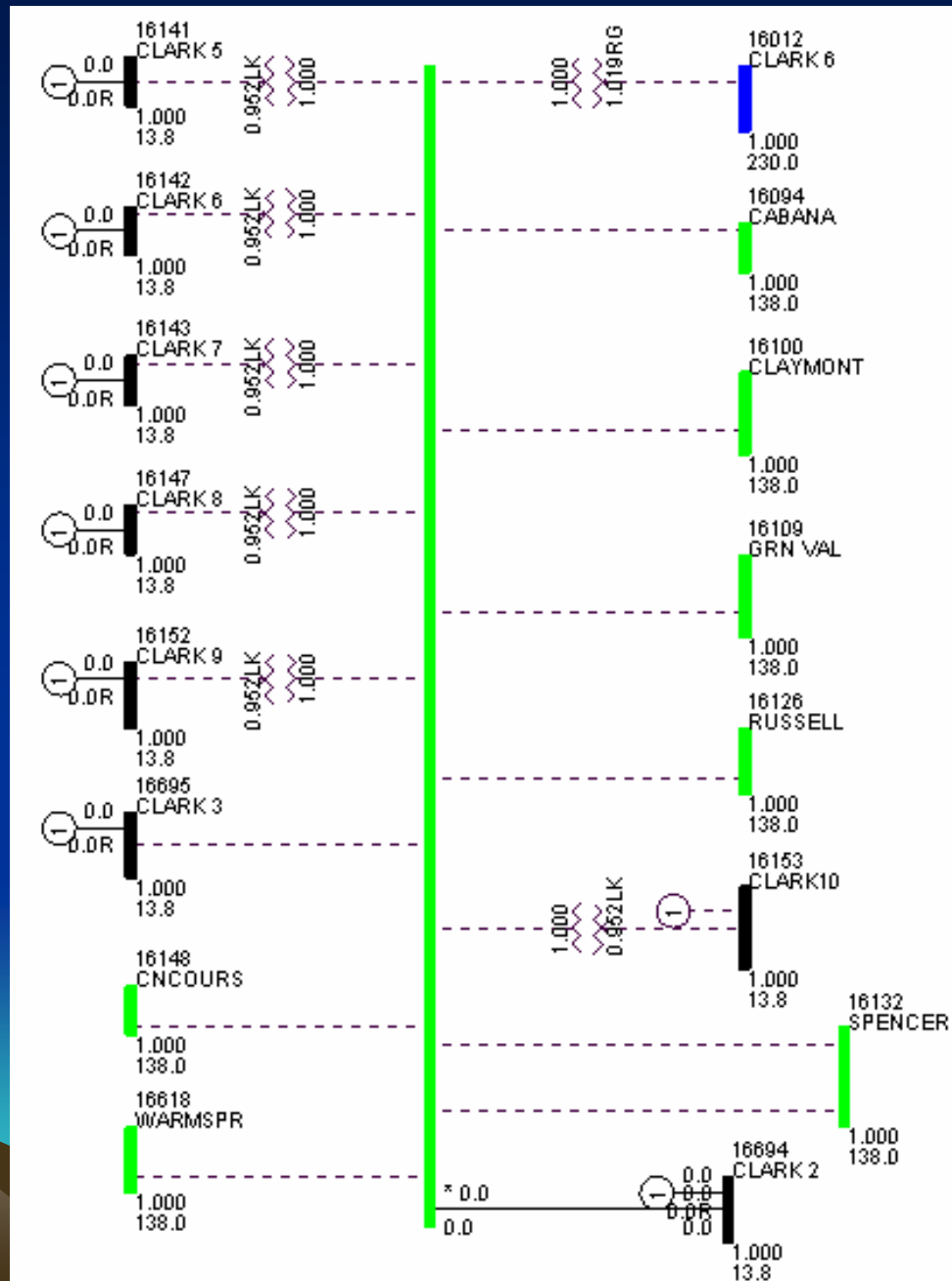
- Initially 623 of 1481 buses with 10 A or higher difference
- Ignore shunts, loads, line charging cap, and phase shift
- Set Transformer and LTCs to unity
- Drops to 442 of 1481 buses with 10 A or higher difference



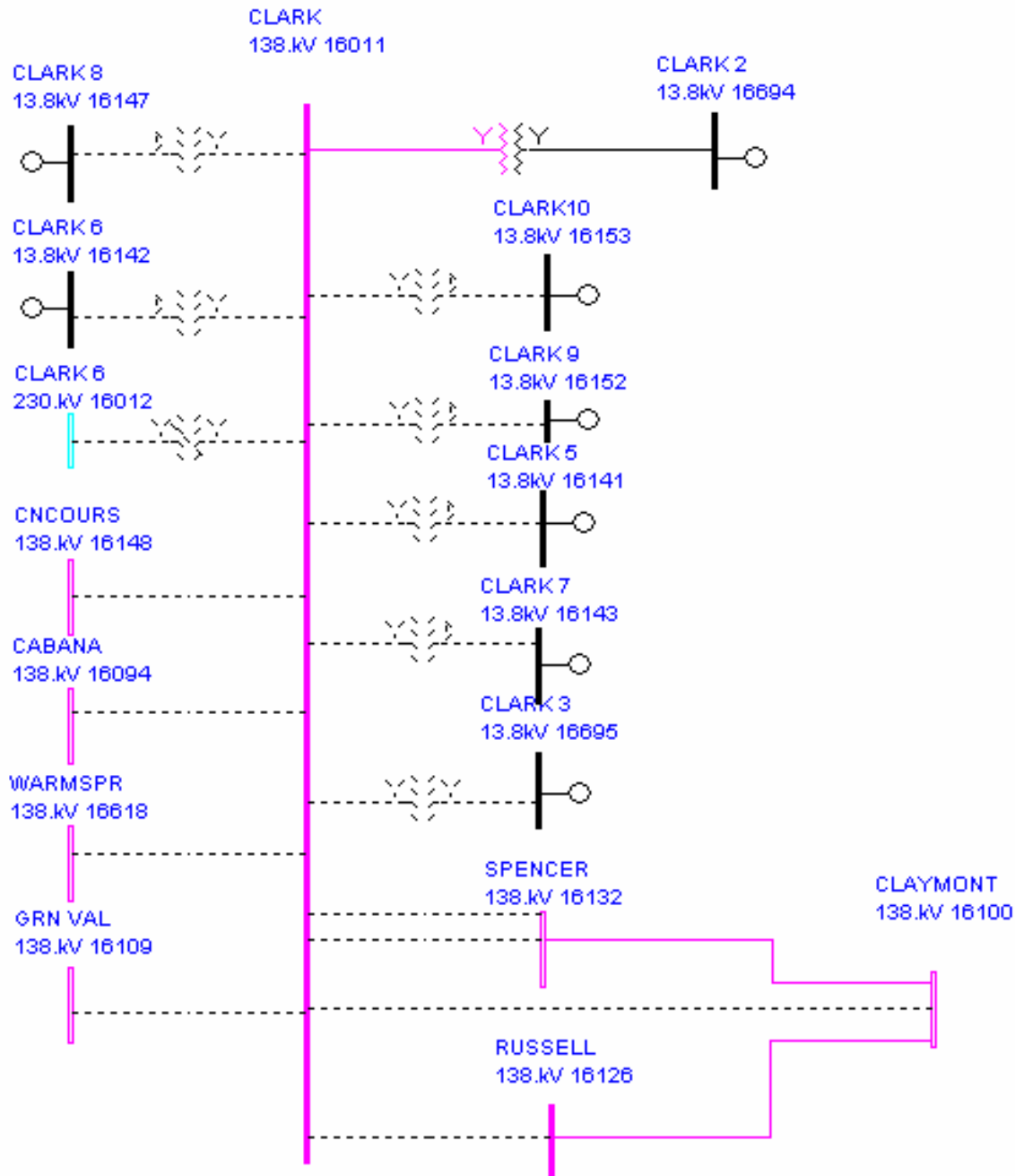
# Differences due to Conversion

3 phase	SLG	max dif	bus name		reason				
11106.16	0.099518	11106.16	SAGUAWT613.8					island	
8.9	7779.3	7779.3	CLARK 2 13.8					transformer not in pti	
10.6	7687.1	7687.1	CLARK 3 13.8					type 2 bus	
21.7	7624.1	7624.1	CLARK 1 13.2					to be looked at	
2.7	4522.7	4522.7	CLARK 4 13.8						
0.4	4492.6	4492.6	SUNRISE213.8					3 phase dif > 10A	
0.5	4284.4	4284.4	SUNRISE113.8						
1067.5	1915.9	1915.9	NAV CP2 525						
6.5	1637.2	1637.2	WINTERWVD69.0						
1529	916.2	1529	BANK H&I 525						
29.7	1525.3	1525.3	HAL BK A13.8						
1502	1077.4	1502	PRKNPST 525			at 9650			
2	1297.4	1297.4	SUNRISE269.0						
1.9	1272.5	1272.5	SUNRISE169.0						
151.7	1165.7	1165.7	CL 6904 69.0						
104.9	1105	1105	CL 6911 69.0						
80	1082.1	1082.1	CL 6912 69.0						
25.6	1061.6	1061.6	CLARK W 69.0						
110.8	1045.9	1045.9	CL 6907 69.0						
14	1030.6	1030.6	CLARK E 69.0						
13.7	1005.5	1005.5	BRINETAP69.0						
994.3	709.7	994.3	MCC BK J 230						
13.3	952.5	952.5	WHITNEY 69.0						
807.3	569.3	807.3	PERKINS 525			at 9650			
604.3	29.5	604.3	MOE CP4 525						
565	279.4	565	LIBTYP5 230						

# Transformer Differences



# Transformer Differences



# Transformer Differences

- PTI Branch Data

R-Zero (pu)	X-Zero (pu)	B-Zero (pu)	Zero Seq G (from) (pu)	Zero Seq B (from) (pu)	Zero Seq G (to) (pu)	Zero Seq B (to) (pu)
0.00630	0.1415	0.00000	0.00000	0.00000	0.00000	0.95238

# Transformer Differences

- Plant Data

## Positive Sequence

Z s o r c e		Rtran	Xtran	Gentap
(pu)	(pu)	(pu)	(pu)	(pu)
0.00000	0.14020	0.00000	0.00000	1.00000

## Zero Sequence

R-Pos	X-Pos	R-Neg	X-Neg	R-Zero	X-Zero
(pu)	(pu)	(pu)	(pu)	(pu)	(pu)
0.00000	0.14020	0.00000	0.14020	0.00000	0.00000

# Aspen Generator Data

Generating Unit Info			
ID=	<input type="text" value="1"/>	Unit rating=	<input type="text" value="77."/> MVA
Impedances (pu based on unit MVA)			
Subtransient	<input type="text" value="0."/>	+j	<input type="text" value="0.1402"/> <input type="button" value="Fill"/>
Transient	<input type="text" value="0."/>	+j	<input type="text" value="0.1402"/>
Synchronous	<input type="text" value="0."/>	+j	<input type="text" value="0.1402"/>
- sequence	<input type="text" value="0."/>	+j	<input type="text" value="0.1402"/>
o sequence	<input type="text" value="9999."/>	+j	<input type="text" value="9999."/>
Neutral Impedance (in actual Ohms)			
	<input type="text" value="0."/>	+j	<input type="text" value="0."/>
Scheduled generation (MW)			
	<input type="text" value="0."/>		
P and Q limits (MW and MVAR)			
Pmax=	<input type="text" value="73."/>	Qmax=	<input type="text" value="30."/>
Pmin=	<input type="text" value="-9999."/>	Qmin=	<input type="text" value="-24."/>



# Aspen Transformer Data

## 2-Winding Transformer Data

16011 CLARK

138.kV - 16694 CLARK 2

13.8kV

Name=

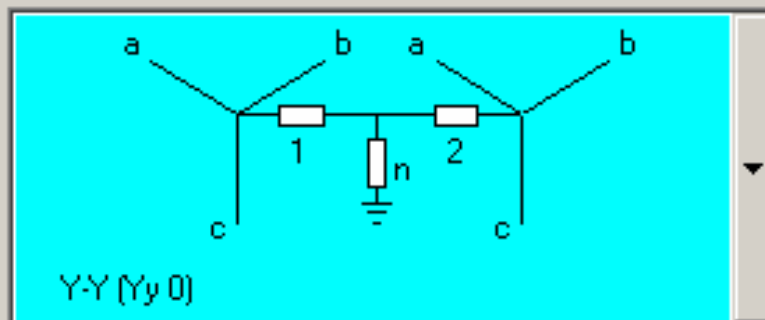
Ckt ID=

MVA1=

MVA2=

MVA3=

MVA base for per-unit quantities=



R=

X=

B=

Ro=

Xo=

Bo=

CLARK 138. kV

Tap kV=

G1\*=

B1\*=

G10\*=

B10\*=

CLARK 2 13.8 kV

Tap kV=

G2\*=

B2\*=

G20\*=

B20\*=

Neutral grounding Z (ohms)

Zg1=

+j

Zg2=

+j

Zgn=

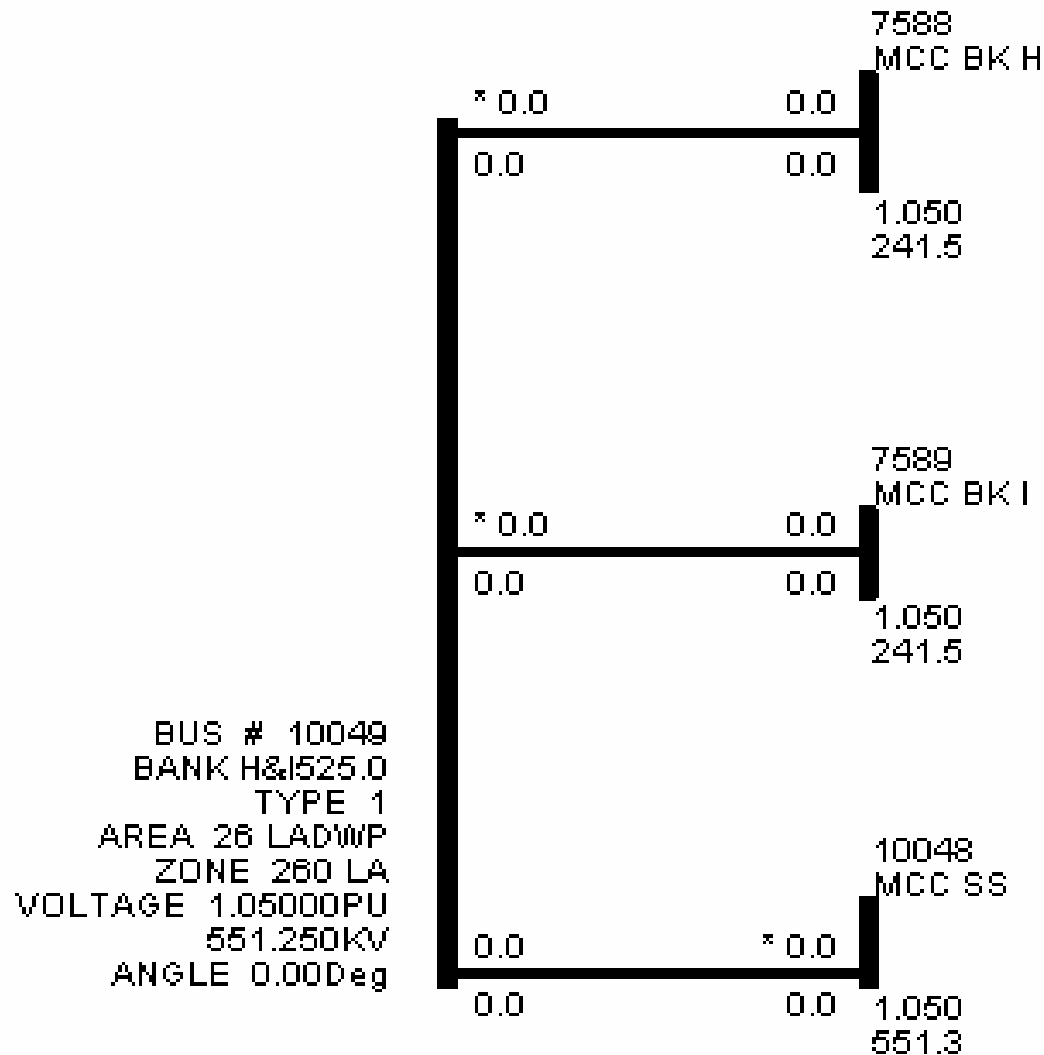
+j

\*Based on system MVA

Metered at:

Last changed Apr 03, 2006

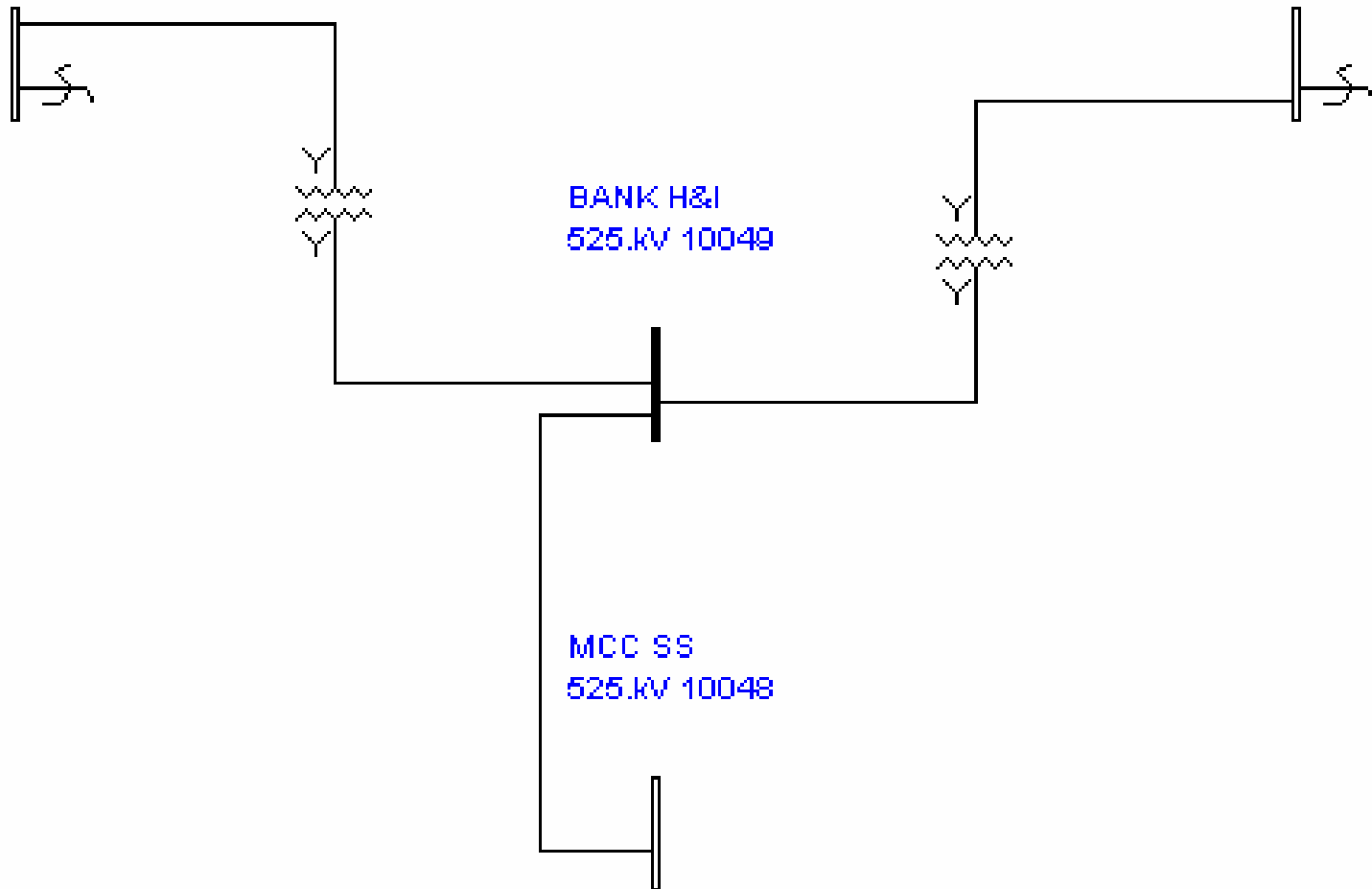
# Other Transformers



# Other Transformers

MCC BK I  
230.kV 7589

MCC BK H  
230.kV 7588



# Other Transformers

## Positive Sequence

Line R (pu)	Line X (pu)	Charging (pu)
----------------	----------------	------------------

0.00000

0.01590

0.00000

Line G,B (from)	
(pu)	(pu)

0.00000

0.00000

## Zero Sequence

R-Zero (pu)	X-Zero (pu)	B-Zero (pu)	Zero seq G,B (from) (pu)		Zero seq G,B (to) (pu)	
----------------	----------------	----------------	-----------------------------	--	---------------------------	--

0.00000

0.01620

0.00000

0.00000

0.00000

0.00000

0.00000

# Other Transformers

## 2-Winding Transformer Data

7589 MCC BK I

230.kV - 10049 BANK HI

525.kV

Name=

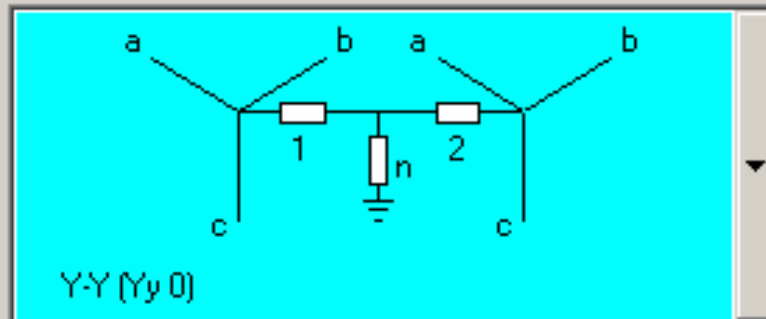
Ckt ID=

MVA1=

MVA2=

MVA3=

MVA base for per-unit quantities=



R=

X=

B=

Ro=

Xo=

Bo=

MCC BK I 230. kV

Tap kV=

G1\*=

B1\*=

G10\*=

B10\*=

BANK HI 525. kV

Tap kV=

G2\*=

B2\*=

G20\*=

B20\*=

Neutral grounding Z (ohms)

Zg1=

+j

Zg2=

+j

Zgn=

+j

\*Based on system MVA

Metered at:

Last changed Apr 03, 2006

# Other Transformers

**Shunt Unit Data**

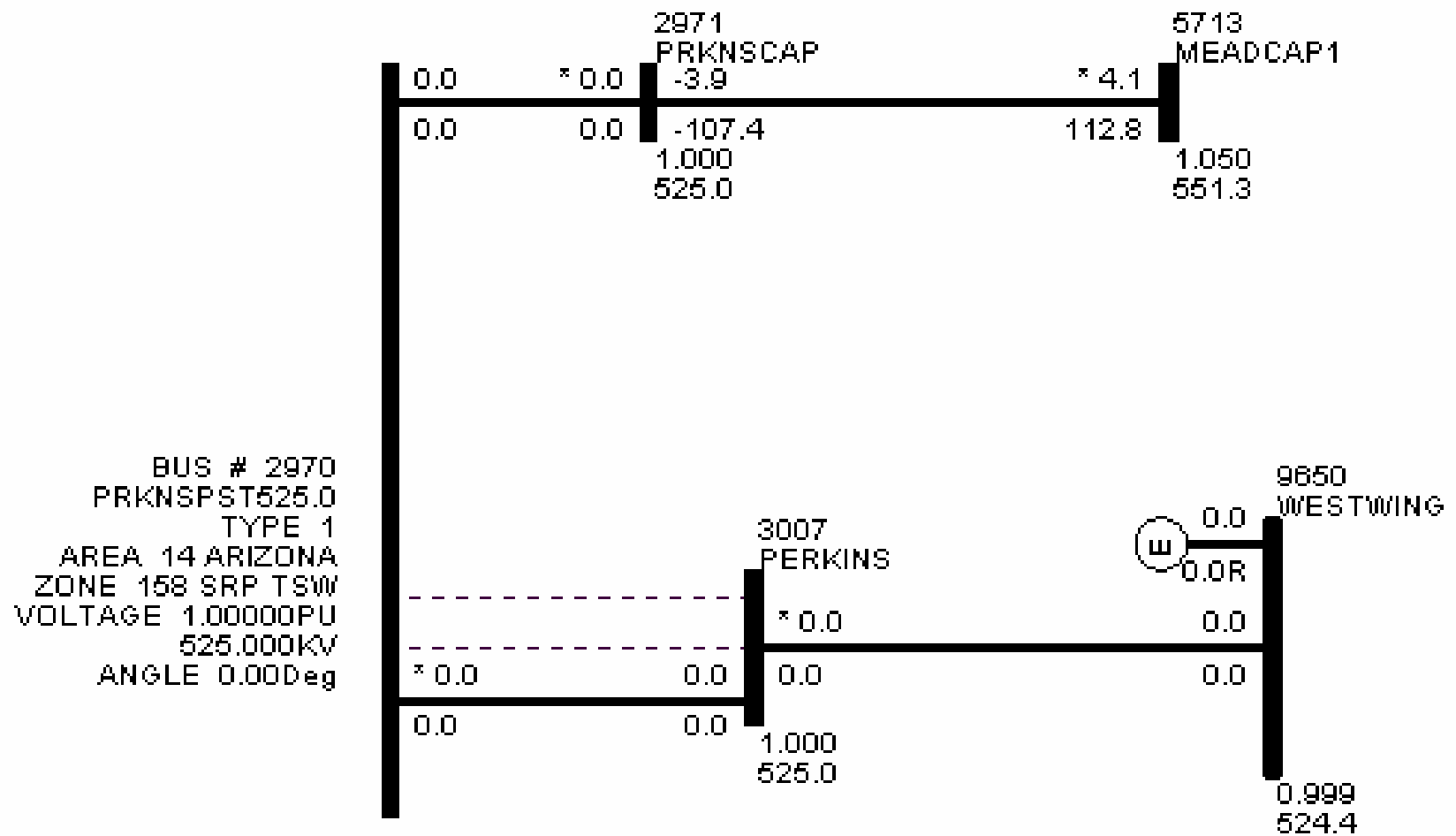
ID=

Admittances (B>0 for capacitor)

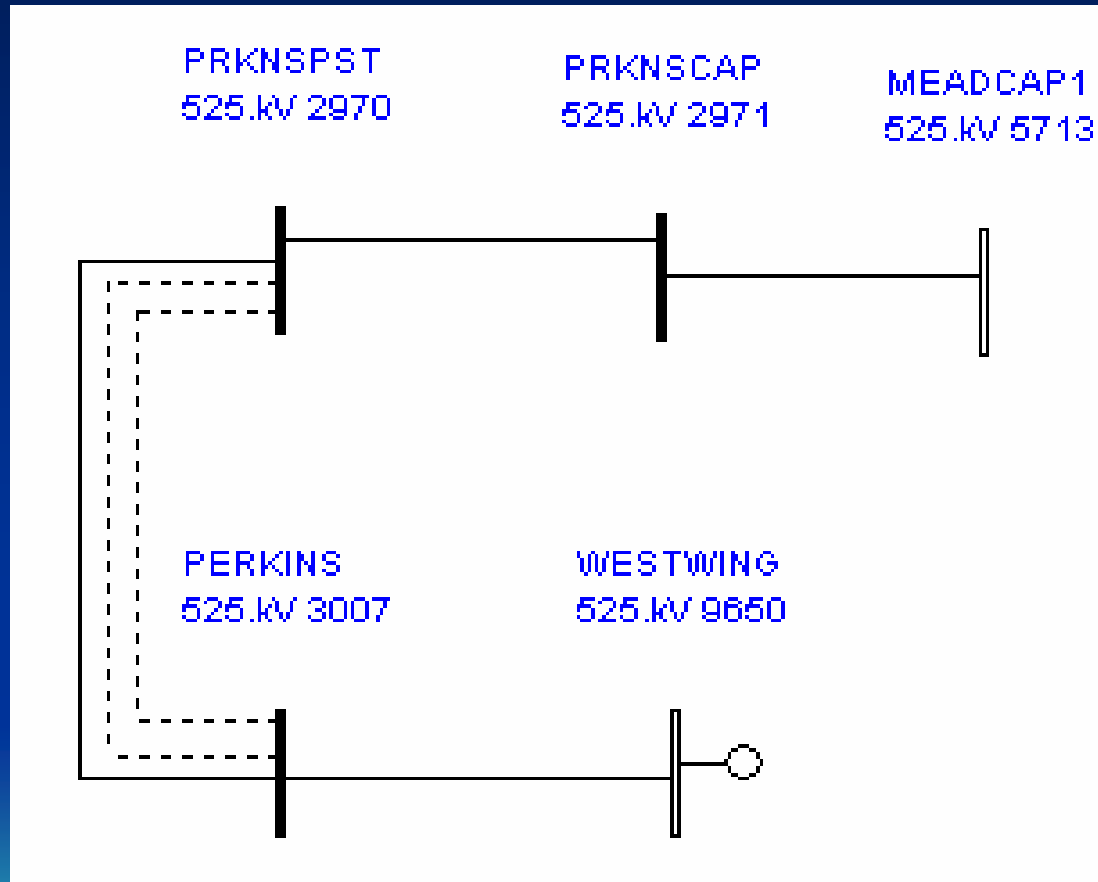
G=	<input type="text" value="0."/>	B=	<input type="text" value="0."/>	<input type="button" value="Convert"/>
G0=	<input type="text" value="0."/>	B0=	<input type="text" value="-2.4468"/>	

☐ 3-winding transformer shunt

# Other Differences – Type 2 buses



# Other Differences – Type 2 Buses





# Other Differences – Type 2 Buses

## Bus Data

Bus	Name	BuskV	Area number	Zone number
9650	WESTWING	525.	14 ARIZONA	141 APS

Owner number	Code	G-Shunt (MW)	B-Shunt (MVAR)
1	2	0.00	0.00

```
WESTWING 525] AREA 14 ZONE 141 OWNER 1 IS TYPE 2 VOLTAGE=0.99881
```

```
ARE CONNECTED TO BUS 9650 [WESTWING 525] BY IN-SERVICE ZERO IMPEDANCE LINES:
```

```
PRKNSPST 525] AREA 14 ZONE 158 OWNER 1 IS TYPE 1 VOLTAGE=1.00000
```

```
PERKINS 525] AREA 14 ZONE 158 OWNER 1 IS TYPE 1 VOLTAGE=1.00000
```

```
TAGE X----- CONTROLLING EQUIPMENT -----X STATUS
```

```
LOCAL GENERATION AT BUS 9650 [WESTWING 525] PERCENT Q= 100.0 2
```

# Other Differences – Type 2 Buses

1502	1077.4	1502	PRKNSPST 525		at 9650			type 2 bus
807.3	569.3	807.3	PERKINS 525		at 9650			

**PSS/E - Setup for Fault Calculations**

Set voltages to unity

Set tap ratios to unity ☐ Yes ☒ No

Set charging to zero ☐ Yes ☒ No

Leave shunts unchanged

Desired voltage magnitude (0.0 for present values)

Generator power factor (0.0 for present QGENs)

## Fault Simulation Options

### Prefault Voltage

- ☒ Assumed "Flat" with  
V (pu)=
- ☐ From a linear network solution
- ☐ From a Power Flow solution

### Generator Impedance

- ☒ Subtransient
- ☐ Transient
- ☐ Synchronous

### Ignore in Short Circuits

- ☒ Loads
- ☒ Transmission line G+jB
- ☒ Shunts with + seq values

### MOV-Protected Series Capacitors

- ☐ Iterate short circuit solutions
- Acceleration factor=

### Define Fault MVA As

- ☒ Current times prefault voltage
- ☐ Current times nominal voltage

- ☐ Do not change display quantity when browsing fault results
- ☐ Include outaged branches in solution report and summary

# Other Differences – Type 2 Buses

```

1. Bus Fault on:      2970 PRKNPST      525. kV 3LG
                        A PHASE          B PHASE          C PHASE
                        33223.6@ -86.7    33223.6@ 153.3    33223.6@
                        0.52177+j9.10837    0.52294+j9.11087    1.48759+j15.4226
                        THEVENIN IMPEDANCE (OHM)
                        SHORT CIRCUIT MVA= 30211.1      X/R RATIO= 17.4567      R0/X1= 0.16332      X0/X1= 1.69323
  
```

```

BUS 2970 PRKNPST      525.KV AREA 14 ZONE 158 TIER 0      (PREFault V=1.000@ 0.0 PU)
VOLTAGE (KV, L-G)      >      A PHASE          B PHASE          C PHASE
BRANCH CURRENT (A) TO  >      0.000@ 0.0      0.000@ 0.0      0.000@
3007 PERKINS 525. 3L    27807.0@ 92.8      27807.0@ -27.2      27807.0@-
2971 PRKNPST 525. 1L    5421.6@ 95.5      5421.6@ -24.5      5421.6@-
CURRENT TO FAULT (A)    >      33223.6@ -86.7      33223.6@ 153.3      33223.6@
THEVENIN IMPEDANCE (OHM) >
  
```

\*\*\* FAULTED BUS IS : 2970 [PRKNPST 525] \*\*\* . 0 LEVELS AWAY.

AT BUS 2970 [PRKNPST 525] AREA 14 (KV L-G) V+: / 0.000/ 0.00

THEV. R, X, X/R: POSITIVE 0.00019 0.00316 16.909

```

                        T H R E E      P H A S E      F A U L T
----- FROM -----AREA CKT I/Z      /I+/      AN(I+)      /Z+/      AN(Z+)      APP X/R
2971 [PRKNPST 525] 14 1 AMP/OHM      5340.9      -79.38      44.93      -90.00 9999.999
3007 [PERKINS 525] 14 3 AMP/OHM      29104.5      -85.93      0.00      0.00      0.000
TOTAL FAULT CURRENT (AMPS) 34416.1      -84.91
  
```

# Other Differences – Type 2 Buses

**PSS/E - Setup for Fault Calculations**

**Set classical short circuit assumptions**

Set tap ratios to unity ☒ Yes ☐ No

Set charging to zero ☒ Yes ☐ No

**Set shunts to zero in all sequences**

Desired voltage magnitude  
(0.0 for present values)

Generator power factor  
(0.0 for present QGENs)

# Other Differences – Type 2 Buses

```

*** FAULTED BUS IS : 2970 [PRKNSPST 525] ***      . 0 LEVELS AWAY.

AT BUS 2970 [PRKNSPST 525] AREA 14 (KV L-G) V+: / 0.000/ 0.00

THEV. R, X, X/R: POSITIVE 0.00019 0.00316 16.895

                                T H R E E   P H A S E   F A U L T
----- FROM -----AREA CKT  I/Z      /I+/    AN(I+)    /Z+/    AN(Z+)  APP X/R
2971 [PRKNSCAP 525] 14 1  AMP/OHM  5404.2   -84.51   44.93   -90.00 9999.999
3007 [PERKINS 525] 14 3  AMP/OHM  29325.1  -87.00    0.00    0.00  0.000
TOTAL FAULT CURRENT (AMPS) 34725.0 -86.61
  
```

1. Bus Fault on: 2970 PRKNSPST 525. kv 3LG

A PHASE		B PHASE		C PHASE	
33223.6@ -86.7		33223.6@ 153.3		33223.6@	
0.52177+j9.10837		0.52294+j9.11087		1.48759+j15.4226	

FAULT CURRENT (A @ DEG)

C PHASE

THEVENIN IMPEDANCE (OHM)

SHORT CIRCUIT MVA= 30211.1

X/R RATIO= 17.4567

R0/X1= 0.16332

X0/X1= 1.69323

2970 PRKNSPST		525.KV	AREA 14	ZONE 158	TIER 0	(PREFault V=1.000@ 0.0 PU)	
		A PHASE		B PHASE		C PHASE	
>		0.000@ 0.0		0.000@ 0.0		0.000@	
RANCH CURRENT (A) TO		>		>		>	
3007 PERKINS	525. 3L	27807.0@	92.8	27807.0@	-27.2	27807.0@	-
2971 PRKNSCAP	525. 1L	5421.6@	95.5	5421.6@	-24.5	5421.6@	-
CURRENT TO FAULT (A)		>		>		>	
THEVENIN IMPEDANCE (OHM)		>		>		>	

# Other Differences – Type 2 Buses

- Change Type 2 to Type 1

```

*** FAULTED BUS IS : 2970 [PRKNPST 525] *** . 0 LEVELS AWAY.

AT BUS 2970 [PRKNPST 525] AREA 14 (KV L-G) V+: / 0.000/ 0.00

THEV. R, X, X/R: POSITIVE 0.00019 0.00324 17.016

                                T H R E E   P H A S E   F A U L T
----- FROM -----AREA CKT  I/Z      /I+ /   AN(I+)   /Z+ /   AN(Z+)   APP X/R
2971 [PRKNPST 525] 14 1 AMP/OHM 5404.2 -84.51 44.93 -90.00 9999.999
3007 [PERKINS 525] 14 3 AMP/OHM 28487.5 -87.04 0.00 0.00 0.000
TOTAL FAULT CURRENT (AMPS) 33887.3 -86.64
    
```

```

1. Bus Fault on:      2970 PRKNPST      525. kV 3LG

                                FAULT CURRENT (A @ DEG)
                                A PHASE      B PHASE      C PHASE
                                33223.6@ -86.7    33223.6@ 153.3    33223.6@
                                0.52177+j9.10837    0.52294+j9.11087    1.48759+j15.4226
                                THEVENIN IMPEDANCE (OHM)

                                SHORT CIRCUIT MVA= 30211.1      X/R RATIO= 17.4567      R0/X1= 0.16332      X0/X1= 1.69323

-----
BUS 2970 PRKNPST      525.KV AREA 14 ZONE 158 TIER 0      (PREFault V=1.000@ 0.0 PU)
VOLTAGE (KV, L-G)      >      A PHASE      B PHASE      C PHASE
BRANCH CURRENT (A) TO  >      0.0000@ 0.0      0.0000@ 0.0      0.0000@
3007 PERKINS 525. 3L      27807.0@ 92.8      27807.0@ -27.2      27807.0@-
2971 PRKNPST 525. 1L      5421.6@ 95.5      5421.6@ -24.5      5421.6@-
CURRENT TO FAULT (A)    >
THEVENIN IMPEDANCE (OHM) >      33223.6@ -86.7      33223.6@ 153.3      33223.6@
    
```

# Access of Participants

- APS - Cape
- SRP – Aspen
- WAPA – PTI and Aspen
- TEP/Unisource – Aspen
- SWTC – Aspen
- IID – Aspen
- EPE – Aspen
- PNM – Aspen
- NPC/SPPC – Aspen



# Outside Cases

- STEP – PTI
- PVD2 SCWG – PTI
- CCPG – Aspen and CAPE
- Utah Area - ?
- WECC – PTI and PSLF
- Others?





# Check Format Conversions

- Aspen Version 10.6 Programs

**EPC-ASPEN Data Conversion**

**EPCPF-ASPEN Data Conversion**

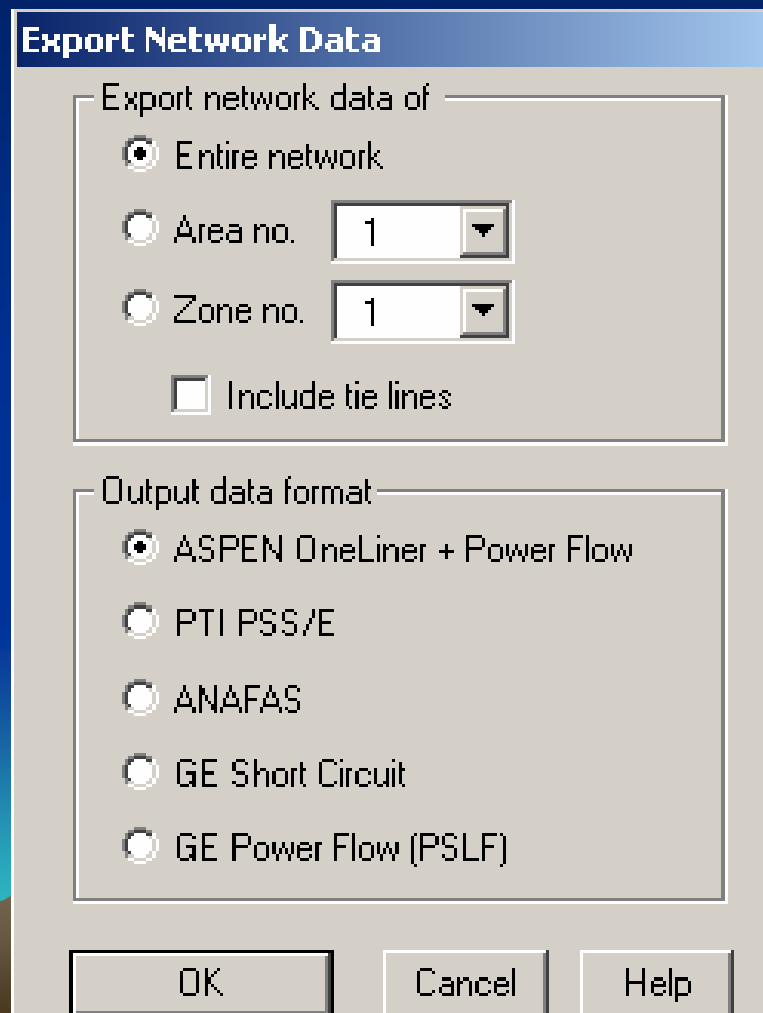
**PSS/E-ASPEN Data Conversion**

**ELECTROCON-ASPEN Data Conversion**



# Check Format Conversions

- Aspen Version 10.6 Programs



The image shows a screenshot of the 'Export Network Data' dialog box from an Aspen software application. The dialog box has a title bar with the text 'Export Network Data'. It contains two main sections: 'Export network data of' and 'Output data format'. In the 'Export network data of' section, there are three radio buttons: 'Entire network' (which is selected), 'Area no.' (with a dropdown menu showing '1'), and 'Zone no.' (with a dropdown menu showing '1'). Below these is a checkbox labeled 'Include tie lines' which is currently unchecked. In the 'Output data format' section, there are five radio buttons: 'ASPEN OneLiner + Power Flow' (selected), 'PTI PSS/E', 'ANAFAS', 'GE Short Circuit', and 'GE Power Flow (PSLF)'. At the bottom of the dialog box are three buttons: 'OK', 'Cancel', and 'Help'.

**Export Network Data**

Export network data of

☒ Entire network

☐ Area no. 1

☐ Zone no. 1

☐ Include tie lines

Output data format

☒ ASPEN OneLiner + Power Flow

☐ PTI PSS/E

☐ ANAFAS

☐ GE Short Circuit

☐ GE Power Flow (PSLF)

OK Cancel Help

# Case to Use for Checks

- DPV2 in Aspen?
- DPV2 in PSS/E?
- DPV2 in CAPE?
- Others?



# Other Issues for File Format

- Program Versions?
- Others?

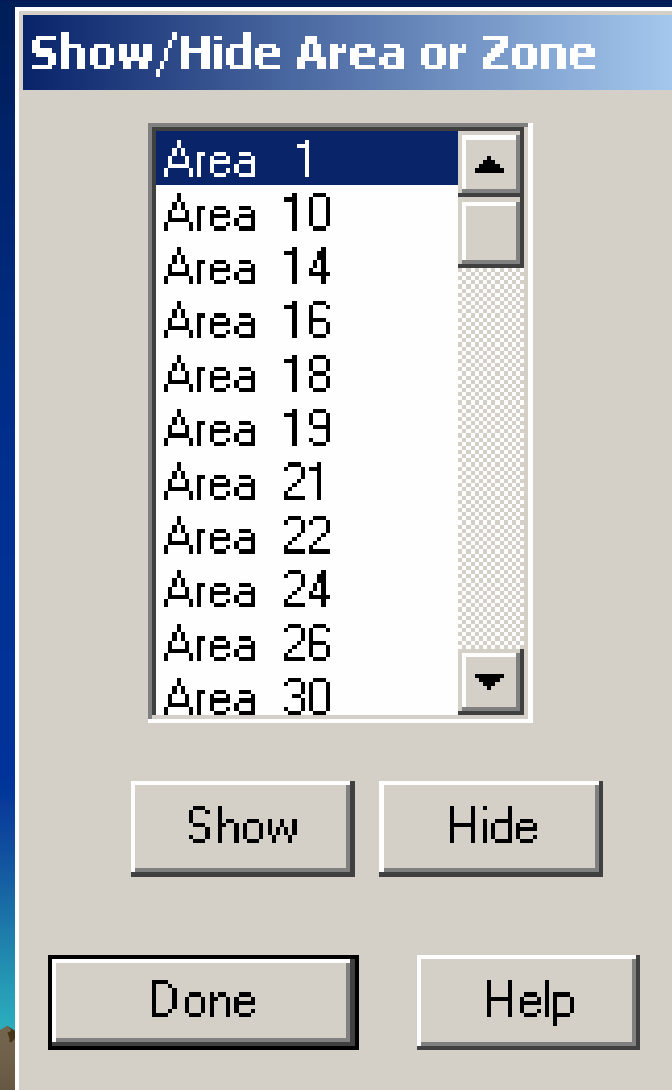


# Identification of Participant's Information

- Zones
- Areas
- In Service Dates
- Others in Participant's Area
- Other Items



# Zones and Areas



# Zones and Areas

**Bus Info** [X]

Bus Data | Breaker Data

Name=  Nominal kV=

Bus no.=

Location=

Area no.=  Zone no.=

Bus type

☐ Tap bus ☐ Transformer Midpoint

Symbol style

☒ Show ID on one-line diagram

State plane coordinates

X =  Y =

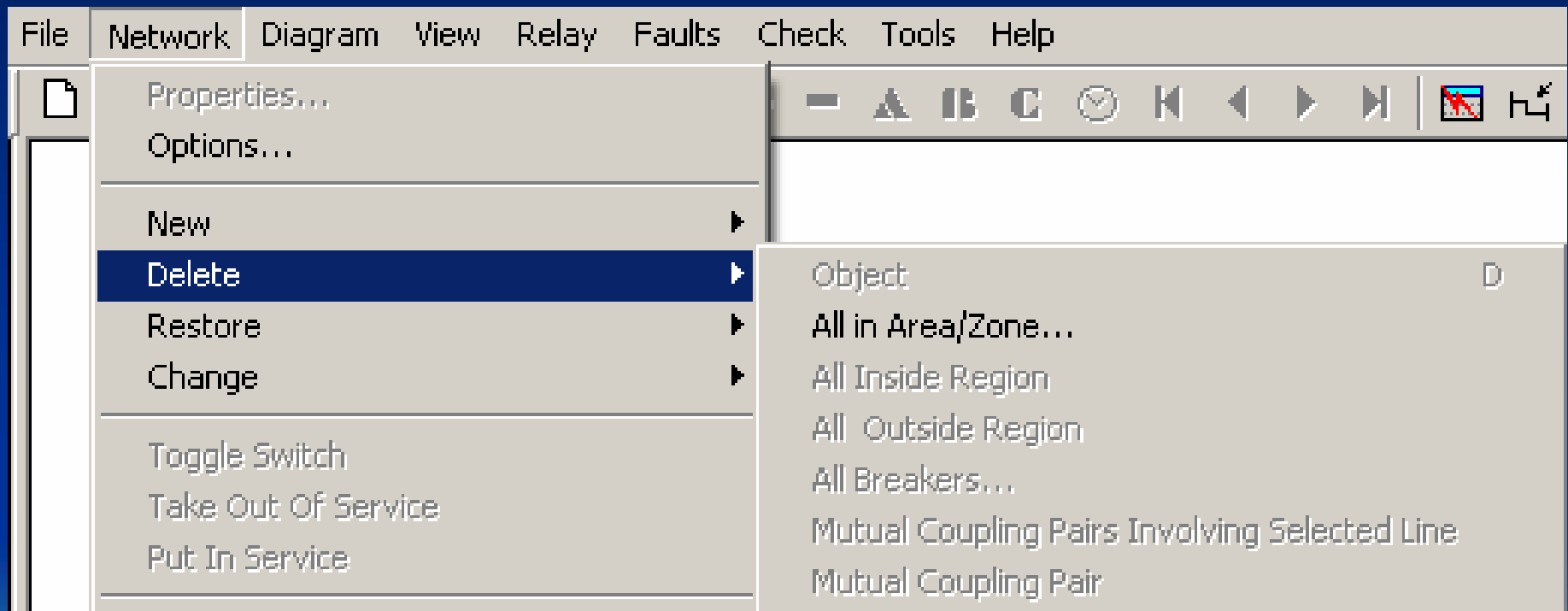
Substation group no. =

Comments=

Last changed Apr 03, 2006

OK Cancel

# Areas and Zones





# Areas and Zones

**Export Network Data**

Export network data of —

☒ Entire network

☐ Area no.

☐ Zone no.

☐ Include tie lines

Output data format —

☒ ASPEN OneLiner + Power Flow

☐ PTI PSS/E

☐ ANAFAS

☐ GE Short Circuit

☐ GE Power Flow (PSLF)

# In Service Dates

- Option in Cape, but not Aspen
- Out of Service in Aspen with note or separate file?
- Nothing with a specific date?



# Others in Participant Area

- Equivalence out
- Put in separate zone
- Others?



# Other Participant Identification Information

- Others?



# Equivalents

- Methods
- Check of Methods
- Number of Buses to Equivalence
- Transfer Impedances
- Others



# Equivalent Methods

- Aspen
- Cape
- Others such as PTI or limit to these two programs?



# Equivalent Calculations

- <http://www.ipst.org/TechPapers/2003/IPST03Paper1-4.pdf>
- Generation of Multi-Port network equivalents in section III.
- <http://72.14.207.104/search?q=cache:dLBGjKZ7tlgJ:www.elsam-eng.com/pdf/ea11eng.pdf+PowerFactory+network+reduction&hl=en&gl=us&ct=clnk&cd=3>
- Network Reduction using Modeal Network Reduction Technique on page 2



# Equivalents Calculations

- <http://ic.net/~eii/cape/scr.htm#methods>
- Two Network Reduction Methods in CAPE





# Check Methods

- Person to Volunteer for Aspen
- Person to Volunteer for CAPE?
- Coordinate efforts so the same area is equivalenced and compared
- Check fault current levels after equivalence
- Equivalence all elements
- Report results at next meeting?



# 3 Aspen Equivalent Options

## Create Network Equivalent



What do you want to do?

- ☒ Reduce the entire network to a small number of buses.
- ☐ Delete a portion of the network and reduce the rest to the boundary buses.
- ☐ Reduce a portion of the network to the boundary buses. Leave the rest of the network unchanged.

NOTE: A new binary file will be created with the equivalent network.  
Your original data file will remain unchanged.

# Aspen Equivalents – option 1

Specify the equivalent

26304	ACACIA	34.5kV
5710	ADELANT	525.kV
92009	AGUAFA	69.kV
92012	AGUAFR	230.kV
92010	AGUAFR N	69.kV
2011	AGUAFRST	69.kV
92014	AGUAFRT1	13.8kV
92013	AGUAFRT1	100.kV
92016	AGUAFRT2	13.8kV
92015	AGUAFRT2	100.kV
92017	AGUAFRT3	100.kV
92018	AGUAFRU1	13.8kV
92019	AGUAFRU2	13.8kV
92020	AGUAFRU3	18.kV
92021	AGUAFRU4	13.2kV
92022	AGUAFRU5	13.8kV
92023	AGUAFRU6	13.8kV
9710	AIRWAY	230.kV
26361	AIRWAY 6361	69.kV
92023	AIRWAY 92023	69.kV

Count=1480

Search for name:

>> ...

>

<

<< ...

Sort by

☒ Name

☐ Number

Buses to be retained

Count=0

Store

Recall

☒ Retain all equipment at boundary buses

# Aspen Equivalents – Option 1

**Add to list**

☒ All buses

☐ Buses in area(s)

☐ Buses in zone(s)

☐ Buses from file

☐ Buses in vicinity of the selected bus on the 1-line  
Tiers =

----- Additional selection criteria -----

Add all neighbor buses within tiers =

Bus numbers =

Nominal kVs =

Enter items and/or ranges in edit boxes separated by comma. For example: 1,3, 4-7

# Aspen Equivalents – Option 1

Ready to create equivalent file

Entire network will be reduced to 308 bus(es) listed below.

Existing equipment at these buses will be retained.

5710	ADELANT 525.kV
92012	AGUAFR 230.kV
2011	AGUAFRST 69.kV
92014	AGUAFRT1 13.8kV
92013	AGUAFRT1 100.kV
92016	AGUAFRT2 13.8kV
92015	AGUAFRT2 100.kV
92017	AGUAFRT3 100.kV
92018	AGUAFRU1 13.8kV
92019	AGUAFRU2 13.8kV
92020	AGUAFRU3 18.kV
92021	AGUAFRU4 13.2kV

Output file name (\*.olr):

C:\convert\eq1

Browse

Do not save fict. branches and sources having impedance greater than: 99. p.u.

Transfer all existing annotations to the equivalent file ☐

# Aspen Equivalents – Option 2

Select Network

Network to reduce

26304	ACACIA	34.5kV
5710	ADELANT	525.kV
92009	AGUAFA	69.kV
92012	AGUAFR	230.kV
92010	AGUAFR N	69.kV
2011	AGUAFRST	69.kV
92014	AGUAFRT1	13.8kV
92013	AGUAFRT1	100.kV
92016	AGUAFRT2	13.8kV
92015	AGUAFRT2	100.kV
92017	AGUAFRT3	100.kV
92018	AGUAFRU1	13.8kV
92019	AGUAFRU2	13.8kV
92020	AGUAFRU3	18.kV
92021	AGUAFRU4	13.2kV
92022	AGUAFRU5	13.8kV
92023	AGUAFRU6	13.8kV
9710	AIRWAY	230.kV

Count=1480

Search for name:

Network to delete

Store Recall

>>...><...<<

Sort by

☒ Name

☐ Number

Count=0

Search for name:

# Aspen Equivalents – Option 2

Specify the boundary buses

26304	ACACIA	34.5kV
5710	ADELANT	525.kV
92009	AGUAFA	69.kV
92012	AGUAFR	230.kV
92010	AGUAFR N	69.kV
2011	AGUAFRST	69.kV
92014	AGUAFRT1	13.8kV
92013	AGUAFRT1	100.kV
92016	AGUAFRT2	13.8kV
92015	AGUAFRT2	100.kV
92017	AGUAFRT3	100.kV
92018	AGUAFRU1	13.8kV
92019	AGUAFRU2	13.8kV
92020	AGUAFRU3	18.kV
92021	AGUAFRU4	13.2kV
92022	AGUAFRU5	13.8kV
92023	AGUAFRU6	13.8kV
9710	AIRWAY	230.kV
26361	AIRWAY 6361	69.kV
26362	AIRWAY 26362	69.kV

Count=1317

Search for name:



Sort by

☒ Name

☐ Number

Boundary buses

2092	BLYTHE	161.kV
2903	CON GORG	10.kV
2890	COTTONWD	230.kV
16044	LAUGHLIN	69.kV
10048	MCC SS	525.kV
40037	MEAD S.	230.kV
16639	MERCHANT	230.kV
9420	MIDWAY	525.kV
9445	MOE CP1	525.kV
9500	PALO VRD	525.kV
2624	PARKER	230.kV
2067	RS F SCE	230.kV
7535	SYL BK E	230.kV
7536	SYL BK F	230.kV
7537	SYL BK G	230.kV

Count=17

Store

Recall

☐ Retain all equipment at boundary buses

# Aspen Equivalents – Option 2

Ready to create equivalent file

1334 bus(es) in area(s):

1,10,14,16,18,19,21,22,26,30,65,70

and zone(s):

1,61,62,63,64,65,66,67,68,69,100,140,141,150,151,152,153,154,156,157,  
158,159,181,182,183,184,185,186,188,189,190,191,210,227,260,261,263,300,657,700,  
790

will be reduced to 17 boundary buses listed below.

The rest of the system will be deleted.

2092	BLYTHE 161.kV
2903	CON GORG 10.kV
2890	COTTONWD 230.kV
16044	LAUGHLIN 69.kV
10048	MCC SS 525.kV

Output file name (\*.olr):

C:\convert\

Browse

Do not save fict. branches and sources having impedance greater than: 99. p.u.

Transfer all existing annotations to the equivalent file ☐



# Aspen Equivalents – Option 3

**Select Network** [X]

Network to reduce

26304	ACACIA	34.5kV
5710	ADELANT	525.kV
92009	AGUAFA	69.kV
92012	AGUAFR	230.kV
92010	AGUAFR N	69.kV
2011	AGUAFRST	69.kV
92014	AGUAFRT1	13.8kV
92013	AGUAFRT1	100.kV
92016	AGUAFRT2	13.8kV
92015	AGUAFRT2	100.kV
92017	AGUAFRT3	100.kV
92018	AGUAFRU1	13.8kV
92019	AGUAFRU2	13.8kV
92020	AGUAFRU3	18.kV
92021	AGUAFRU4	13.2kV
92022	AGUAFRU5	13.8kV
92023	AGUAFRU6	13.8kV
9710	AIRWAY	230.kV

Count=1480      Search for name:

>>...      >      <      ...<<

Sort by  
☒ Name  
☐ Number

Network to be left unchanged

Store      Recall

Count=0      Search for name:

# Aspen Equivalents – Option 3

**Select Network** [X]

Network to reduce

26304	ACACIA	34.5kV
5710	ADELANT	525.kV
92009	AGUAFA	69.kV
92010	AGUAFR N	69.kV
9710	AIRWAY	230.kV
26361	AIRWAY 6361	69.kV
26362	AIRWAY 26362	69.kV
26363	AIRWAY 26363	69.kV
1	ALAMEDA	34.5kV
8361	ALAMITO1	230.kV
8362	ALAMITO2	230.kV
3040	ALAMT1 G	18.kV
3041	ALAMT2 G	18.kV
3042	ALAMT3 G	18.kV
3043	ALAMT4 G	18.kV
3044	ALAMT5 G	20.kV
3045	ALAMT6 G	20.kV
8071	ALL C1G	18.kV

Count=1173 Search for name:

Network to be left unchanged

Store Recall

92012	AGUAFR	230.kV
2011	AGUAFRST	69.kV
92014	AGUAFRT1	13.8kV
92013	AGUAFRT1	100.kV
92016	AGUAFRT2	13.8kV
92015	AGUAFRT2	100.kV
92017	AGUAFRT3	100.kV
92018	AGUAFRU1	13.8kV
92019	AGUAFRU2	13.8kV
92020	AGUAFRU3	18.kV
92021	AGUAFRU4	13.2kV
92022	AGUAFRU5	13.8kV
92023	AGUAFRU6	13.8kV
2029	ALEXANDR	230.kV
2039	ANDERSON	230.kV
3232	ARLINGTON	525.kV
92103	BRADY	115.kV

Count=307 Search for name:

>>... > < ...<<

Sort by  
☒ Name  
☐ Number

# Aspen Equivalents – Option 3

**Specify the boundary buses**

26304	ACACIA	34.5kV
5710	ADELANT	525.kV
9710	AIRWAY	230.kV
26361	AIRWAY 6361	69.kV
26362	AIRWAY 26362	69.kV
26363	AIRWAY 26363	69.kV
1	ALAMEDA	34.5kV
8361	ALAMITO1	230.kV
8362	ALAMITO2	230.kV
3040	ALAMT1 G	18.kV
3041	ALAMT2 G	18.kV
3042	ALAMT3 G	18.kV
3043	ALAMT4 G	18.kV
3044	ALAMT5 G	20.kV
3045	ALAMT6 G	20.kV
8071	ALL C1G	18.kV
8072	ALL C2G	18.kV
8074	ALL C3G	18.kV
8075	ALL C4G	18.kV
8076	ALL C5G	18.kV

Count=1117

Search for name:

>

<

Sort by

☒ Name

☐ Number

Boundary buses

92009	AGUAFA	69.kV
92010	AGUAFR N	69.kV
9116	ALLEGTAP	525.kV
2092	BLYTHE	161.kV
2094	BOUSE	161.kV
2115	BUCKEYTP	230.kV
2130	CASAGRND	115.kV
2169	COOLIDGE	115.kV
2170	COOLIDGE	230.kV
10086	CRYS CP1	525.kV
40011	DAVIS 1G	13.8kV
40012	DAVIS 2G	13.8kV
40013	DAVIS 3G	13.8kV
40014	DAVIS 4G	13.8kV
40015	DAVIS 5G	13.8kV

Count=56

Store Recall

☐ Retain all equipment at boundary buses

# Aspen Equivalents – Option 3

Ready to create equivalent file

1173 bus(es) in area(s):

1,10,16,18,19,21,22,24,26,30,65,70

and zone(s):

1,61,62,63,64,65,66,67,68,69,100,181,182,183,184,185,186,188,189,190,

191,210,227,240,244,246,247,248,250,252,254,260,261,263,300,657,700,790,999

will be reduced to 56 boundary buses listed below.

The rest of the system will remain unchanged.

92009 AGUAFA 69.kV

92010 AGUAFR N 69.kV

9116 ALLEG TAP 525.kV

2092 BLYTHE 161.kV

2094 BOUSE 161.kV

2115 BUCKEYTP 230.kV

Output file name (\*.olr):

C:\convert\

Browse

Do not save fict. branches and sources having impedance greater than: 99. p.u.

Transfer all existing annotations to the equivalent file ☐

# Equivalent Issues

- How many buses back do we want to equivalence?
- Do we want to include transfer impedances?
- Other issues?



# Cases to Use

- Case for Checking Format Conversions
- Case for Checking Equivalents
- Cases to use for combined case



# Case for Format and Equivalent Checks

- DPV2 Case?
- Converted in Aspen format?
- Converted in CAPE format?
- Issues of conversion from PSS/E to Aspen and PSS/E to CAPE giving 2 different cases for the conversion
- Is there a single case in ASPEN and CAPE that can be used for comparisons?



# Cases to Use for Combined Case

- DPV2 Case or is it included in NPC case?
- Internal Company cases?
- A specific year case?
- Other cases?





# Determine Plan of Work

- How to Combine Cases
- Date for Submitting Cases
- Formats for Combined Case



# How to Combine Cases

- Individual Person
- Multiple People
- Single Contacts of Participants
- Others



# Individual Person

- Resources required (time) – Volunteers?



# Multiple People

- Two companies combine their zones into one case
- Two people can work together as pairs in parallel
- Combined cases put together by another person with 2 at a time
- One person put the combined combined cases together



# Multiple People

Updated DPV2 Case

APS Case

SRP Case

WAPA DSW Case

TEP/Unisource Case

SWTC Case

IID Case

EPE Case

PNM Case

NPC/SPPC Case

# Multiple People – 7 required

- APS and SRP – case 1 (APS or SRP)
- TEP and SWTC – case 2 (TEP or SWTC)
- EPE and PNM – case 3 (EPE or PNM)
- NPC, WAPA, IID – case 4 (NPC, WAPA, or IID)
- Case 1 and Case 2- case 5 (SRP or SWTC or APS or TEP)
- Case 3 and Case 4 – case 6 (PNM or WAPA or IID or EPE or NPC)
- Case 5 and Case 6 – case 7 or final case – anyone that did not perform one of the other conversions



# Single Contacts of Participants

- Should be people that work with the short circuit case
- Contacts may not necessarily be the person listed on website
- For example, Ron at APS will probably be the contact for the technical work, but another APS employee listed as primary contact on website for the working group



# Other Ideas for Combining Cases

- Others?
- Checking of results?





# Date for Submitting Cases

- 5/15/06 or other date?
- On website by 5/17/06 or other date?



# Formats for Combined Case

- Aspen
- CAPE? – SWAT member APS uses
- PTI? – adjacent STEP members use
- Use multiple formats only after case 7 developed?



# Determine Location of Next Meeting

- Casa Grande on May 18 – Mark E. volunteered to setup at February 2006 meeting



# Website address

- <http://www.oatioasis.com/WALC/WALCdocs/page1.htm>

