Analysis Summary of the Big Cajun 2 to Cocodrie 230kV Line

Joint Planning Meeting

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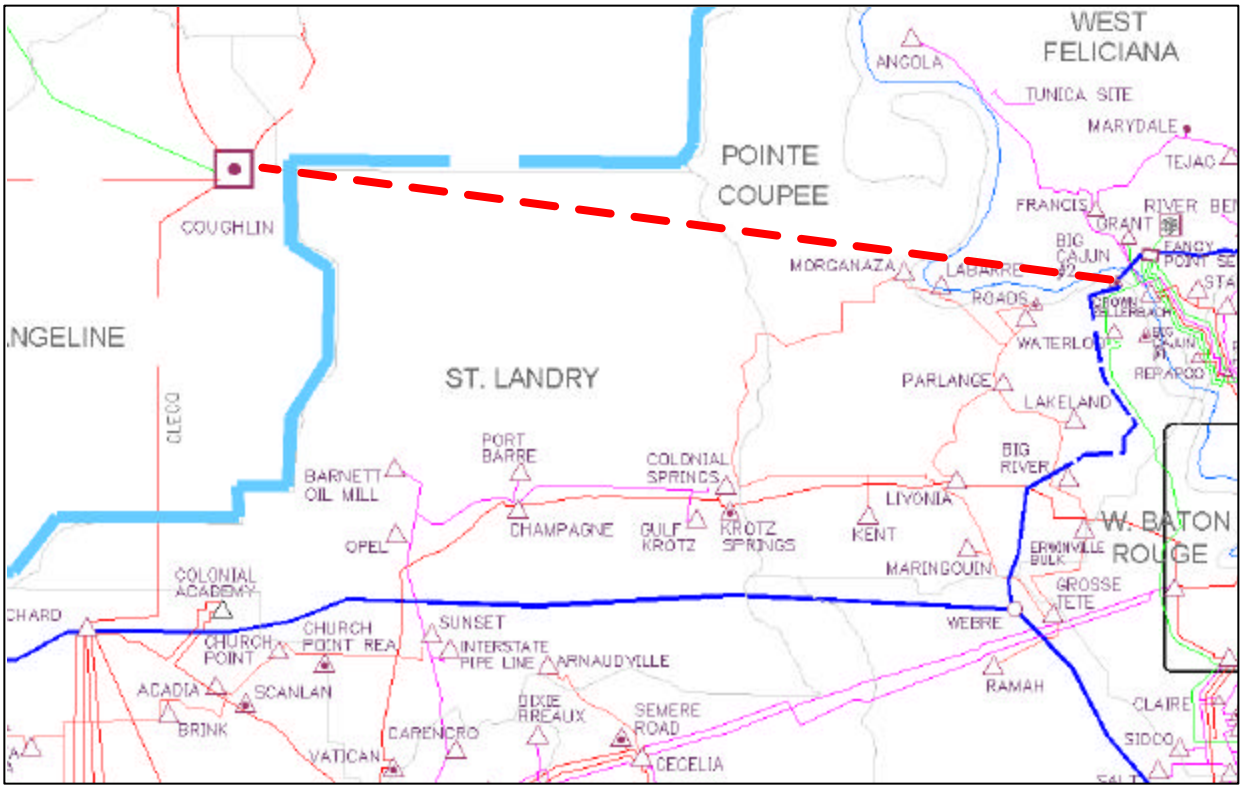
1. Introduction

Under existing system conditions, loss of the Webre to Richard 500kV transmission line causes the underlying 138kV and 115kV lines interconnecting Entergy's West of the Atchafalaya Basin (WOTAB) region and Entergy's East of the Atchafalaya Basin (EOTAB) region to overload. To mitigate the effects of these potential overloads, Entergy is currently employing an operating guide to open the underlying 138kV and 115kV lines when they exhibit overloading conditions under the loss of the Webre to Richard line. In addition, Entergy limits the flow on Webre-Richard to approximately 1,200MW.

Because a possible solution to this contingency is a 230kV line between LaGen's Big Cajun 2 substation, located in Entergy's service area, and Cocodrie Substation, located In Cleco's service territory, Entergy and Cleco have joined efforts to study this proposed solution and its impact on the rest of the Entergy and Cleco system.



2. Purpose of Joint Study

- Determine the need, benefits, and effects of a 230kV transmission line between Big Cajun 2 and Cocodrie Substations from a load flow perspective.[1]
  - Determine the required line rating and impedance.
  - Determine the required size of the 500/230kV autotransformer.
- Determine the required time frame.
- Perform sensitivity studies with various merchant generation units that have filed Interconnection and Operating Agreements in the WOTAB, northern, and southeastern areas (*i.e.*, EOTAB) of the Entergy system.

3. Model Development & Assumptions

Given the line construction constraints and approval process for building a 230kV transmission line, it was agreed that the proposed line could be online by the summer of 2005. Thus, the basis of this study is a jointly developed 2005 summer load flow model. For the detailed steps on how the cases were developed, see Attachment A.

The six cases developed are as follows:

Case 1. *2005 Base Case*

Case 2. *2005 Revised Case: Base Case with proposed 230kV line*

Case 3. *2005 Revised Case with SRW on but without proposed 230kV line*
- 450MW at SRW

Case 4. *2005 Revised Case with WOTAB Generation On*
- 4,361MW that are directed to Entergy, Cleco, LaGen, Southern Company, AEP West, and TVA.
- The units are SRW, RS Cogen, Dynegy Calcasieu, Cottonwood/Intergen, Acadia, Evangeline, and Tenaska/Frontier. The generation level and location of each unit is described in Attachment A.

Case 5. *2005 Revised Case with WOTAB and Northern Generation On*
- 4,361MW in WOTAB that are directed to Entergy, Cleco, LaGen, Southern Company, AEP West, and TVA.
- 3,672MW in the northern area that are directed to AEP West, AECI, TVA, and Southern Company.
- The northern units are Panda, Perryville, Cogentrix, and Koch Sterlington.

Case 6. *2005 Revised Case with Southeast Generation On*
- 3,347MW that are directed to TVA and Southern Company.
- The southeast units are Skygen Carville, Occidental Taft, Occidental Convent, Calpine Bogalusa, and AEP/Dow.

[1] The impact of this line on system stability will be evaluated separately outside the scope of this joint study.

The 230kV Big Cajun 2-Cocodrie line was assumed to have the following characteristics:

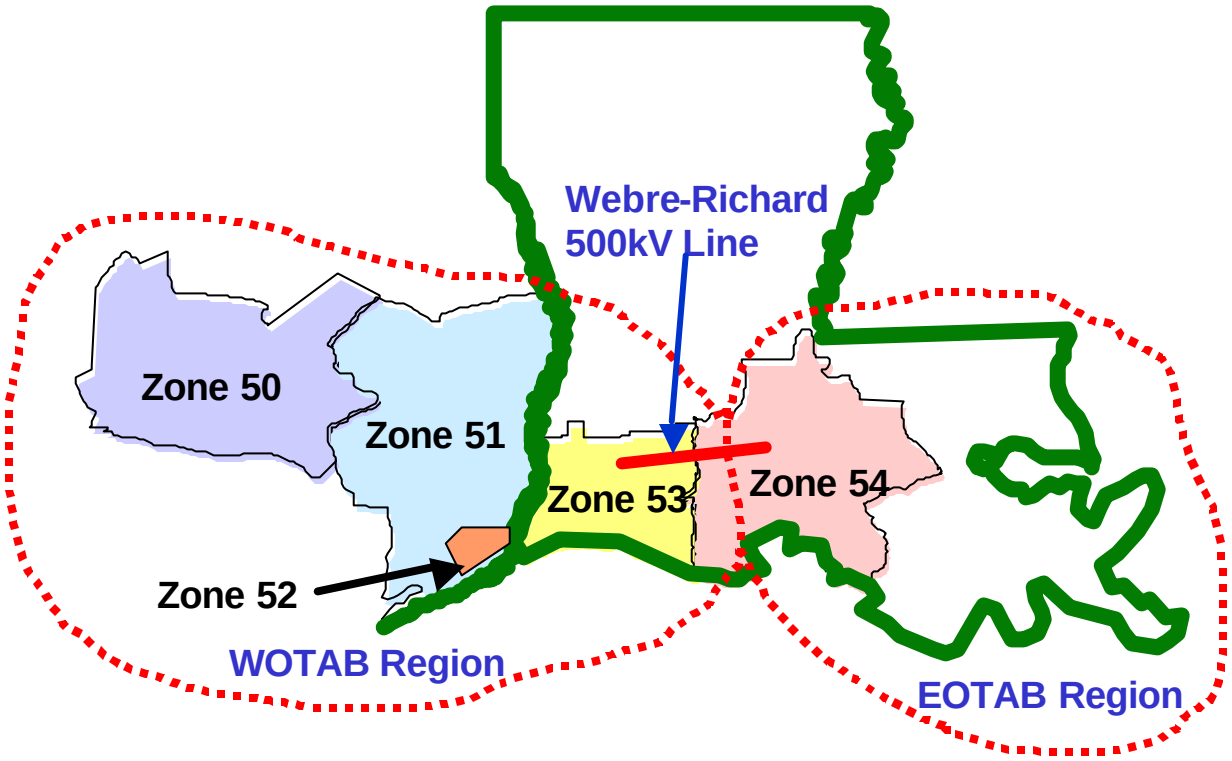
- The 500/230kV autotransformer has the same characteristics as the Mt. Olive 500/230kV auto except for the higher rating of 685MVA
- The conductor is assumed to be 2-649 ACAR 230kV (685MVA) for 60 miles. The Amelia-Cypress 230kV line was used as a reference. The line characteristics are: R = 0.00966, X = 0.0665, B = 0.22718, and Rate A = Rate B = 685MVA.

4. Contingency Analysis & Results

Because there are various local area constraints not germane to the purpose of this analysis, those constraints have been isolated and will be addressed separately. Only the relevant overloads are documented in this summary.

The Entergy zones and regions referenced in this analysis are defined as follows:

Zone 51: Beaumont area
Zone 52: Port Arthur area
Zone 53: Lake Charles area
Zone 54: Baton Rouge area



Case 1. 2005 Base Case

- Under the Webre-Richard contingency, the resulting overloads are:

```
OUTPUT FOR ZONE 54 [SO-BR   ]
 BRANCH LOADINGS ABOVE 100.0 % OF RATING SET A:

 X-------FROM BUS-------X  X--------TO BUS--------X       CURRENT(MVA)
   BUS    NAME  BSKV AREA    BUS    NAME  BSKV AREA CKT LOADING  RATING PERCENT
 97318* 4KSPRGS  138  132  98141  4CHAMPNE 138  151  1    328.7   289.0   113.7
 97318  4KSPRGS  138  132  98147* 4L-642TP 138  151  1    350.5   290.0   120.9
 98147  4L-642TP 138  151  98410* 4LIVON   138  151  1    357.0   289.0   123.5
 98235* 8MCKNT   500  151  99027  8FRKLIN  500  151  1   1769.8  1732.0   102.2
 98248  4WGLEN   138  151  98251* 4ADDIS   138  151  1    229.9   224.0   102.6
 98410* 4LIVON   138  151  98411  4WILBT   138  151  1    383.0   289.0   132.5
```

For clarification, the abbreviated substation names as defined in the load flow models are:

4KSPRGS	Krotz Springs
4CHAMPNE	Champagne
4L-642TP	Line 642 Tap
4LIVON	Livonia
8MCKNT	McKnight
8FRKLIN	Franklin
4WGLEN	Willow Glen
4ADDIS	Addis
4WILBT	Wilbert

- There were no overloads for the Cleco area or for Entergy zones 51, 52, & 53.

Case 2. 2005 Revised Case: Base Case with proposed 230kV line

- The overloads that resulted from the loss of the Webre-Richard line no longer exist.
- The remaining overloads are local area issues.

Case 3. 2005 Revised Case with SRW on but without proposed 230kV line

- The overloads that resulted from the loss of the Webre-Richard still exist but are less in magnitude.
- The remaining overloads are local area issues.

Case 4. 2005 Revised Case with WOTAB Generation On

- Franklin-McKnight appears to be a base case overload with this additional generation.
- After isolating most of the local area constraints, there remain 14 line segments whose loading is above 110% after a contingency.
- However, the overloads that resulted from the loss of the Webre-Richard line no longer exist.

Case 5. 2005 Revised Case with WOTAB & Northern Generation On

- Franklin-McKnight appears to be a base case (*i.e.*, without loss of Webre-Richard) overload with this additional generation.
- After isolating most of the local area constraints, there remain 19 line segments whose loading is above 110% after a contingency.
- However, the overloads that resulted from the loss of the Webre-Richard line no longer exist.

Case 6. 2005 Revised Case with Southeast Generation On

- Franklin-McKnight appears to be a base case overload with this additional generation. Under the worst case contingency, loss of Nelson-Richard 500kV, Franklin-McKnight loads to 142%.
- Gypsy-Madisonville appears to be a base case overload with this additional generation. Under the worst case contingency, loss of Franklin-McKnight 500kV, Gypsy-Madisonville loads to 174%.
- After isolating most of the local area constraints, there remain 13 line segments whose loading is above 110% after a contingency.
- Under the Webre-Richard contingency, the resulting overloads are:

```
OUTPUT FOR AREA 502 [CELE    ]
 BRANCH LOADINGS ABOVE 100.0 % OF RATING SET A:

 X-------FROM BUS-------X  X--------TO BUS--------X       CURRENT(MVA)
   BUS    NAME  BSKV AREA    BUS    NAME  BSKV AREA CKT LOADING  RATING PERCENT
  9999* BIGC230  230  151  50031  COCODR 6 230  502  1    797.4   685.0   116.4
 50031  COCODR 6 230  502  50039* COUGH  4 138  502  1    450.2   386.0   116.6
 50092  IVANHOE4 138  502  98185* 4BUWHSE  138  151  1    149.6   141.0   106.1
 50106  MADISON6 230  502  98578* 6FAIRVW  230  151  1    548.3   454.0   120.8
 50192  TECHE  4 138  502  50283* G3TECHE 24.0  502  1    539.5   385.0   140.1
```

Area 502 refers to Cleco's service territory. For clarification, the abbreviated substation names as defined in the load flow models are:

BIGC230	Big Cajun 230kV
COCODR	Cocodrie
COUGH	Coughlin
IVANHOE4	Ivanhoe
4BUWHSE	Bayou Warehouse
MADISON6	Madison
6FAIRVW	Fairview
TECHE	Teche 138kV
G3TECHE	Teche #3 Generator

```
OUTPUT FOR ZONE 54 [SO-BR   ]
 BRANCH LOADINGS ABOVE 100.0 % OF RATING SET A:
 X-------FROM BUS-------X  X--------TO BUS--------X       CURRENT(MVA)
   BUS    NAME   BSKV AREA    BUS    NAME   BSKV AREA CKT LOADING  RATING PERCENT
  9999* BIGC230  230  151   50031  COCODR 6 230  502  1    797.4   685.0   116.4
  9999* BIGC230  230  151   97301  8CAJUN2  500  132  1    797.4   685.0   116.4
 50092  IVANHOE4 138  502   98185* 4BUWHSE  138  151  1    149.6   141.0   106.1
 97318* 4KSPRGS  138  132   98141  4CHAMPNE 138  151  1    342.8   289.0   118.6
 97318  4KSPRGS  138  132   98147* 4L-642TP 138  151  1    367.6   290.0   126.8
 98147  4L-642TP 138  151   98410* 4LIVON   138  151  1    374.8   289.0   129.7
 98177  4MORIL   138  151   98184* 4DUBOIN  138  151  1    114.0   112.0   101.8
 98184* 4DUBOIN  138  151   98185  4BUWHSE  138  151  1    135.0   112.0   120.6
 98235  8MCKNT   500  151   99027* 8FRKLIN  500  151  1   2746.1  1732.0   158.5
 98248  4WGLEN   138  151   98251* 4ADDIS   138  151  1    264.9   224.0   118.3
 98410* 4LIVON   138  151   98411  4WILBT   138  151  1    403.0   289.0   139.4
```

For clarification, the abbreviated substation names as defined in the load flow models are:

BIGC230	Big Cajun 230kV
COCODR	Cocodrie
8CAJUN2	Big Cajun 2
IVANHOE4	Ivanhoe
4BUWHSE	Bayou Warehouse
4KSPRGS	Krotz Springs
4CHAMPNE	Champagne
4L-642TP	Line 642 Tap
4LIVON	Livonia
4MORIL	Moril
4DUBOIN	Duboin
4BUWHSE	Bayou Warehouse
8MCKNT	McKnight
8FRKLIN	Franklin
4WGLEN	Willow Glen
4ADDIS	Addis
4LIVON	Livonia
4WILBT	Wilbert

- There were no overloads for Entergy zones 51, 52, & 53.

A summary of the load flow cases with selective contingencies (Webre-Richard 500kV, Franklin-McKnight 500kV, Hartburg-Mt. Olive 500kV) is given in Table 1.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**LOAD FLOW MODEL**	**NO CONTINGENCY**				**LOSS OF WEBRE-RICHARD**			**LOSS OF FRANKLIN-McKNIGHT**			**LOSS OF HARTBURG-MT. OLIVE**		
2		Webre-Richard	McKnight-Franklin	Hartburg-Mt. Olive	Big Cajun 2-Cocodrie	McKnight-Franklin	Hartburg-Mt. Olive	Big Cajun 2-Cocodrie	Webre-Richard	Hartburg-Mt. Olive	Big Cajun 2-Cocodrie	Webre-Richard	McKnight-Franklin	Big Cajun 2-Cocodrie
3	Case 1. 2005 Base Case	1276 (74%)	1148 (66%)	74 (4%)	n/a	1787 (103%)	-508 (29%)	n/a	1649 (95%)	308 (18%)	n/a	1231 (71%)	1180 (68%)	n/a
4	Case 2. 2005 Revised Case: Base Case with proposed 230kV line	1153 (67%	1106 (64%)	81 (5%)	215 (31%)	1528 (88%)	-346 (20%)	536 (78%)	1456 (84%)	309 (18%)	305 (45%)	1103 (64%)	1142 (66%)	214 (31%)
5	Case 3. 2005 Revised Case with SRW on but without 230kV Line	1071 (62%)	1232 (71%)	222 (13%)	n/a	1763 (102%)	-264 (15%)	n/a	1471 (85%)	473 (27%)	n/a	942 (54%)	1326 (77%)	n/a
6	Case 4. 2005 Revised Case with WOTAB Generation On	-426 (25%)	1861 (107%)	1103 (64%)	67 (10%)	1715 (99%)	1241 (72%)	-54 (8%)	76 (4%)	1468 (85%)	195 (28%)	-1019 (59%)	2297 (133%)	39 (6%)
7	Case 5. 2005 Revised Case with WOTAB and Northern Generation On	-582 (34%)	1723 (99%)	903 (52%)	34 (5%)	1529 (88%)	1098 (63%)	-130 (19%)	-96 (6%)	1270 (73%)	159 (23%)	-1062 (61%)	2059 (119%)	14 (2%)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**LOAD FLOW MODEL**	**NO CONTINGENCY**				**LOSS OF WEBRE-RICHARD**			**LOSS OF FRANKLIN-McKNIGHT**			**LOSS OF HARTBURG-MT. OLIVE**		
2		Webre-Richard	McKnight-Franklin	Hartburg-Mt. Olive	Big Cajun 2-Cocodrie	McKnight-Franklin	Hartburg-Mt. Olive	Big Cajun 2-Cocodrie	Webre-Richard	Hartburg-Mt. Olive	Big Cajun 2-Cocodrie	Webre-Richard	McKnight-Franklin	Big Cajun 2-Cocodrie
8	Case 6. 2005 Revised Case with Southeast Generation On	1627 (94%)	2080 (120%)	446 (26%)	328 (48%)	2619 (151%)	-171 (10%)	770 (112%)	2166 (125%)	843 (49%)	491 (72%)	1379 (80%)	2253 (130%)	318 (46%)

Note: All values in MW. The "from" bus is listed first. For example, cell B3 indicates that the flow is 1,276MW from Webre to Richard while cell B6 indicates a flow of 426 from Richard to Webre. The (%) indicates the *approximate* line loading. The actual loading will be slightly higher since the approximation is obtained by dividing the “line flow in MW” by the “line rating in MVA”.

Thermal Line Ratings: Webre-Richard (1,732MVA)
McKnight-Franklin (1,732MVA)
Hartburg-Mt. Olive (1,732MVA)
Big Cajun 2-Cocodrie (685MVA).

Due to changing system conditions (*i.e.*, stability or operational constraints), these lines may be rated lower than the thermal ratings. For example, the Webre-Richard 500kV line has an operating limit of approximately 1,200MW.

Table 1. Summary of major transmission line flows.

5. Summary

The results shown in the previous section indicate that the construction of a 230kV transmission line from Big Cajun 2 to Cocodrie will help the transmission system under certain scenarios. This line is most beneficial if merchant generation in the southeastern portion of the Entergy service area materializes. However, as demonstrated by the results above, the 230kV line will not be a sufficient solution with the 3,346MW of southeastern merchant generation modeled.

As recent merchant generation activities have demonstrated, generation development is materializing system wide. It appears that additional generation in the WOTAB area will significantly reduce or even eliminate the need for the subject 230kV line. With additional generation in WOTAB, the flow on the proposed 230kV line could be insignificant even under the loss of the Webre-Richard 500kV line.

Given the uncertainty of the merchant generation development, it is not definitive that the proposed 230kV line between Big Cajun 2 and Cocodrie Substations will be an optimal solution to the Webre-Richard contingency.

Attachment A
Steps in Creating the Load Flow Models

In documenting the case development, either a description of the change is provided along with the associated IDV file name or only the IDV file name is provided. The merchant generation projects considered at the time of this studied are as follows:

WOTAB Generation Project	Location (Sub, Co./Parish, City)	Generation (MW)
SRW	Cow Sub, Orange, TX	514
RS Cogen	PPG Sub, Lake Charles, LA	450
Dynegy Calcasieu	Calcasieu Sub, Sulphur, LA	348
Cottonwood/Intergen	Hartburg Sub, Newton Co., TX	1249
Acadia	Richard Sub, Acadia Parish	1200
Evangeline	Evangeline, Evangeline Parish	300
Tenaska/Frontier	Frontier Sub, Grimes Co.	300

Northern Generation Project	Location (Sub, Co./Parish, City)	Generation (MW)
Panda	Eldorado Sub, Union Co., AR	2039.2
Perryville	Perryville, LA	740
Cogentrix Ouachita	Sterlington, LA	787
Koch Sterlington	Sterlington, LA	106.4

Southeastern Generation Project	Location (Sub, Co./Parish, City)	Generation (MW)
Skygen Carville	Carville Sub, St. Gabriel, LA	561
Occidental Taft	Taft, LA	835
Occidental Convent	Convent, LA	500
Calpine Bogalusa	Bogalusa, LA	600
AEP/Dow	Dow Sub, Plaquemine, LA	850

Case 1. 2005 Base Case:

- Adjusted Cleco load for 2195.6MW to 2100MW (adjust Cleco load.IDV)
- Remove Penton Road to Toledo Bend (remove-penton-rd-toledo.idv)
- Montgomery-Colfax upgrade.IDV
- Installed the Beaver Creek phase shifting transformer (BC 120MVA PST.idv)
- Corrected the existing Beaver Creek auto and Beaver Creek to Jena line ratings (adjust Beaver Creek auto and Jena line.IDV)
- Corrected rating of Van Ply to Toledo (revise Van Ply to Toledo line.IDV)
- adjust Cleco industrial loads.IDV
- Adjusted Cleco generation
  - Turn off Evangeline G6-1 150MW @ 50298
  - Turn off Evangeline G6 100MW @ 50296

- Reduced Evangeline G7 @ 50297 from 200 to 150MW
- Increased Dolet Hills @ 50280 to 660MW
- Increased Rodemacher @ 50281 to 430MW
- Increased Teche 2 @ 50284 to 48MW
- Turn on Teche 1 @ 50285 to 23MW

- There are two customer facilities are that modeled in detail, PPG and Dow. To eliminate customer-related problems, the customer net load is placed on the 230kV buses.
  - extract-ppg & put load on 230.idv
  - extract-dow.idv
  - Dow_net_load_on_230.idv
- Isolate the EGSI-LA loads to keep them constant (change-egsi-la-ind-load-to-new-zones2.idv)
- Adjusted the non-industrial EGSI-LA loads (EGSI-LA 2005 Non-Ind Loads.IDV)
- Return the EGSI-LA loads back to their original zones (change-egsi-la-ind-load-to-old-zones2.idv)
- EGSI-TX 2005 Loads.IDV
- ELI-ENOI 2005 Loads.IDV
- scale down rest of Entergy.IDV
- Redispatch (internal.ecd)
- Ran EGSI-TX IDV files. These files account for system upgrades that have been performed or approved for 2002.
- Manually revised Metro substation transformer rating to 300MVA
- Remove 600MW transaction from EES to AECI (remove 600MW EES-AECI transaction.IDV)
- Scaled down AECI load by 600 MW (scale AECI load by 600MW.IDV)
- Redispatch
- Saved as 2005 Base Case

Case 2. 2005 Revised Case: Base Case with proposed 230kV line

- Installed 230kV line between Big Cajun 2 and Cocodrie
- Saved as 2005 Revised Case

Case 3. 2005 Revised Case with SRW on but without proposed 230kV line

- Turn on SRW load and generation (535MW)

Case 4. 2005 Revised Case with WOTAB Generation On

Only WOTAB generators with filed IOAs are turned on for this case. Most of these generators will be completed by the end of 2002.

- SRW – 514MW (completed) (bus #'s 97785 - 97787)
- RS Cogen – 450MW (ISD of summer 2002) (bus # 97920)
- Dynegy Calcasieu– 348MW (completed?) (bus #98094)
- Cottonwood/Intergen – 1249MW (Dec 2002) (bus #'s 97818 –97827)
- Acadia – 1200MW (Jun 2002) (bus #'s 50290 – 50295)
- Evangeline - 300MW for merchant activity (completed) (bus #'s 50296 – 50300)
- Tenaska/Frontier – 300MW (completed) (bus #'s 97547 – 97550)

- *Total WOTAB generation turned on = 4,361MW*

- step 1. adjust Cleco area interchange.IDV (Cleco takes some of the additional generation at Evangeline and Acadia but directs the rest to AEP West and TVA)
- step 2. direct Frontier generation.idv (to AEP West and Entergy)
- step 3. direct SRW generation.idv (to LaGen but turned off generation at Big Cajun 1, whose total capacity is 373MW)
- step 4. direct 148MW of Dynegy generation.idv (to Entergy)
- step 5. direct RS Cogen to SOCO.idv (to Southern Company)
- step 6. direct Cottonwood to SOCO and TVA.idv (to Southern Company and TVA)

Case 5. 2005 Revised Case with WOTAB and Northern Generation On

Only WOTAB generators with filed IOAs and the following northern IPPs are turned on for this case.

- Panda – 2039.2MW (bus #'s 99426 – 99440)
- Perryville – 740MW (bus #'s 99204 –99209)
- Cogentrix Ouachita – 787MW (bus #'s 99199 –99202)
- Koch Sterlington – 106.4MW (bus #'s 99211 - 99216)
- *Total northern generation turned on = 3,673MW*
- *Total WOTAB & northern generation turned on = 8,034MW*
- direct northern generation.IDV (to AECI, SOCO, TVA and AEP West)

Case 6. 2005 Revised Case with Southeast Generation On

Only generators in the southeast area of Entergy's service territory with filed IOAs are turned on for this case.

- Skygen Carville – 561MW (bus #'s 98435 - 98437)
- Occidental Taft – 835MW (bus #'s 98574 - 98577)
- Occidental Convent – 500MW (bus #'s 98465 - 98467)
- Calpine Bogalusa – 600MW (bus #'s 98493 - 98495)
- AEP/Dow – 850MW (bus #'s 98320 - 98324)
- *Total southeast generation turned on = 3,346MW*

- direct southeast generation.IDV (to SOCO and TVA)