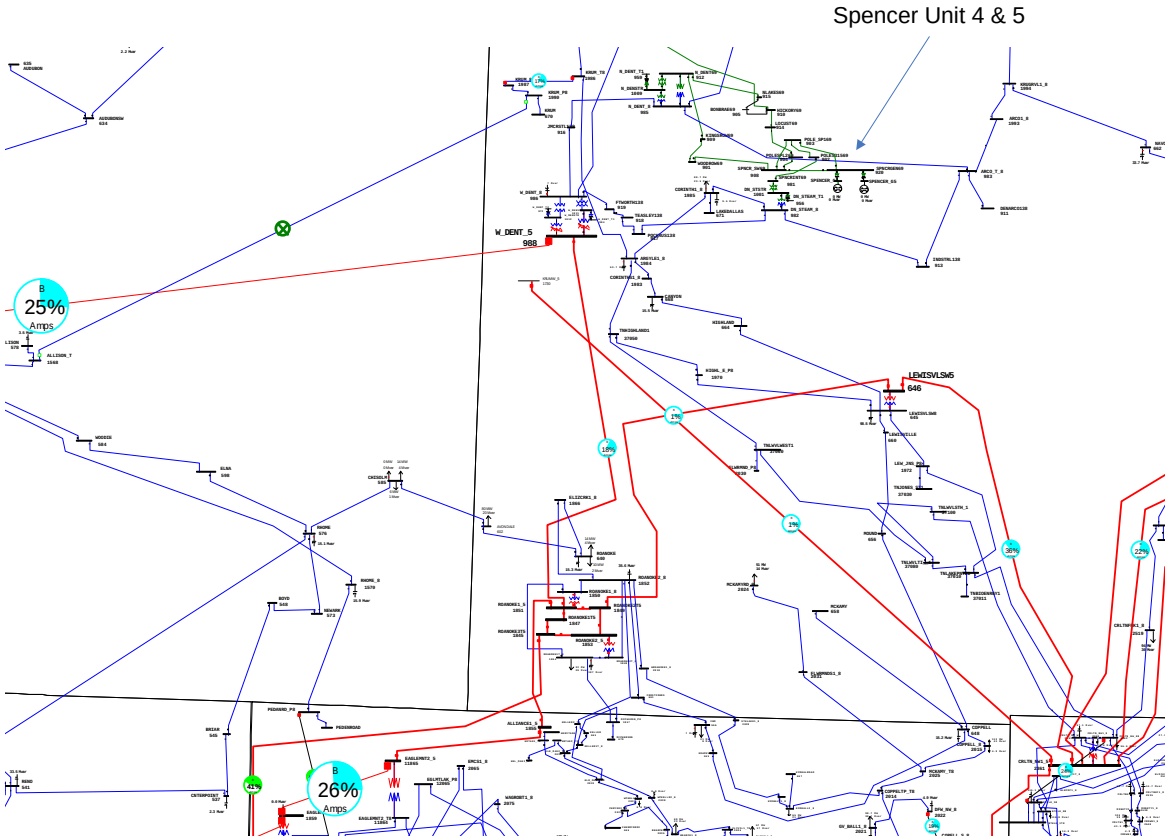
Attachment A-1, Spencer Unit 5 RMR Exit Strategy

Background

On December 1, 2009, the City of Garland submitted a Notification of Suspension of Operations for two Spencer generation units located in Denton County. ERCOT's analysis determined that one unit is necessary as a Reliability Must Run (RMR) unit to meet planning criteria requirements; maintain load and stability under normal and contingency conditions.

Denton County is located north of the Dallas – Fort Worth Metroplex with a population over 600,000. It is one of the fastest-growing counties in the United States. The availability of one of the Spencer units enables ERCOT to comply with NERC criteria by eliminating post-contingency violations. Under the current system topology and with both Spencer units unavailable, several post-contingency thermal overloads during spring peak load conditions would not be relieved.



ERCOT Independent Analysis

ERCOT performed an independent analysis of transmission upgrades and additions necessary to allow the operational suspension of Spencer Unit 5. Generation re-dispatch once the Spencer units were removed could not resolve several post-contingency overloads. In accordance with Protocol Section 6.5.9.2, this analysis includes review of new and expansion of existing transmission facilities.

For these reasons, the following upgrades or additions to the transmission facilities are being proposed to allow the RMR service exit for the Spencer unit. Parts of the exit strategy are already approved or planned projects and the remainder represents the most direct method to mitigate post contingency overloads. Since the completion date of some of the required projects are past the date they are needed, temporary Remedial Action Plans (RAPs) or Mitigation Plans (MPs) have been developed to mitigate the post contingency overloads and allow exit of the Spencer RMR.

Voltage studies

Voltage studies were conducted for years 2010, 2011, and 2012 using the SSWG Data Set A (DSA) 2010 summer peak case and the SSWG Data Set B summer peak case for 2011 and 2012 as updated on December 11, 2009. These base cases were modified to make Valley 2 unavailable in scenario 1 (S1) and the Jack County Combined-cycle plant unavailable in scenario 2 (S2). A subset of the latest 2010 contingencies in the surrounding counties of Denton, including Grayson, Cooke, Montague, Wise, Parker, Tarrant, Dallas, and Collin were selected to conduct the AC contingency analysis. In addition bus voltages and line loadings in these counties were monitored.

In the scenarios that had Spencer unit 5 modeled as available, it was modeled as generating at its maximum output. The low and high voltage limits were initially set at 0.95 and 1.03 respectively and later expanded to 0.90 and 1.05 in accordance with the ERCOT Steady State Voltage Control Procedure. Below is the sensitivity of Spencer unit 5 on specific bus voltages under contingency.

Sensitivity (percent)						
Bus-contingency	**2010 S1**	**2010 S2**	**2011 S1**	**2011 S2**	**2012 S1**	**2012 S2**
Panther Creek Bus 649 C: 681 FRISCO - 2370 COLLINSS1_8 138 1	1.152	1.191	n/a	n/a	n/a	n/a
Frisco Bus 681 C: 681 FRISCO - 2370 COLLINSS1_8 138 1	1.168	1.206	n/a	n/a	n/a	n/a

In the 2010 case, the voltage of Frisco (681) and Panther Creek (649) is below .90 for the contingency of the Frisco to Collin 138kV line. Although the Spencer unit does not help relieve the overload on the Arco to Krugerville line, it helps support voltage at both the Frisco (681) and Panther Creek (649) substations. The Arco to Krugerville line is a post-contingency overload and a mitigation plan has been developed. This line is scheduled to be rebuilt by summer peak 2011 in the March 2010 TPIT, project 10TPIT0032.

To support the post-contingency voltages at Frisco and Panther Creek in this study, the West Denton 138kV voltage had to be increased to 1.02 pre-contingency by adjusting the 345/138 kV autotransformer taps allowing the voltage at Frisco and Panther Creek to remain above 0.90 post-contingency. This voltage issue only appears in the 2010 summer peak case. In the 2011 and 2012 base cases, additional capacitance can be installed at existing nearby stations Navo and Panther Creek.

Spencer unit exit strategy

In the initial and final RMR determination studies, it was concluded that one Spencer unit was required to resolve some of the post-contingency overloads observed in the two scenarios analyzed. The following table lists overloaded elements that cannot be resolved by the re-dispatch of other generation.

Issue	Description	Contingency
1	Woodrow to Kingsrow 69kV and Kingsrow to North Denton 69kV line overload	Maintenance outage of North Lake to Hickory 69kV line and contingency of Denton Steam auto-transformer
2	Lewisville Switch (645)-Highland E 138kV(1970) line overload	Lewisville Switch (645)-Highland(664) 138 kV line
3	Lewisville Switch (645)-Highland E 138kV(1970) line overload	Highland (664)-Canyon(668) 138 kV line
4	Carrollton Northwest-LakePointe 138kV line overload	Lewisville Switch 345/138kV autotransformer
5	Lewisville Switch (645)-Highland E 138kV(1970) 138kV line overload	Coppell-Lewisville Switch
6	Collin (2370) – Frisco (681) 138kV line overload	Denton Steam auto – Corinth 138kV line Teasley – Pockrus 138kV line
7	West Denton (986) – Jim Christal (916) 138kV line overload	Denton Steam auto – Corinth 138kV line Teasley – Pockrus 138kV line
8	Low voltage at Frisco and Panther Creek	Collin to Frisco 138kV line

Table 1: Overloaded elements cannot be resolved by the re-dispatch of other generation.

In this analysis, the Spencer unit 5 was modeled as mothballed.

Issue 1

The Woodrow to Kingsrow 69kV and Kingsrow to North Denton 69kV line will be overloaded for the contingency of the Denton Steam auto-transformer and construction outage of North Lake to Hickory 69kV line. This event occurred during real-time operations in December 2009 and ERCOT Operations ordered one of the Spencer units to come on-line to alleviate the overloads.

Recommended Solution

The solution to this problem is to construct a new line from RD Wells to Hickory. This new line is a tier 4 RPG project with an estimated in-service date of end of June 2010

which the City of Denton has already constructed and is performing substation work to get the line in-service.

Issue 2

The Lewisville Switch (645) to Highland E (1970) 138kV line will be overloaded for the contingency of the Lewisville Switch (645) to Highland (664) 138kV line. This problem shows up in every year from 2010 to 2012.

Recommended Solutions

Permanent

The solution to this problem is to upgrade the Lewisville Switch to Highland (TNMP) 138 kV line to 290MVA or above.

Temporary

Since this line upgrade has an estimated in-service date of the year 2015, the following Carrollton MP would be required in order to exit the Spencer unit 5 RMR Agreement earlier:

345kV-plan

a) Open the NW Carrollton (2361) – Lewisville Switch (646) 345kV line
b) Open the NW Carrollton (2362) – Lewisville Switch (645) 138kV line
c) This MP may cause the Collin to Frisco line to overload which can be controlled by the Arco-Krugerville RAP
    a. Arco-Krugerville RAP: Open Arco – Krugerville 138kV line

Alternative 138kV-plan

a) Open the TNMP Highland (37050) – TNMP Lewisville (37060) 138kV line
b) This MP may cause the Collin to Frisco line to overload which can be controlled by the Arco-Krugerville RAP
    a. Arco-Krugerville RAP: Open Arco – Krugerville 138kV line
c) If Allison – Krum line is not in-service, Lewisville Switch (645) – Highland E 138kV (1970) line may still be overload after opening Arco – Krugerville. Open Argyle (1984) to Corinth (1985) 138kV line to correct the problem.

Hybrid plan

a) Perform the 345 kV-plan upon initial detection of overload on the Lewisville Switch to Highland (TNMP) 138 kV line.
b) Implement the Alternative 138kV plan, and then put the opened NW Carrollton – Lewisville 345 and 138kV circuits back in service.
c) This allows a quicker response since only one transmission operator is involved in the implementation of the 345kV-plan.

Issue 3

The Lewisville Switch (645) to Highland E (1970) 138kV line will be overloaded for the contingency of Highland (664) to Canyon (668) 138kV line. This problem shows up in every year from 2010 to 2012.

Recommended Solutions

Same as issue 2

Issue 4

The Carrollton Northwest to Lake Pointe 138kV line will be overloaded for the contingency of Lewisville Switch 345/138kV autotransformer. This problem shows up in year 2011 and 2012.

Recommended Solutions

Permanent

The solution to this problem is to add a second 345/138kV autotransformer at Lewisville switching substation (07TPIT0042). This new transformer is a tier 3 RPG project with an estimated in-service date of June 2012.

Temporary

Since the second Lewisville auto-transformer has an estimated in-service date of June 2012, the following Lake Pointe RAP/MP would be required in order to exit the Spencer unit 5 RMR Agreement earlier:

1. Open the line TNMP Lake Pointe (37010) – TNMP Lewisville (37080).
2. This RAP/MP may cause the Collin to Frisco line to overload which can be controlled by the Arco-Krugerville RAP.
3. This RAP/MP is not needed until the 138 kV line from NW Carrollton to Lewisville is removed from service to make way for a 345 kV line around November 2010.

Issue 5

The Lewisville Switch (645) to Highland E (1970) 138kV line will be overloaded for the contingency of Coppell to Lewisville Switch 138kV line sectionalized to Lewisville Switch to Lewisville. This problem shows up in 2012.

In addition, the Euless (2016) to Grapevine NorthEast #2 (12022) and Coppell Tap (2014) to McKamy Tap (2025) 138kV line are overloaded. However, these overloads cannot be resolved by the Spencer resource. A mitigation plan has been developed.

Recommended Solution

Permanent

The solution to this problem is to upgrade Lewisville Switch to Highland (TNMP) 138 kV line to 290MVA or above.

Temporary

Since the line upgrade has an estimated in-service date of the year 2015, the following Highland RAP/MP would be required in order to exit the Spencer unit 5 RMR Agreement earlier:

a) Open Coppell bus tie breaker 1895 (branch 648 – 2015)
b) Adjust tap on Roanoak to raise voltage on the 138kV system to 141kV
c) If the Lewisville Switch (645) to Highland E (1970) 138kV line overload, open Lewisville Highlands (37050) – Lewisville West (37060)

Issue 6

The Collins (2370) to Frisco (681) 138kV line will be overloaded for the contingency of the Denton Steam auto-transformer to Corinth and Teasley to Pockrus 138kV line. This problem shows up in the 2010 Scenario 2 only.

Recommended Solution

Permanent

The solution to this issue is to upgrade Collins to Frisco 138kV line to 326MVA (08TPIT0068). This upgrade is a tier 4 RPG project with an estimated in-service date of June 2013.

Temporary

Since the line upgrade has an estimated in-service date of the year 2013, the following Frisco RAP would be required in order to exit the Spencer unit 5 RMR Agreement earlier:

a) Raise the voltage of the West Denton 138kV side to 140kV
b) Modify the Collin Switch Reactor SPS so that it will operate when the Collin to Frisco line overloads.
c) If this does not resolve the overload, put all three capacitor banks at Navo in-service.

Note that the Arco – Krugerville RAP would cause overload of West Denton to Jim Christal under contingency in this issue; therefore, Arco – Krugerville RAP is not recommended for this issue.

Issue 7

The West Denton (986) to Jim Christal (916) 138kV line will be overloaded for the contingency of the Denton Steam auto-transformer to Corinth and Teasley to Pockrus 138kV line. This problem shows up in year 2011 and 2012.

Recommended Solution

Permanent

The solution to this issue is to upgrade the West Denton to Jim Crystal 138kV line to 250 MVA or above.

Temporary

Since the line upgrade has an estimated in-service date of the year 2012, the following North Denton RAP/MP would be required in order to exit the Spencer unit 5 RMR Agreement earlier:

a) Open North Denton (985) – Rector Road (672) 138kV line

Issue 8

The voltage of Frisco (681) and Panther Creek (649) is low under the contingency of the Collin to Frisco 138kV line. This issue only shows up in the year 2010 because additional capacitors where in the 2011 base case.

Recommended Solution

Permanent

The solution to this problem is the capacitor bank which Brazos has already studied and included in the Mustang Substation transmission plan (TPIT project 10TPIT0083). However, since the Mustang Substation project has been delayed, Brazos will need to install additional capacitance to existing stations Navo and possibly Panther Creek to resolve the low voltage by peak 2011. The new Mustang Substation capacitor bank is a tier 4 RPG project. Due to Right-Of-Way issues, there is a high probability that the Mustang station will not be available in the year 2011 as originally planned.

Temporary

Since the Mustang capacitor addition cannot be completed as planned, the following operational procedure may help alleviate the voltage issue observed in the study

a) Hold voltage on the 138kV side of the West Denton 345/138kV transformer between 1.03 and 1.05. This will provide adequate post-contingency voltage support to the Frisco and Panther Creek stations.
b) Brazos is planning on adding capacitors at Navo and possibly Panther Creek until the Mustang station and capacitor bank are in place. The current estimated in-service date of the additional Navo or Panther Creek capacitors is the year peak 2011.
c) When voltage is held above 1.02 on the 138 kV West Denton bus, the West Denton (986) to Jim Christal (916) may overload post-contingency. It is only when the voltage is held at or below 1.02 that the line does not overload. The voltage at the Frisco substation is 0.9237pu which is above 0.92pu, the voltage criteria of Brazos under contingency and above ERCOT Steady State voltage requirements.

Additionally, the Arco to Krugerville 138kV line overloads in this study for the same contingency, Collin to Frisco 138kV line. In this case, the Spencer unit cannot alleviate the overload since the load is radial post-contingency. Therefore, the solution to this issue is to upgrade the Arco to Krugerville line which Oncor has already included in their transmission plan as TPIT project 10TPIT0032. A mitigation plan has been developed for the post-contingency overload of the Arco to Krugerville line until the line is rebuilt by

peak 2011. Also, if the Lewisville to Highland 138kV line is overloaded, it may be corrected by Carrollton MP outlined above.

The specific details of the final RAPs and MPs implemented may vary from the descriptions provided in this document. Each RAP/MP will be analyzed upon submission from the appropriate Transmission Service Provider by the date it is needed if an annual review confirms its need.

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Summary

In order to allow the exit of the Spencer unit 5 RMR Agreement, the following transmission improvements and RAP/Operating Procedures need to be implemented

a) Completion of the Denton RD Wells to Hickory line, this is a tier 4 RPG project with an estimated in-service date of June 2010.
b) Implementation of temporary solutions as listed in the table below. All RAPs or Operating Procedures for 2010 need to be approved prior to RMR exit unless otherwise noted.

The following projects are the permanent solutions:

a) The completion of the Lewisville Switch to Highland (TNMP) 138 kV line upgrade to 290MVA or above would retire the Carrollton RAP and Highland RAP.
b) The addition of a new 345/138kV autotransformer at Lewisville switching substation (07TPIT0042), which is a tier 3 RPG project, would retire the Lake Pointe RAP.
c) The rebuild of the Collin to Frisco 138kV line (98TPIT0068) to 326 MVA or above would retire the Frisco RAP.
d) The upgrade of the West Denton to Jim Christal to North Denton 138kV line to 250 MVA or above would relieve the overload seen in 2012.
e) The addition of additional capacitor banks at Navo and Panther Creek to support the post-contingency voltage at Frisco and Panther Creek at 0.90 or above.
f) The rebuild of the Arco to Krugerville 138kV (10TPIT0032).

					Estimated hours of RAP operation (2010)[1]	
Issue	**Description**	**Contingency**	**Solution – Permanent**	**Solution – Temporary ***	**Jack County out-of-service[2]**	**Jack County in-service[3]**
1	Woodrow to Kingsrow 69kV and Kingsrow to North Denton 69kV line overload	Maintenance outage of North Lake to Hickory 69kV line and contingency of Denton Steam auto-transformer	New RD Wells to Hickory line	N/A - Completed	n/a	n/a
2	Lewisville Switch (645)-Highland E 138kV(1970) line overload	Lewisville Switch (645)-Highland(664)	Upgrade Lewisville switch to Highland (TNMP) 138kv to 290MVA or above	Carrollton MP	722	1
3	Lewisville Switch (645)-Highland E 138kV(1970) line overload	Highland (664)-Canyon(668)	Upgrade Lewisville switch to Highland (TNMP) 138kv to 290MVA or above	Carrollton MP	39	0
4	Carrollton Northwest-LakePointe 138kV line overload	Lewisville Switch 345/138kV autotransformer	Add a new 345/138kV transformer at Lewisville	Lake Pointe RAP/MP	0[4]	0
5	Lewisville Switch (645)-Highland E 138kV(1970) 138kV line overload	Coppell-Lewisville Switch	Upgrade Lewisville switch to Highland (TNMP) 138kv to 290MVA or above	Highland RAP/MP	17	0
6	Collins (2370) to Frisco (681) 138kV	Denton Steam – Corinth	Upgrade Collins to Frisco 138kV line to 326MVA	Frisco RAP	278	0

[1] The number of hours of operation of RAPs was estimated with the assumption that contingent line(s) is (are) opened for the entire year.
[2] The entire train of Jack County generation is out of service.
[3] The entire train of Jack County generation is in-service.
[4] The RAP is not needed in 2010 because of a change of construction schedule of Oncor; Northwest Carrollton to Lewisville switch 138kV line will be in-service until Nov 2010.

	line overload	Teasley to Pockrus				
7	W-Denton (986) – Jim Christal (916) and Jim Christal (916) to N-Denton (985) 138kV line overload	Denton Steam – Corinth Teasley to Pockrus	Upgrade West Denton to Jim Crystal to North Denton 138kV line to 250MVA or above.	North Denton RAP/MP	0	0
8	Low voltage at Frisco and Panther Creek	Collin to Frisco 138kV line	New substation and capacitor bank at Mustang or additional capacitors at Navo and Panther Creek	Frisco Voltage MP	90	0

Table 2: Summary of issues, contingency, permanent solutions, and temporary solutions

RAP	RAP description	Overload Elements	Contingency	2010	2011	2012
1	Carrollton MP	Lewisville Switch (645)-Highland E 138kV(1970) line overload	Lewisville Switch (645)-Highland(664)	RAP	RAP (138)[5]	line upgrade[6]
		Lewisville Switch (645)-Highland E 138kV(1970) line overload	Highland (664)-Canyon(668)	RAP	RAP	line upgrade[7]
2	Lake Pointe RAP/MP	Carrollton Northwest-LakePointe 138kV line overload	Lewisville Switch 345/138kV autotransformer	n/a	RAP	new auto[8]
3	Highland RAP/MP	Lewisville Switch (645)-Highland E 138kV(1970) 138kV line overload	Coppell-Lewisville Switch sectionalized to Lewisville switch to Lewisville	RAP[9]	RAP	RAP
4	Frisco RAP	Collins (2370) to Frisco (681) 138kV line overload	Denton Steam – Corinth Teasley to Pockrus	RAP	n/a	n/a
5	North Denton RAP/MP	W-Denton (986) – Jim Christal (916) and Jim Christal (916) to N-Denton (985) 138kV line overload	Denton Steam – Corinth Teasley to Pockrus	n/a	RAP[10]	RAP
6	Frisco voltage MP	Low voltage at Frisco and Panther Creek	Collin to Frisco 138kV line	RAP	n/a[11]	n/a

Table 3: Summary RAP, overload elements, contingency, and expected year required service

[5] The alternative 138kV plan opening TNMP Highland (37050) to TNMP Lewisville (37060) 138kV line is the only option.
[6] The RAP will not be needed with the completion of upgrading Lewisville Switch (645)-Highland E 138kV(1970) line.
[7] The RAP will not be needed with the completion of upgrading Lewisville Switch (645)-Highland E 138kV(1970) line.
[8] The RAP will not be needed with the completion of the additional Lewisville Switch 345/138kV autotransformer
[9] Although no RAP is needed because of Spencer, Euless (2016) to Grapevine NorthEast #2 (12022) and Coppell Tap (2014) to McKamy Tap (2025) 138kV line is overloaded as a result of contingency.
[10] The mothball of Valley resources negatively impact the flow of the West Denton to Jim Christal and Jim Christal to North Denton 138kV line
[11] Additional capacitor banks will be installed at Panther Creek and Navo by 2011.

Item	Project	TPIT number	Estimated completion Date
1	RD Wells to Hickory 69kV (Denton)	06TPIT0198 (tier 4)	Complete
2	Upgrade Lewisville Switch to Highland (TNMP) 138 kV line to 290MVA or above	07TPIT0018 (tier 4)	May 2015
3	Add second 345/138kV autotransformer at Lewisville switching substation	07TPIT0042 (tier 3)	June 2012
4	Upgrade Collin to Frisco 138kV line to 326MVA	08TPIT0068 (tier 4)	June 2013
5	Upgrade West Denton to Jim Christal to North Denton138kV line to 250 MVA or above	Not available	Summer 2012[12]
6	Additional capacitor banks at Navo and Panther Creek Substations (interim for Mustang capacitor bank)	Not available	June 2011[13]
7	New Mustang Substation and capacitor bank	10TPIT0083 (tier 4)	June 2013
8	Upgrade Arco to Krugerville 138kV	10TPIT0032 (tier 4)	May 2011

Table 4: Summary of projects and estimated completion date

[12] The estimated completion date is based on an email from Mr. Schroeder with TMPA on March 10, 2010
[13] The estimated completion date is based on emails from Mr. Albers with Brazos Electric Coop on February 18, 2010 and February 22, 2010