

2008 VACAR Drought Study

The purpose of this study is to assess the potential impact of drought conditions on the operations of the systems within VACAR during the upcoming spring and summer seasons.

Case and Scenario Definition

Utilizing the most recent SERC NTSG OASIS Support Study base cases for the 2008 spring and 2008 summer seasons, a base case and two drought cases were developed as follows:

- Base Case – Normal generation dispatch with no drought impacts.
- Expected Drought Case – Projected generation dispatch with expected drought impacts.
- Moderate Drought Case – Projected generation dispatch with potential constrained operation of hydro and thermal units due to moderate drought conditions.

Three scenarios were analyzed to assess the impact of imports into the VACAR sub-region to replace the drought impacted generation reductions. Scenario 1 simulated power transfers to replace drought impacted generation transitioning from Base Case conditions to Expected conditions. Scenario 2 simulated power transfers to replace additional drought impacted generation transitioning from Expected conditions to Moderate conditions. Scenario 3 simulated power transfers to replace additional drought impacted generation transitioning from Moderate conditions to Severe conditions. The table below summarizes the replacement power required by VACAR member companies:

Drought-related Import Replacement Power¹			
Scenario	Study Case Used	2008 Spring Import Requirement	2008 Summer Import Requirement
1	Base Case	275 MW	275 MW
2	Expected Drought	299 MW	1768 MW
3	Moderate Drought	1208 MW	2736 MW

¹ For a breakdown of replacement power by company, see Appendix A.

For each scenario, the replacement power was imported from each of the five different areas listed below:

- MISO/CommEd: MISO control areas, Commonwealth Edison
- PJM West: Allegheny, AEP, Dayton, Duquesne
- PJM Mid-Atlantic: historic PJM
- TVA
- Southern Company

Procedure

Siemens PTI PSS/E version 30.2 was used to create the three study base cases for 2008 Spring and Summer as outlined above.

Siemens PTI MUST version 8.3 was used to run FCITC Analysis on each drought study base case. Typical monitored element, contingency element, and subsystem MUST input files were used for this analysis. All replacement power for the FCITC analysis was imported from each of the five different control areas or combinations of control areas described above. Load was scaled in the exporting area(s) to allow the generation to be available for export to VACAR.

Limiting constraints with Transfer Distribution Factors (TDFs) greater than or equal to 3 percent are discussed in the report below. The results were reviewed by all VACAR member companies and invalid results were removed. The table below summarizes the transfer limits found for each scenario.

2008 Spring			
Export Region	Scenario 1	Scenario 2	Scenario 3
MISO/CommEd	No limit	No limit	No limit
PJM West	No limit	No limit	No limit
PJM Mid-Atlantic	No limit	No limit	No limit
TVA	No limit	No limit	500 MW
Southern Company	No limit	No limit	No limit
2008 Summer			
Export Region	Scenario 1	Scenario 2	Scenario 3
MISO/CommEd	No limit	No limit	1800 MW
PJM West	No limit	No limit	1800 MW
PJM Mid-Atlantic	No limit	No limit	2200 MW
TVA	No limit	No limit	1800 MW
Southern Company	No limit	No limit	1600 MW

For the 2008 Spring, no limits were identified for Scenario 1 or 2. In Scenario 3, which simulates VACAR imports under severe drought conditions, import from TVA is limited to 500 MW by Southern Company's Gaston-Roopville 230 kV line for an outage of Farley-Raccoon Creek 230 kV line.

For 2008 Summer, no limits were identified for Scenario 1 or 2. In Scenario 3, which has an import test level of 2736 MW, imports are limited from all five exporting areas. Imports from MISO/Commonwealth, PJM West, and PJM Mid-Atlantic are limited to 1800 MW, 1800 MW, and 2200 MW, respectively, by Axton-Danville 138 kV line. Imports from TVA and Southern Company TVA are limited to 1800 MW and 1600 MW, respectively, by Duke's Parkwood 500/230 kV bank 6 for an outage of Parkwood 500/230 kV bank 5.

Individual Assessments

2008 Spring

Dominion Virginia Power

Expected Scenario – No generation changes were made, and no additional imports were added for the Dominion Virginia Power territory in this scenario. No DVP facilities were found to limit the transfers to VACAR from the five different sources at the 275 MW test level.

Moderate Scenario – No generation changes were made, and no additional imports were added for the Dominion Virginia Power territory in this scenario. No DVP facilities were found to limit the transfers to VACAR from the five different sources at the 299 MW test level.

Severe Scenario – All Dominion Hydro generating units (a total of 564 MW) were removed from dispatch, and no additional imports were added for the Dominion Virginia Power territory in this scenario. No DVP facilities were found to limit the transfers to VACAR from the five different sources at the 1,208 MW test level.

Duke Energy

Generation reductions to simulate three drought condition scenarios included hydro and fossil units. The spring base case includes 3,500 MW of scheduled generation maintenance outages, two 230/100 kV bank outages, one 230 kV line outage, and five 100 kV line outages. The Duke-TVA 161 kV tie line is outaged in the case as well.

Expected Scenario – For the Expected Scenario study, 700 MW of hydro generation was made unavailable for dispatch. But since only 191 MW of that hydro generation was actually dispatched in the base case, Duke's hydro generation was reduced by 191 MW for the Expected Scenario study. The overall VACAR reductions for the Expected Scenario were 275 MW, so Duke was responsible for much of that total reduction. No Duke facilities were found to limit transfers into VACAR from the five sources tested.

Moderate Scenario – The Expected Case served as the starting point for the Moderate Scenario study. The 191 MW reduction studied as part of the Expected Scenario study was replaced by Duke internal generation to create the Expected Case. Duke's fossil generation was reduced by 65 MW for the Moderate Scenario study. The overall VACAR reductions for the Moderate Scenario were 299 MW. No Duke facilities were found to limit transfers into VACAR from the five sources tested.

Severe Scenario – The Moderate Case served as the starting point for the Severe Scenario study. The hydro and fossil reductions studied in the previous two scenarios were replaced by Duke internal generation to create the Moderate Case. Duke's fossil generation was reduced by 102 MW for the Severe Scenario study. The overall VACAR reductions for the Severe Scenario were 1,208 MW. No Duke facilities were found to limit transfers into VACAR from the five sources tested.

Progress Energy

Expected Scenario – No generation changes were made, and no additional imports were added in this scenario for the Progress Energy control areas CPLE and CPLW. Therefore, from a Progress Energy perspective, the Expected case is the same as the Revised Base case. No Progress Energy facilities were found to limit the transfers to VACAR from the five different sources with a 275 MW test level.

Moderate Scenario – All Progress Energy Hydro units (110 MW in CPLE and 105 MW in CPLW) were turned off. In order to build the Moderate case, replacement power came from internal generation for CPLE and CPLW plus part of a firm network DNR for CPLW. The DNR power was moved from CPLE to CPLW with the interchanges adjusted accordingly. No Progress Energy facilities were found to limit the transfers to VACAR from the five different sources with a 299 MW test level.

Severe Scenario – Progress Energy turned off two fossil units (164 MW) in CPLE and nothing in CPLW. No additional imports were added for this scenario. No Progress Energy facilities were found to limit the transfers to VACAR from the five different sources with a 1208 MW test level.

South Carolina Electric & Gas

Generation reductions to simulate the three Drought Scenarios included Fossil, Hydro and Pumped Storage units.

Expected Scenario – No generation changes were made to the base case to build the Expected Case; therefore no additional imports were required for South Carolina Electric & Gas Company (SCEG) in this scenario. No limiting facilities or outage facilities were found in SCEG's system for imports into VACAR from any of the five exporting areas.

Moderate Scenario – Hydro generation was reduced by 19 MW from the Expected Case to represent a Moderate Scenario simulation. No limiting facilities or outage facilities were found in SCEG's system for imports into VACAR from any of the five exporting areas.

Severe Scenario – Fossil generation was reduced by 150 MW and Pumped Storage was reduced by 228 MW from the Moderate Case to represent the Severe Scenario simulation. No limiting facilities or outage facilities were found in SCEG's system for imports into VACAR from any of the five exporting areas.

Santee Cooper

Generation reductions to simulate three drought condition scenarios included hydro units.

Expected Scenario – For the Expected Scenario study, 84 MW of hydro generation was made unavailable for dispatch. No Santee Cooper facilities were found to limit transfers into VACAR from the five sources tested.

Moderate Scenario - The Expected Case served as the starting point for the Moderate Scenario study. The 84 MW reduction studied as part of the Expected Scenario study was replaced by Santee Cooper internal generation to create the Expected Case. No additional generation changes were required for Santee Cooper in this scenario. No Santee Cooper facilities were found to limit transfers into VACAR from the five sources tested.

Severe Scenario – The Moderate Case served as the starting point for the Severe Scenario study. No additional generation changes were required for Santee Cooper in this scenario. No Santee Cooper facilities were found to limit transfers into VACAR from the five sources tested.

2008 Summer

Dominion Virginia Power

Expected Scenario – No generation changes were made, and no additional imports were added for the Dominion Virginia Power territory in this scenario. No DVP facilities were found to limit the transfers to VACAR from the five different sources at the 275 MW test level.

Moderate Scenario – No generation changes were made, and no additional imports were added for the Dominion Virginia Power territory in this scenario. No DVP facilities were found to limit the transfers to VACAR from the five different sources at the 1,768 MW test level.

Severe Scenario – All Dominion Hydro generating units (564 MW) were removed from dispatch, and no additional imports were added for the Dominion Virginia Power territory in this scenario. Transfers to VACAR from the five different sources were tested at the 2,736 MW level.

No DVP facilities were found to limit the transfers to VACAR from MISO, TVA, and Southern at the test level.

For the PJM West to VC transfer, DVP's Halifax-Mt. Laurel 115 kV line was found to be a limit at 2,570 MW for the loss of the Halifax-Person 230 kV tie line (DVP-CPLE). There were several other limits identified for the transfer starting at 1,880 MW limited by different facilities.

For the PJM East (Mid Atlantic) to VC transfer, DVP's Halifax-Mt. Laurel 115 kV line was found to be a limit at 2,470 MW for the loss of the Halifax-Person 230 kV tie line (DVP-CPLE). There were several other limits identified for the transfer starting at 2,270 MW limited by different facilities.

Other than limiting the north to south transfers, there are some circuit reconfiguration arrangements available depending on the system conditions to alleviate the overload of the Halifax-Mt. Laurel 115 kV line for the loss of the Halifax-Person 230 kV tie line.

Duke Energy

Generation reductions to simulate three drought condition scenarios included hydro and fossil units. As was mentioned in SCEG's write-up, a 420 MW transfer from SCEG to Duke was

modeled in all scenarios for the summer studies. There are no generation outages modeled in the base case. The Duke-TVA 161 kV tie line is outaged in the case.

Expected Scenario – For the Expected Scenario study, 700 MW of hydro generation was made unavailable for dispatch. But since only 191 MW of that hydro generation was actually dispatched in the base case, Duke’s hydro generation was reduced by 191 MW for the Expected Scenario study. The overall VACAR reductions for the Expected Scenario were 275 MW, so Duke was responsible for much of that total reduction. In all five import analyses, CPLE’s Camden-Elgin Tap 115 kV line showed up as a limit, but Duke’s DK1 Operating Guide can be used to mitigate loading on this facility.

Moderate Scenario – The Expected Case served as the starting point for the Moderate Scenario study. The 191 MW reduction studied as part of the Expected Scenario study was replaced by Duke internal generation to create the Expected Case. Duke’s fossil generation was reduced by 540 MW for the Moderate Scenario study. The overall VACAR reductions for the Moderate Scenario were 1,768 MW. No Duke facilities were found to limit transfers into VACAR from the five sources tested.

Severe Scenario – The Moderate Case served as the starting point for the Severe Scenario study. The hydro and fossil reductions studied in the previous two scenarios were replaced by Duke internal generation to create the Moderate Case. Duke’s fossil generation was reduced by 212 MW for the Severe Scenario study. The overall VACAR reductions for the Severe Scenario were 2,736 MW. Duke’s Parkwood 500/230 kV bank-6 for loss of Parkwood 500/230 kV bank-5 emerged as a limiting facility according to the following table:

Duke’s Parkwood 500/230 kV bank-6 for loss of Parkwood 500/230 kV bank-5	
<u>2736 MW Transfer Test Level</u>	<u>FCITC</u>
MISO – VACAR	2570 MW
PJM West – VACAR	No Duke limit
PJM Mid – VACAR	No Duke limit
TVA – VACAR	1880 MW
SOCO – VACAR	1640 MW

These first contingency limits on the 500/230 kV Parkwood banks have routinely surfaced in planning studies, but a permanent fix for this loading issue is not required at this time. The Parkwood station is configured such that both banks are supplied by a single 500 kV line from the Pleasant Garden station. Opening this line has the same effect as opening both 500/230 kV banks at Parkwood. Studies have shown that opening this 500 kV Pleasant Garden line to mitigate flow on these banks has no adverse effects on the system. However, implementing this mitigation plan requires relay changes to trip one bank for loss of the other (same as opening the Pleasant Garden – Parkwood 500 kV line). Planning studies indicate that this work won’t be necessary for a few years yet. Between now and that time, it may be possible to take a closer look at the ratings on the Parkwood banks to see if it can be increased, even if it is for a short time. This potential rating increase would bump up the FCITC somewhat.

Progress Energy

Expected Scenario – No generation changes were made, and no additional imports were added for the Progress Energy control areas CPLE and CPLW in this scenario. Therefore, from a Progress Energy perspective, the Expected case is the same as the Revised Base case. No Progress Energy facilities were found to limit the transfers to VACAR from the five different sources with a 275 MW test level.

Moderate Scenario – All Progress Energy Hydro units (110 MW in CPLE and 105 MW in CPLW) plus a couple Fossil units (934 MW in CPLE) were turned off. In order to build the Moderate case, replacement power came from internal generation for CPLE and part of a firm network DNR for CPLW. The DNR power was moved from CPLE to CPLW with the interchanges adjusted accordingly. No Progress Energy facilities were found to limit the transfers to VACAR from the five different sources with a 1,768 MW test level.

Severe Scenario – Progress Energy turned off one fossil unit and reduced two others by over 50 percent (1104 MW) in CPLE while doing nothing in CPLW. No additional imports were added for this scenario. No Progress Energy facilities were found to limit the transfers to VACAR from the five different sources with a 2,736 MW test level.

South Carolina Electric & Gas

Generation reductions to simulate the three Drought Scenarios included Fossil, Hydro and Pumped Storage units. A new transfer of 420 MW from Columbia Energy Center (an IPP in SCEG's system) to Duke was included in the base case for all reserved timeframes. This is a new transmission service and will be included in all of SCEG's models except for cases built for the April and May timeframe.

Expected Scenario – No generation changes were made to the base case to build the Expected Case; therefore no additional imports were required for South Carolina Electric & Gas Company (SCEG) in this scenario. No limiting facilities or outage facilities were found in SCEG's system for imports into VACAR from any of the five exporting areas.

Moderate Scenario – Hydro generation was reduced by 79 MW from the Expected Case to represent a Moderate Scenario simulation. No limiting facilities or outage facilities were found in SCEG's system for imports into VACAR from any of the five exporting areas.

Severe Scenario – Fossil generation was reduced by 312 MW and Pumped Storage was reduced by 544 MW from the Moderate Case to represent the Severe Scenario simulation. No limiting facilities or outage facilities were found in SCEG's system for imports into VACAR from any of the five exporting areas.

Santee Cooper

Generation reductions to simulate three drought condition scenarios included hydro units.

Expected Scenario – For the Expected Scenario study, 84 MW of hydro generation was made unavailable for dispatch. No Santee Cooper facilities were found to limit transfers into VACAR from the five sources tested.

Moderate Scenario - The Expected Case served as the starting point for the Moderate Scenario study. Non-firm load in the case was reduced to replace the 84 MW reduction studied as part of the Expected Scenario study to create the Expected Case. No additional generation changes were required for Santee Cooper in this scenario. No Santee Cooper facilities were found to limit transfers into VACAR from the five sources tested.

Severe Scenario – The Moderate Case served as the starting point for the Severe Scenario study. No additional generation changes were required for Santee Cooper in this scenario. No Santee Cooper facilities were found to limit transfers into VACAR from the five sources tested.

Appendix A

VACAR Drought Study Assumptions						
	2008 Spring			2008 Summer		
Company	Expected	Moderate	Severe	Expected	Moderate	Severe
DVP	0	0	564	0	0	564
Duke	191	65	102	191	540	212
PEC	0	215	164	0	1149	1104
SCEG	0	19	378	0	79	856
SCPSA	84	0	0	84	0	0
Total	275	299	1208	275	1768	2736