System Impact Study for Interconnection of <Omitted Text< Generation Facility

Southwest Transmission Planning
(#OAIS 02 002)

May 2002

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Executive Summary

>omitted text< (>omitted text<) has requested an Impact Study for the interconnection of a merchant plant at the >omitted text< site near >omitted text<, Louisiana. The plant will have a maximum output of 868 MW in the summer and 904 MW in the winter. The projected in service date is 2004.

The principal objectives of this study are to: 1) identify any system problems associated with the connection of the proposed plant, 2) determine potential system modifications that might be necessary to facilitate the installation of the plant while maintaining system reliability and stability, and 3) estimate the costs associated with those system modifications. The study includes a steady state contingency analysis, a transient stability analysis, and an analysis of whether the interrupting capabilities of the existing circuit breakers in the area are exceeded with the addition of this new generation.

For the purposes of this study, two seasons were studied, the 2005 summer peak and the 2005 winter peak. In each case all of the plant's output was delivered to the western control area of American Electric Power (AEP).

The estimated cost of interconnecting the new >omitted text< generation to the transmission system is $67.3 million. This cost includes interconnection costs on the AEP system including upgrades needed for short circuit problems. The minimum recommended lead time is 42 months, which extends well beyond the projected in service date mentioned above.

The analysis in this document shows that to accommodate a transfer, upgrades may be required on the AEP 345 kV, 138 kV, and 69 kV transmission systems to relieve certain criteria violations. These violations are listed in Tables 1 and 2 of the Steady State Analysis section. The analysis also showed that a large number of facilities in other control areas were overloaded in the transfer case and not in the base case. Those facilities in the other control areas were not tabulated. Many of these problems were on systems not covered by the Southwest Power Pool (SPP) Tariff.

Introduction

>omitted text< has requested an Impact Study for the interconnection of a merchant plant at the >omitted text< site >omitted text<. The plant will have a maximum output of >omitted text< in the summer and >omitted text< in the winter. The projected in service date is 2004.

The principal objectives of this study are to: 1) identify any system problems associated with the connection of the proposed plant, 2) determine potential system modifications that might be necessary to facilitate the installation of the plant while maintaining system reliability and stability, and 3) estimate the costs associated with those system modifications. The study includes a steady state contingency analysis, a transient stability analysis, and an analysis of whether the interrupting capabilities of the existing circuit breakers in the area are exceeded with the addition of this new generation.

The steady-state analysis considers the impact of the new generation on transmission facility loading and transmission bus voltages for outages of single, double, and triple circuit transmission lines, autotransformers, and generators.

Stability analysis shows the effects of the new generation on the transient stability of Southwestern Electric Power Company (SWEPCO) and surrounding utility generators. Transient stability is concerned with recovery from faults on the transmission system that are in close proximity to generating facilities.

This study also includes a short circuit analysis that determines whether the interruption capabilities of existing circuit breakers are exceeded with the addition of the new generation.

Interconnection Facilities

All of the facilities described below will be constructed using current AEP standards, practices, and processes.

>Omitted text< Station
The proposed >omitted text< plant is to be interconnected with the transmission facilities, which must be built to >omitted text< from Southwest Shreveport, Hart's Island, South Shreveport, and Red Point stations. The line to Southwest Shreveport will be 345 kV, and the lines to Hart's Island, South Shreveport, and Red Point will be 138 kV. Details of the analysis showing the need for these facilities are discussed in the Steady State Analysis section. AEP will construct a 345/138 kV station adjacent to the plant to provide the interface. The switching facility will consist of a 345 kV yard and a 138 kV yard. The 345 kV switchyard will contain one 345 kV breaker for the Southwest Shreveport line terminal and one 345/138 kV autotransformer terminal with space and layout expandable to a breaker-and-a-half configuration. (See the One-line Diagram.) The 138 kV yard will consist of nine breakers in a breaker-and-a-half configuration including three 138 kV line terminals, a 345/138 kV autotransformer terminal, and two generator terminals. A 345/138 kV, 675 MVA autotransformer with high and low side disconnects will be included in the facility. The facility will include all metering, protection and SCADA systems. >omitted text< will construct and own the generating plant and maintain the equipment including the disconnect switches on the high-side of the generator step-up transformers at the ownership boundary. >omitted text< will also provide the property and initial site preparation for the construction of the facility. As no specific site has been identified to date, the feasibility study assumed there will be ample room provided to install all required equipment and provide for all necessary transmission ingress. It is assumed in this estimate that this station will be located adjacent to the generation plant. However, costs to connect the generation plant to the station are not included in this estimate. A significant amount of open land currently exists at the >omitted text< facility so there should be no difficulty at this time in securing the required real estate and ingress easements. AEP will retain ownership and operating authority of the 345 kV and 138 kV switchyard up to the disconnect switches on the high-side of the generator step-up transformers.

The design and construction of the switching station will meet all AEP specifications for stations. Support structures and line terminal equipment will be designed to terminate the respective circuits for the Southwest Shreveport, Hart's Island, South Shreveport, and Red Point transmission lines which are described below. Bus work and disconnect switches will be designed to accommodate the loading requirements, and circuit breakers will be rated to ensure adequate load and fault interrupting capability. Metering equipment will be installed to monitor the plant output and will meet the required accuracy specifications. The cost of the station is estimated to be $7,000,000. A more detailed cost review would be required prior to authorization of budget funds when a firm project scope is determined.

Construction should require approximately 10 months. As the station is being built on a new site, minimal impediments to progress are anticipated. The 345/138 kV autotransformer delivery will be the critical schedule task, driving the overall schedule lead time to an estimated 18 months minimum (including design and procurement).

>omitted text<-Southwest Shreveport 345 kV Transmission Line

AEP will construct a single circuit 345 kV transmission line from the new >omitted text< station to the existing Southwest Shreveport station, a distance of approximately 25 miles. The line shall be supported on single pole steel structures (double circuited where required) on anchor bolt foundations on an AEP acquired easement. The phase conductors shall be 2-1590 ACSR with a 3/8" EHS steel shield wire. The cost of the new line construction including right-of-way is estimated to be $24,400,000. This is with the line routed south of Wallace Lake. For the alternative of routing the line north of Wallace Lake, the cost of the new line construction including right-of-way is estimated to be $27,800,000. In either case, once a route has been defined, a more detailed estimate with known scope will be required.

The new 345 kV line between >omitted text< to the existing Southwest Shreveport station will encounter significant routing difficulties. Ingress at either RRP or Southwest Shreveport should not cause major difficulties nor require special considerations, such as underground construction. The line routing will, however, encounter minor to major challenges and risks depending on the routing alternative selected.

Line routes on the southern and northern sides of Wallace Lake were considered. Routing the line south of Wallace Lake should be relatively straight-forward, as this area does not currently see a great deal of development. If this alternative is employed, all new 150' wide easement should be secured for the entire line route, with the possible exception of very short double circuit segments at either station's ingress. Land in this area, while more expensive than cross-country easements, should be significantly less expensive than easement on the north side of Wallace Lake. While there is always potential for land owner opposition, particularly near or within urban areas, land owner opposition should be significantly less than it would be with the northern route, resulting in fewer delays and legal expenses. The largest drawback to this route is the additional line length. This south route is about 6 miles longer than the route on the northern side of the lake. Since greater land availability was assumed for the southern route, this area was not reconnoitered as thoroughly as the other line routes. But no significant obstacles or threats are anticipated, so construction should be considered relatively typical.

Routing this line on the northern side of Wallace Lake would introduce a significant increase in cost, risk, time, and public opposition. While at about 19 miles, this route is shorter than the route south of the lake, these risks and costs are almost a certainty. The cost increase will be seen in all areas, including design, construction, right-of-way acquisition, and legal fees. The high risk of public opposition, transmission clearance coordination, and construction techniques required, will also result in significant schedule impact. While ingress at either station is relatively straight forward, the balance of this line route will require rebuilding several existing 69 kV and 138 kV lines to double circuit as well as building in several wet areas to avoid the extensive development north of Wallace Lake. This is particularly true on the eastern end of the route, about one to two miles out of RRP. The construction of the Southern Trace Country Club and multiple high value housing areas in the vicinity have virtually eliminated an opportunity for a new easement corridor though this area. Any new easement sought, if not along an existing road, will be extremely expensive and holds a high risk of significant litigation. Even with the higher costs, a condemnation factor of 40%-50% for new tracts could be encountered in this area. To the west of this area of high value real estate exists more typical mature development that would severely limit new corridors as development has gown up to, and often encroaches on, existing easements. Construction on this route would be considerably slower than construction south of Wallace Lake and would require close coordination with Transmission Dispatch. Operational concerns would likely limit available construction windows. Public opposition with the aim of stopping the project would be a considerable risk with this route alternative. Delays in the projected initiation date for the construction increases risk and cost of this alternative due to rapid area development.

The balance of this study will assume the route south of Wallace Lake will be the selected alternative for cost, schedule, and public impact reasons.

Construction south of Wallace Lake should be able to proceed with little or no operational impacts. Overall construction (clearing, foundations, and line) should be allocated a minimum of 14 months. To accommodate right-of-way acquisition, engineering, and construction, a minimum of 30 months is recommended. Due to complications associated with a route north of Wallace Lake, as discussed above, a minimum of 42 months would be required if that route were selected.

Southwest Shreveport 345 kV Terminal

A 345 kV terminal will be added at Southwest Shreveport station for the new 345 kV line to the >omitted text< station. This will require the addition of one 345 kV breaker. The cost of this terminal work is estimated to be $800,000.

Addition of a new 345 kV terminal at the Southwest Shreveport station should be relatively straightforward. The station is currently arranged to accommodate another line terminal. All new dead end towers and other structural members will be required, but adequate room is available. An inspection of the control building was not undertaken, but it should be reasonable to assume adequate room exists to add the necessary additional relay and control panels. No significant station modifications should be necessary. As no detailed construction plan has been prepared at this stage it is not possible to assess the impact of construction to operations, and vice versa, but it can be safely assumed some degree of clearance coordination will be required. Ingress for 345 kV transmission should be available from the south.

The estimated construction window for the 345 breaker addition is 4 months, but may be constrained regarding calendar sequencing by operational concerns. The overall schedule (design, procurement, and construction) is estimated to be 15 months minimum.

>omitted text<-South Shreveport 138 kV Transmission Line

AEP will construct a single circuit 138 kV transmission line from >omitted text< station to South Shreveport station, a distance of approximately 8 miles. The line shall be supported predominantly on single pole steel or concrete structures, direct buried, double circuited in several locations, with several self supporting anchor bolt foundations on an AEP acquired easement. The phase conductors shall be 2156 ACSR with a 3/8" EHS steel shield wire. The cost of the new line construction including right-of-way is estimated to be $9,200,000. Once a route has been defined, a more detailed estimate with known scope will be required.

Construction of a new 138 kV line between RRP and the existing Southwest Shreveport station will be subject to some of the same constraints as the 345 kV line. As the only transmission ingress to South Shreveport is from the south, it will be necessary double circuit either the 138 kV or 69 kV line extending south and then east from the station at least to the point where Highway 49 is crossed. Given the extent of development in the area, it is highly probably this circuit will have to be double-circuited as well along the railroad, where the 69 kV and 138 kV lines now share an easement, to Bert Kouns Boulevard. From Bert Kouns Boulevard the new line can extend east across cropland to Highway 1 and then cross Highway 1 and enter the RRP facility.

This route will make construction of the new circuit contingent on multiple clearances of existing lines for part of the line length. It will be necessary to rework existing transmission exits from the south side of South Shreveport station so that line crossings can be eliminated or minimized. No underground transmission is required on this line route.

The construction schedule for this line will be significantly impacted by operational constraints. As such, a minimum of 6 months should be allowed for construction alone. Construction must occur, it is assumed, during October through April due to operational limitations. Given the complexity of design, material requirements, and R/W coordination required a minimum of 24 months should be allowed for the overall schedule.

South Shreveport 138 kV Terminal

AEP will add a 138 kV breaker terminal at South Shreveport station for the new 138 kV line to the >omitted text< station. This will require the addition of one 138 kV breaker to the existing ring bus. AEP will also replace the 800 A wave trap at South Shreveport on the 138 kV line to Wallace Lake with a 1200 A wave trap. The estimated cost of this bus and terminal work is $600,000. A more detailed cost review would be required prior to authorization of budget funds when a firm project scope is determined.

South Shreveport station has an open terminal position in the middle of the existing dead end towers. Physical space therefore exists in the station yard to install the new terminal, but construction will be slow and complicated given proximity to adjacent energized facilities that will probably have be kept energized.

The control building at South Shreveport is constructed of concrete block. There is insufficient room for addition of any panels. Therefore, the building must either be expanded or additional enclosures must be built to accommodate panels required for this new terminal.

Construction is estimated to require 4 months minimum to complete and will be constrained by operational conditions regarding calendar sequencing. The overall schedule (design, procurement, and construction) should be allocated 12 months minimum.

>omitted text<-Hart's Island 138 kV Transmission Line

AEP will construct a single circuit 138 kV transmission line from >omitted text< station to Hart's Island station, a distance of approximately 7 miles. The line shall be supported on single pole steel or concrete structures, primarily direct embedded, (though special care and/or backfill may be required due to the location inside the levee), with a minimal number of anchor bolt foundations on an AEP acquired easement. The phase conductors shall be 2156 ACSR with a 3/8" EHS steel shield wire. The cost for the preferred routing of the new line construction including right-of-way is estimated to be $6,100,000. Once a route has been defined, a more detailed estimate with known scope will be required.

Construction of a new 138 kV line between RRP and the existing Hart’s Island station has several routing alternatives. These alternatives include overbuilding existing distribution along Highway 1 or overbuilding existing distribution along East Kings Highway or building along the Red River levee.

Overbuilding distribution along Highway 1 offers the benefit of existing right-of-way, albeit highway right-of-way. While the Department of Transportation will not allow building new transmission construction along any highway, overbuilding existing facilities in those right-of-ways is allowed. It is assumed construction would have to be on the west side of the road for the most part, as construction on the east side of the road would be along the toe of the levee in several locations, which is not anticipated to be allowed due to levee integrity concerns. The major obstacle to this alternative is cost and difficulty of construction, with many small angles being required and very close clearances to existing structures. It can also be anticipated that considerable public opposition will be encountered, along with some associated legal proceedings, due to the high number of commercial and residential structures adjacent to the existing distribution along this four-lane road. This route also requires major construction at the intersection of Highway 1 and Bert Kouns Boulevard. During construction, this will have a major impact on traffic and the operation of multiple businesses.

The second option, overbuilding existing distribution along East Kings Highway, offers a little clearer route, as congestion is not nearly as heavy along this two-lane road as on Highway 1. While several residences adjacent to the road will be encountered, this route impacts a significantly smaller number of structures. Traffic management would be an issue of concern during construction, but should not pose nearly the volume of traffic problems as would be encountered along Highway 1. The most significant obstacle regarding this route is the need to circumvent land owned by Louisiana State University just southwest of Hart's Island station. SWEPCO has previously sought to route lines through this property and was unsuccessful in court on the issue. This resulted in having to route around the property.

The preferred alternative for this new line would be to build along all new right-of-way along, and preferably just inside, the levee. While historically not considered to be a viable alternative, construction of locks and dams along the Red River has resulted in highly improved flood control, so much in fact that several residential developments are now being constructed inside the levee. As the area to be built in would be considered a "fringe" area (as opposed to the main channel) even under flooding conditions, the risk associated with flood control in this area seems minimal. The benefits of this alternative, on the other hand, are multiple. Much of the land to be crossed is currently open, which should result in less opposition and impact to existing structures. The cost of land, if purchased in the relatively near future, should be more reasonable than for some other alternatives. Construction activities will have minimal impact on the community. Also, the new line will come into Hart's Island from the south (as would be necessary per discussion below) without impacting any major intersections or thoroughfares.

The alternative routes along Highway 1 and East Kings Highway would result in higher costs due to increased right-of-way acquisition, construction labor, and material. The most significant risk with the preferred routing would be Corps of Engineer permitting that may place requirements on structure design for conductor clearance or other reasons, that result in significant cost increases. If encountered, consideration should be given to the other alternatives.

The minimum construction window for this line is estimated at 4 months. Coordination with existing facilities at each end will subject the schedule to operational limitations, but the majority of the line could be constructed without these limitations. Including right-of-way acquisition, overall minimum lead time is estimated at 18 months.

Hart's Island 138 kV Terminal

AEP will add a 138 kV breaker terminal at Hart's Island station for the new 138 kV line to the >omitted text< station. This will require the addition of a four-breaker 138 kV ring bus. The estimated cost of this bus and terminal work is $1,950,000. This costs assumes SWEPCO already owns land necessary for expansion.

The existing Hart's Island station is essentially two distribution transformers tapped from a 138 kV line between South Shreveport and Fort Humbug. The facility is located just inside the Red River levee and immediately adjacent to a backwater steep bank on the east side of the facility. Adequate property exists south of the existing fenced station on which a new site could be developed and a four-breaker 138 kV ring bus facility could be constructed. This should permit construction of the new transmission facilities with minimal interruption to existing service. After construction of new transmission station facilities, the two distribution transformers could be tied into the ring bus as a single position in the ring. Adequate room exists in the metal control building to add several new relay panels, presumably enough for the new ring bus. Should expansion of the control building be necessary, it should be achievable with minimal cost or difficulty. Adequate transmission ingress exists to retain the line from Fort Humbug entering the station from the north and the lines from South Shreveport and RRP entering from the south. In summary, expansion of this station should incur minimal risk or difficulty.

The majority of this construction could be completed with minimal disturbance of existing operations, assuming the land adjacent to the existing station is available for construction. Only when the existing transformers are tied into the new ring bus will operational limitations exist, which will require work to be done at off-peak times. Overall construction will require 5 months minimum and 16 months minimum should be allowed for the overall schedule.

>omitted text<-Red Point 138 kV Transmission Line

AEP will construct a single circuit 138 kV transmission line from >omitted text< station to Red Point station, a distance of approximately 18 miles. The line shall be supported primarily on single pole steel or concrete structures, with some being directly embedded but with several anchor bolt foundations also being required. Crossing the river, even on overhead structures, will incur additional costs above typical line construction costs. The line shall be built on an AEP acquired easement. The phase conductors shall be 2156 ACSR with a 3/8" EHS steel shield wire. The cost of the new line construction including right-of-way is estimated to be $15,300,000. Once a route has been defined, a more detailed estimate with known scope will be required.

The new line between RRP and the existing Red Point station must cross to the east side of the Red River. Given the development on the west (Shreveport) side of the river it is recommended that the river crossing take place at or near the RRP facility. At this location the river is narrow enough that overhead lines should be a feasible without the crossing span being so great (1500’ estimated) in length as to require extremely tall or expensive structures. Avoidance of a submarine crossing, which would be necessary if made further north along the river, is a high priority due to cost and schedule management concerns.

Once on the east side of the river the new line will be built on new right-of-way. The route will be fairly wooded. It will be prudent to route around Bossier City to avoid the higher right-of-way and construction costs that would be encountered in constructing that alternative and to avoid large amounts of land owned by the United States Government at

Barksdale Air Force Base. No significant obstacles are anticipated to securing new right-of-way.

Construction on a new line route should be able to progress relatively unimpeded by operational constraints. A minimum of 10 months should be allowed for construction. To cover all right-of-way acquisition, design, and construction a minimum of 30 months should be allocated.

Red Point 138 kV Terminal

AEP will add a 138 kV breaker terminal at Red Point station for the new 138 kV line to the >omitted text< station. This will require the addition of one 138 kV breaker. The estimated cost of this bus and terminal work is $750,000. This cost assumes the station can be built within existing property confines.

Expansion of the existing Red Point station to accommodate an additional 138 kV terminal is projected to be very difficult. The station's location, orientation, adjacent residences, adjacent highways, and an adjacent creek limit any expansion beyond the existing fence. Transmission ingress is available from the southeast, which coincides with the above-mentioned routing of the RRP-Red Point 138 kV line. Construction will be difficult and very probably limited on work hours due to adjacent residences and commercial establishments.

The only feasible way to add a new terminal within the existing fence would be to add a dead end tower to the southeast end of the existing 138 kV bays. This addition will extend station steel structure to within 6' clearance of the station fence, but fence expansion at this location is impossible due to the creek located immediately outside the fence. Installing this terminal at this location will require removal of existing bus extending to a 138 kV capacitor bank located in the station. While relocation of the capacitor bank could be considered as an alternative, installing a 138 kV underground dip to the capacitor bank is a more prudent alternative, and is included in this estimate.

The existing control building has limited expansion capabilities due to its location in a corner of the fenced station area. It is likely that some provision must be made for the new panels required with this terminal addition due to inadequate space.

In summary, expansion of this station to add a 138 kV terminal will be very difficult, must be closely coordinated with partial station clearances, and design must adapt to existing construction rather than employing new design standards.

Construction is estimated to require 4 months minimum to complete and will be constrained by operational conditions regarding calendar sequencing. The overall schedule (design, procurement, and construction) should be allocated 12 months minimum.

Arsenal Hill Breaker Replacements

AEP will replace 69 kV circuit breakers 430, 480, 2360, 3720, 8230, and 9760 and 138 kV circuit breaker 4980 at Arsenal Hill station due to short circuit ratings violations caused by the added generation of the >omitted text< facility. Details of the analysis are discussed in the Short Circuit Analysis section. The estimated cost of the breaker replacements is $880,000.

South Shreveport Breaker Replacements

AEP will replace 138 kV circuit breakers 7260 and 7270 at South Shreveport station due to short circuit ratings violations caused by the added generation of the >omitted text< facility. Details of the analysis are discussed in the Short Circuit Analysis section. The estimated cost of the breaker replacements is $320,000.

Project Summary

The project costs and schedule lead times detailed above are as summarized below:

>omitted text< 345/138 kV Station	$7,000,000	18 months
>omitted text<-Southwest Shreveport 345 kV Line	$24,400,000	30 months
Southwest Shreveport 345 kV Terminal	$800,000	15 months
>omitted text<-South Shreveport 138 kV Line	$9,200,000	24 months
South Shreveport 138 kV Terminal	$600,000	12 months
>omitted text<-Hart's Island 138 kV Line	$6,100,000	18 months
Hart's Island 138 kV Terminal	$1,950,000	16 months
>omitted text<-Red Point 138 kV Line	$15,300,000	30 months
Red Point 138 kV Terminal	$750,000	12 months
Arsenal Hill Breaker Replacements	$880,000	10 months
South Shreveport Breaker Replacements	$320,000	10 months

The total project cost for facilities described herein to connect the new RRP generation into the SWEPCO transmission grid is estimated to be $67.3 million. These cost estimates are based on the project only as defined herein and should be considered conceptual estimates. Refined estimates should be prepared when the project scope and schedule are fully defined and may vary from these conceptual estimates.

The schedule durations detailed above are minimum recommended schedule allowances. While unlimited personnel resources would suggest that 30 months would be an adequate overall lead time (from time of release of project scope and funds to energization of all facilities), these constraints will impact the overall project schedule. A minimum of 42 months overall lead time should be allocated to this project, and 48 month contract lead time is highly recommended. A lead time of less than 42 months would increase the estimated costs that should be expected. The increase in amount would be dependant upon the amount of lead time eliminated.

Interconnection Costs

Listed below are the costs associated with interconnecting the >omitted text< 868 MW generation facility to the transmission system.

SYSTEM IMPROVEMENT	COST (2002 DOLLARS)
>omitted text< 345/138 kV station with 675 MVA autotransformer (includes nine 138 kV breakers and one 345 kV breaker)	$7,000,000
* >omitted text<-Southwest Shreveport 25-mile, 2-1590 ACSR, 345 kV line	$24,400,000
Southwest Shreveport 345 kV terminal	$800,000
>omitted text<-South Shreveport 8-mile, 2156 ACSR, 138 kV line	$9,200,000
South Shreveport 138 kV terminal (includes wave trap replacement on 138 kV line to Wallace Lake)	$600,000
>omitted text<-Hart's Island 7-mile, 2156 ACSR, 138 kV line	$6,100,000
Hart's Island 138 kV terminal (requires four-breaker ring bus)	$1,950,000
>omitted text<-Red Point 18-mile, 2156 ACSR, 138 kV line	$15,300,000
Red Point 138 kV terminal	$750,000
Replace (6) 69 kV breakers at Arsenal Hill (430, 480, 2360, 3720, 8230, and 9760) and (1) 138 kV breaker (4980) at Arsenal Hill	$880,000
Replace (2) 138 kV breakers at South Shreveport (7260 and 7270)	$320,000
TOTAL	$67,300,000

* The route south of Wallace Lake was chosen, since the route north of Wallace Lake had an estimated cost $3,400,000 higher, or $27,800,000.

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A. Steady State Analysis

Study Methodology

The AEP and Southwest Power Pool (SPP) criteria state that the following conditions be met in order to maintain a reliable and stable system.

1) More probably contingency testing .... must conclude that

   a) All facility loadings are within their emergency ratings and all voltages are within their emergency limits (0.90-1.05 per unit) and
   b) Facility loadings can be returned to their normal limits within four hours

2) Less probable contingency testing .... shall conclude that

   a) Neither uncontrolled islanding, nor uncontrolled loss of large amounts of load will result.

More probable contingency testing is defined as losing any single piece of equipment or multi-circuit transmission lines. Less probable contingency testing involves the loss of any two critical pieces of equipment such as 345 kV autotransformers and generating units or the loss of critical transmission lines in the same right-of-way.

The 2002 series Southwest Power Pool 2005 summer and winter peak base cases were used to model the transmission network and system loads. These cases were modified to reflect known firm point to point transmission requests that have been approved.

Per information received from >omitted text<, the point of receipt of the generated capacity of the new plant called for 100% of the output to be sent to the western control area of AEP (AEPW).

Using the created 2005 summer peak model and PTI's PSS/E program, single and select double contingency outages on the SPP system were analyzed to determine the necessary facilities to interconnect the proposed plant to the transmission system. This load flow analysis is described on the following pages.

Next, using the two created models and the ACCC function of PTI's PSS/E program, single and select double contingency outages on the SPP system were analyzed. Facilities in the western AEP control area found to be overloaded in the transfer cases and not in the base cases were flagged and listed in Tables 1 and 2. A large number of such facilities in other control areas were also found to be overloaded in the transfer case and not in the base case. Those facilities in the other control areas were not tabulated.

Load Flow Analysis

The discussion below is not a summary of all outages or criteria violations. It lists certain key flow results most relevant to the discussion. These load flow analysis results do not include any additions or changes found in the stability analysis or the short circuit analysis. The modeling of new lines in these load flow cases is not an indication of whether construction of such a line is physically or economically feasible. The line lengths provided are rough approximations.

Base Case

2005 summer peak base case with no generation added at >omitted text<: The 600 MW transaction to Entergy was added to the model from the East DC tie in this case (05sp base.sav) **and the corresponding 2005 winter peak case** (05wp base.sav)**. These are the two cases to which the respective ACCC runs, mentioned later, were compared.**

>Omitted text< Plant

>Omitted text< 138 kV bus with 138 kV lines to Hart's Island and Wallace Lake, with a 675 MVA, 345-138 kV autotransformer and a 345 kV line to Southwest Shreveport (case 05SP rrp 868a.sav): This >omitted text< MW power transfer was sent to the AEP western control area.

Description of outage	Circuit loadings in % of emergency (E) or normal (N) ratings
No outages	RRP-Hart's Island 138 kV 96% of N
RRP-Wallace Lake 138 kV	RRP-Hart's Island 138 kV 110% of E
RRP-Hart's Island 138 kV	RRP-Wallace Lake 138 kV 91% of E Wallace Lake-South Shreveport 138 kV 117% of E
RRP-Southwest Shreveport 345 kV	RRP-Hart's Island 138 kV 103% of E
Dolet Hills 345-230 kV autotransformer	Wallace Lake-I. P. Mansfield (CLECO *) 138 kV 106% of E

* Central Louisiana Electric Company

With one 345 kV line from >omitted text<, this case shows the need for at least three 138 kV lines from >omitted text< rather than two.

>Omitted text< 138 kV bus with 138 kV lines to Hart's Island, Wallace Lake, and Red Point with a 675 MVA, 345-138 kV autotransformer and a 345 kV line to Southwest Shreveport (case 05SP rrp 868b.sav):

Description of outage	Circuit loadings in % of emergency (E) or normal (N) ratings
No outages	RRP-Hart's Island 138 kV 79% of N
RRP-Wallace Lake 138 kV	RRP-Hart's Island 138 kV 89% of E
RRP-Hart's Island 138 kV	RRP-Wallace Lake 138 kV 73% of E Wallace Lake-South Shreveport 138 kV 85% of E
RRP-Southwest Shreveport 345 kV	RRP-Hart's Island 138 kV 80% of E
Dolet Hills 345-230 kV autotransformer	Wallace Lake-I. P. Mansfield (CLECO) 138 kV 105% of E

The addition of the RRP-Red Point 138 kV line relieved the >omitted text<-Hart's Island and Wallace Lake-South Shreveport overloadings. However, this case still has first contingency overload of the conductor on the 138 kV line to CLECO.

>Omitted text< 138 kV bus with 138 kV lines to Hart's Island, South Shreveport, and Red Point with a 675 MVA, 345-138 kV autotransformer and a 345 kV line to Southwest Shreveport (case 05SP rrp 868c.sav):

Description of outage	Circuit loadings in % of emergency (E) or normal (N) ratings
No outages	RRP-Hart’s Island 138 kV 77% of N
RRP-South Shreveport 138 kV	RRP-Hart’s Island 138 kV 89% of E
RRP-Hart’s Island 138 kV	RRP-South Shreveport 138 kV 81% of E
RRP-Southwest Shreveport 345 kV	RRP-Hart’s Island 138 kV 76% of E
South Shreveport 138-69 kV autotransformer	Other South Shreveport 138-69 kV autotransformer 98% of E
Dolet Hills 345-230 kV autotransformer	* South Shreveport-Wallace Lake 138 kV 96% of E Wallace Lake-I. P. Mansfield (CLECO) 138 kV 86% of E
Both Dolet Hills-Southwest Shreveport 345 kV and RRP-Southwest Shreveport 345 kV	No violations in the Shreveport area (This contingency was run to check the reliability of double circuiting these two lines for the two or three miles nearest Southwest Shreveport.)

* The conductor is the limiting facility in summer on the South Shreveport-Wallace Lake 138 kV line. But in the winter peak case, the South Shreveport 800 A wave trap on 138 kV line to Wallace Lake is the limiting facility, and it overloads its emergency rating 102% for the outage of the Dolet Hills 345-230 kV autotransformer.

This case shows that having the >omitted text<-South Shreveport 138 kV line, rather than the >omitted text<-Wallace Lake 138 kV line, helps to relieve the flow on the 138 kV line to CLECO.

In the breaker and a half arrangement at >omitted text<, the line terminals to South Shreveport and Hart’s Island are the best two terminals to place side by side, since an outage to both of them due to a breaker failure would not result in any facilities being overloaded.

>Omitted text< 138 kV bus with 138 kV lines to Hart's Island, South Shreveport, and Red Point with a 675 MVA, 345-138 kV autotransformer and a 345 kV line to Station Z. (case 05SP rrp 868d.sav): Station Z does not presently exist. Station Z would be located west of Southwest Shreveport with the Longwood-Southwest Shreveport and Diana-Southwest Shreveport 345 kV lines each routed into it. In this case, Station Z was modeled 4 miles west of Southwest Shreveport.

Description of outage	Circuit loadings in % of emergency (E) or normal (N) ratings
No outages	RRP-Hart's Island 138 kV 78% of N Each Station Z-Southwest Shreveport 345 kV 7% of N (73 MW)
RRP-South Shreveport 138 kV	RRP-Hart's Island 138 kV 90% of E
RRP-Hart's Island 138 kV	RRP-South Shreveport 138 kV 82% of E
RRP-Station Z 345 kV	RRP-Hart's Island 138 kV 76% of E
South Shreveport 138-69 kV autotransformer	Other South Shreveport 138-69 kV autotransformer 98% of E
Dolet Hills 345-230 kV autotransformer	South Shreveport-Wallace Lake 138 kV 96% of E Wallace Lake-I. P. Mansfield (CLECO) 138 kV 85% of E
Both Dolet Hills-Southwest Shreveport 345 kV and RRP-Station Z 345 kV	No violations in the Shreveport area (This contingency was run to check the reliability of these two lines crossing one another.)

This case has flows which are very similar to the flows in case 05SP rrp 868c.sav above. However, this case would require a greater amount of station and transmission construction.

>Omitted text< 345 kV bus with two 345 kV lines to Southwest Shreveport (case 05SP rrp 868e.sav): No generator step-up transformer data had been provided for connecting to the 345 kV bus. So the 138 kV data was used.

Description of outage	Circuit loadings in % of emergency (E) or normal (N) ratings
No outages	Southwest Shreveport 345-138 kV autotransformers 72% and 76% of N respectively
Southwest Shreveport 345-138 kV autotransformer	Other Southwest Shreveport 345-138 kV autotransformer 113% of E
Southwest Shreveport-Western Electric ‘T’ 138 kV	Southwest Shreveport-Southwest Shreveport ‘T’ 138 kV 118% of E Southwest Shreveport ‘T’-South Shreveport 138 kV 100% of E Powell-Linwood 138 kV 108% of E
Southwest Shreveport-McCoy 138 kV	Southwest Shreveport- Southwest Shreveport ‘T’ 138 kV 93% of its E Southwest Shreveport-Western Electric ‘T’ 138 kV 94% of E Western Electric-South Shreveport 138 kV 99% of E

The overloaded facilities in and around the Southwest Shreveport station show that adding two 345 kV lines from >omitted text< to Southwest Shreveport would not be sufficient. In order to accommodate the two 345 kV lines, considerable additional substation and transmission construction would be required. This would include adding a 675 MVA, 345-138 kV autotransformer to Southwest Shreveport station to help unload the two existing 600 MVA autotransformers. It would also include upgrades to multiple 138 kV lines or perhaps the addition of one or more new 138 kV lines from Southwest Shreveport station.

This brings up another concern. The load in the Shreveport zone in the 2005 summer peak case used in this study is 1121 MW. In this case (05SP rrp 868e.sav), 858 MW is flowing through the Southwest Shreveport autotransformers. That flow is equal to 77% of the total load in the Shreveport zone. This is compared with 56% in the base case. Adding a third autotransformer to Southwest Shreveport station and increasing the 138 kV line capacity exiting the station would increase the flow through Southwest Shreveport station upwards from the 77% mentioned above.

Section 3.3.1 (a) of the SPP Criteria says, “Excessive concentration of power being carried on any single transmission circuit, multi-circuit transmission line, or right-of-way, as well as through any single transmission station shall be avoided.” Therefore, no further analysis was performed on this alternative, and the plan modeled in case 05SP rrp 868c.sav was chosen. That is the plan with 138 kV lines to Hart's Island, South

Shreveport, and Red Point with a 675 MVA, 345-138 kV autotransformer at >omitted text< station and a 345 kV line to Southwest Shreveport.

ACCC runs were then performed on case 05SP rrp 868c.sav and also on the 2005 winter peak case 05WP rrp 904a.sav which has those same improvements added. Facilities in the AEPW control area found to be overloaded in these two transfer cases but not in the corresponding base cases were flagged and listed in Tables 1 and 2.

<u>Table 1</u> – Overloaded facilities in the AEPW control area for 2005 summer peak with 868 MW transfer to AEPW, which were not overloaded in the base case. These overloaded facilities may require mitigation in order to obtain transmission service. Transmission service must be requested from SPP before the actual transmission service upgrades required may be determined.

Branch Over 100% Rate B (Emergency Rating)	Rate B (MVA)	868 MW Transfer Case % Loading	Outaged Branch That Caused Overload
NW TEXARKANA-PATTERSON 138 KV	261	115.9	LYDIA-VALLIANT 345 KV
(81-512) ONETA-BROKEN ARROW 101ST N 138 KV	210	103.2	RIVERSIDE STATION-ORU EAST TAP 138 KV
JENKS-SOUTHERN HILLS W 138 KV	235	105.7	RIVERSIDE STATION-S. HUDSON 138 KV RIVERSIDE STATION-96TH & YALE 138 KV RIVERSIDE STATION-TULSA PWR. STA. 138 KV
HUGO-VALLEY TIMBER 69 KV	48	107.5	TUPELO (SWPA *)-ALLEN 138 KV
VALLIANT- KIAMICHI PUMP T 69 KV KIAMICHI PUMP T-FT. TOWSON 69 KV FT. TOWSON-HUGO 69 KV	48 48 39	103.2 101.6 104.1	HUGO-HUGO TAP 138 KV
NASHOBA-BETHEL 138 KV	107	101.0	PITTSBURG-VALLIANT 345 KV
(81-522) RIVERSIDE STATION-TULSA PWR. STA. 138 KV	187	108.2	RIVERSIDE STATION-JENKS-T.P.S. 138 KV RIVERSIDE STATION-OAKS-T.P.S. 138 KV
WELSH-LYDIA 345 KV	1059	105.1	WELSH-WILKES 345 KV WELSH-NW TEXARKANA 345 KV

* Southwestern Power Administration

Table 2 – Overloaded facilities in the AEPW control area for 2005 winter peak with 904 MW transfer to AEPW, which were not overloaded in the base case. These overloaded facilities may require mitigation in order to obtain transmission service. Transmission service must be requested from SPP before the actual transmission service upgrades required may be determined.

Branch Over 100% Rate B (Emergency Rating)	Rate B (MVA)	904 MW Transfer Case % Loading	Outaged Branch That Caused Overload
BROKEN BOW (SWPA)-BETHEL 138 KV	96	108.6	VALLIANT-PITTSBURG 345 KV
(81-512) ONETA-BROKEN ARROW 101ST N 138 KV	210	100.8	RIVERSIDE STATION 345-138 KV AUTO

B. Stability Analysis

Introduction

Per >omitted text< Development Company, LLC (>omitted text<) request, American Electric Power (AEP) has conducted a stability performance study to evaluate the feasibility of connecting 904 MW (winter, net) of generation to the proposed >omitted text< 138 kV station, which would in turn be connected to the existing transmission system via the base interconnection plan as follows: 1) a new 345/138 kV autotransformer and 345 kV line to S. W. Shreveport; 2) a new 138 kV line to S. Shreveport; 3) a new 138 kV line to Hart's Island; and 4) a new 138 kV line to Red Point. This report documents the stability performance study for this proposed generation facility.

Overview of Generation Facilities

Figure 1 of Attachment 1 shows the transmission system configuration in the vicinity of the new >omitted text< 138 kV Station. Figure 2 shows the configuration of the >omitted text< combined cycle generation facility. This proposed facility would consist of one simple-cycle combustion turbine-generator with a maximum net winter capacity of >omitted text<, two identical simple-cycle combustion turbine-generators each with a maximum net winter capacity of 164.4 MW, and one steam topping turbine-generator with a maximum net winter capacity of 400 MW, for a total of >omitted text< MW (winter, net). Each generator is to be connected through a step-up transformer and generator breaker. One >omitted text< MW combustion turbine-generator would be paired together with one >omitted text< MW combustion turbine-generator beyond their generator breakers, and the other >omitted text< MW combustion turbine-generator would be paired together with the steam turbine generator beyond their generator breakers. Each generator pair would be connected into a breaker-and-a-half arrangement at the new >omitted text< 138 kV station as shown in Figure 2. The proposed >omitted text< 138 kV station would be connected to the existing transmission system via the proposed 138 kV lines to S. Shreveport, Hart's Island and Red Point, and the proposed 345/138 kV autotransformer and 345 kV line to S. W. Shreveport. The dynamic modeling data for the combined cycle generating unit, as provided by >omitted text< and used in this study, is documented in Attachment 2.

Dynamics Base Case

A Southwest Power Pool (SPP) dynamics base case representing 2002 summer peak load conditions was used for this study. This dynamics case was assembled using data from the 2001 SPP Dynamics Database. The case was modified to reflect recent upgrades to the system, and merchant plant additions including 904 MW (winter, net) of new >omitted text< generation. The new >omitted text< generating facilities were added to the case using data and configuration information provided by >omitted text< and their equipment vendors as shown in Attachments 1 and 2. The 904 MW from >omitted text< were transferred to the AEP System.

Testing Criteria

AEP transient stability criteria for 138 kV connected generation facilities shown in Table 1 below specify the conditions and events for which stable operation is required. In addition, satisfactory damping of generator post-disturbance power oscillations is required.

Table 1
AEP Stability Testing Criteria for Connected Generation

Prefault System Condition		Fault Disturbance Scenario
All Transmission Facilities In Service	3A	Permanent single-phase-to-ground fault with three-phase breaker failure. Fault clearing by backup breakers.
	3B	Permanent three-phase-to-ground fault with unsuccessful high-speed reclosing (HSR), if applicable. Fault cleared by primary breakers.
	3C	Three-phase line opening without fault.
One Transmission Facility Out	3D	Permanent three-phase-to-ground fault with unsuccessful HSR, if applicable. Fault cleared by primary breakers.
	3E	Three-phase line opening without fault.

The above criteria are used in time domain simulations to evaluate the stability performance of a proposed generation facility. For each disturbance, the resulting transmission system response is simulated and then analyzed to assess the impact of the disturbance scenarios on the proposed generators and the surrounding system.

Study Scope

Dynamic simulations were conducted for selected event scenarios and various post-contingency network configurations as follows:

SINGLE-CONTINGENCY SCENARIOS:

CASE 1 - No prior outage. Permanent single-phase fault at proposed >omitted text< 138 kV station on line to Hart's Island. Fault clearing at Hart's Island end of line in 4.5 cycles with circuit breaker failure at >omitted text< 138 kV. Delayed clearing at >omitted text< 138 kV station 15 cycles following fault initiation also removing proposed line to S. Shreveport 138 kV.

Proposed generation remains connected through Red Point 138 kV, and through S. W. Shreveport 345 kV. (Criterion 3A)

CASE 2 - No prior outage. Permanent three-phase fault on 138 kV side of proposed >omitted text< 345/138 kV autotransformer. Fault clearing at 345 kV side in 4.5 cycles. Proposed generation remains connected via the proposed 138 kV lines to S. Shreveport, Hart’s Island and Red Point. (Criterion 3B)

DOUBLE-CONTINGENCY SCENARIOS:

CASE 3 - Prior outage of proposed >omitted text< 345/138 kV autotransformer. Permanent three-phase fault at proposed >omitted text< 138 kV station on line to Hart’s Island. Fault clearing in 4.5 cycles with unsuccessful high-speed reclosing of >omitted text<-Hart’s Island 138 kV 30 cycles following breaker opening. Proposed generation remains connected through S. Shreveport 138 kV and Red Point 138 kV. (Criterion 3D)

CASE 4 - Prior outage of proposed >omitted text< 345/138 kV autotransformer. Non-fault initiated tripping of >omitted text<-Hart’s Island 138 kV line. Proposed generation remains connected through S. Shreveport 138 kV and Red Point 138 kV. (Criterion 3E)

CASE 5 - Prior outage of proposed >omitted text< 345/138 kV autotransformer. Permanent three-phase fault at proposed >omitted text< 138 kV station on line to S. Shreveport. Fault clearing in 4.5 cycles with unsuccessful high-speed reclosing of >omitted text<-S. Shreveport 138 kV 30 cycles following breaker opening. Proposed generation remains connected through Hart’s Island 138 kV and Red Point 138 kV. (Criterion 3D)

CASE 6 - Prior outage of >omitted text<-Hart’s Island 138 kV line. Permanent three-phase fault on 138 kV side of proposed >omitted text< 345/138 kV autotransformer. Fault clearing at 345 kV side in 4.5 cycles. Proposed generation remains connected through S. Shreveport 138 kV and Red Point 138 kV. (Criterion 3D)

CASE 7 - Prior outage of >omitted text<-S. Shreveport 138 kV line. Permanent three-phase fault at proposed >omitted text< 138 kV station on line to Hart’s Island. Fault clearing in 4.5 cycles with unsuccessful high-speed reclosing of >omitted text<-Hart’s Island 138 kV 30 cycles following breaker opening. Proposed generation remains connected through Red Point 138 kV, and through S. W. Shreveport 345 kV. (Criterion 3D)

The above cases were simulated using the 2002 summer peak load base case noted in the Dynamics Base Case section.

Stability Simulation Results

The stability performance study results are presented in Attachment 3 and are summarized below. Attachment 3 contains a case summary table and plots of generator speed deviation and voltage for the proposed >omitted text< generating units, as well as speed deviation plots for nearby existing generators such as Dolet Hills, Arsenal Hill, Welsh, Pirkey, Tenaska Rusk County, and Wilkes.

CASE NO.	CRITERION	TRANSIENT STABILITY	OSCILLATORY STABILITY
Case 1	3A	Stable	Satisfactory
Case 2	3B	Stable	Satisfactory
Case 3	3D	Stable	Satisfactory
Case 4	3E	Stable	Satisfactory
Case 5	3D	Stable	Satisfactory
Case 6	3D	Stable	Satisfactory
Case 7	3D	Stable	Satisfactory

The transient stability of the proposed generating units was found to be acceptable in all cases. No adverse transient stability impacts were observed on the surrounding transmission system for the reported cases. Other cases with extended fault clearing times (not shown in this report) indicate the existence of adequate transient stability margins. The oscillatory stability was also found to be acceptable.

Summary

- The study results show that from a stability perspective, the proposed >omitted text< generating units totaling >omitted text< MW (winter, net) can be accommodated by a direct connection to the new >omitted text< 138 kV station via: 1) a new 345/138 kV autotransformer and 345 kV line to S. W. Shreveport; 2) a new 138 kV line to S. Shreveport; 3) a new 138 kV line to Hart’s Island; and 4) a new 138 kV line to Red Point.

- If the proposed generation project is built, follow-up stability studies by AEP would be required based on dynamics data and modeling for the proposed generating unit that have been revised to reflect equipment commissioning tests and field settings.

- If an Interconnection Agreement for a new generation facility in the general vicinity is executed or significant transmission network changes occur within AEP or adjacent systems, prior to the execution of an Interconnection Agreement for this facility, then a new study would be required to reassess the impact of this generation addition, and the study results contained in this report would no longer be valid.

- These study results would have to be shared with neighboring systems such as Entergy and CLECO for a review of the impact on their systems, if >omitted text< plan to add generation firms up.

Attachment 1

>omitted text> Generation

Configuration of Proposed Facility

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Attachment 2

>omitted text< Generation

Dynamics Data

GENROU - CT 1-3

Round Rotor Generator Model (Quadratic Saturation)

Value	Description
221.4	Base MVA
0.003	R_a
4.767	T'_{do} (>0) (sec)
0.033	T''_{do} (>0) (sec)
0.401	T'_{qo} (>0) (sec)
0.072	T''_{qo} (>0) (sec)
5.12	Inertia, H
0	Speed damping, D
2.024	X_d
1.932	X_q
0.305	X'_d
0.480	X'_q
0.216	$X''_d = X''_q$
0.179	X_l
0.05	S(1.0)
0.23	S(1.2)

X_d, X_q, X'_d, X'_q, X''_d, X''_q, X_l, H, and D are in pu, machine MVA base.

X''_q must be equal to X''_d.

IBUS, 'GENROU', I, T'_{do}, T''_{do}, T'_{qo}, T''_{qo}, H, D, X_d, X_q, X'_d, X'_q, X''_d, X_l, S(1.0), S(1.2)/

EXPIC1 - CT 1-3

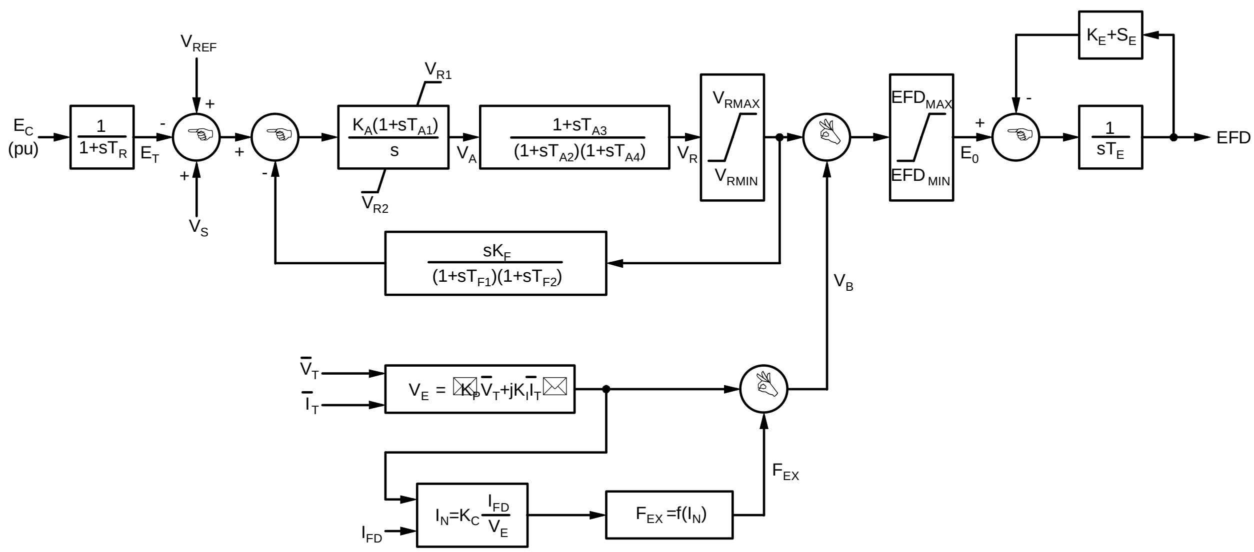
Proportional/Integral Excitation System

Value	Description
0.0	T_R (sec)
3.77	K_A
1.0	T_{A1} (sec)
1.0	V_{R1}
-0.87	V_{R2}
0.01	T_{A2} (sec)
0.0	T_{A3} (sec)
0.0	T_{A4} (sec)
1.0	V_{RMAX}
-0.87	V_{RMIN}
0	K_F
10	T_{F1} (>0) (sec)
0.0	T_{F2} (sec)
6.64	EFD_{MAX}
0.0	EFD_{MIN}
0.0	K_e
0.0	T_e (sec)
0.0	E_1
0.0	SE_1
0.0	E_2
0.0	SE_2
5.31	K_P
0	K_I
0.08	K_C

IBUS, 'EXPIC1', I, T_R, K_A, T_{A1}, V_{R1}, V_{R2}, T_{A2}, T_{A3}, T_{A4}, V_{RMAX}, V_{RMIN}, K_F, T_{F1}, T_{F2}, EFD_{MAX}, EFD_{MIN}, K_e, T_e, E_1, SE_1, E_2, SE_2, K_P, K_I, K_C/

EXPIC1 - CT 1-3

Proportional/Integral Excitation System



I_N → F_{EX}

If $I_N \le 0$.	$F_{EX} = 1$
If $I_N \le 0.433$	$F_{EX} = 1-0.577\, I_N$
If $0.433<I_N<0.75$	$F_{EX} = \sqrt{0.75-I_N^2}$
If $I_N \ge 0.75$	$F_{EX} = 1.732(1-I_N)$
If $I_N>1$	$F_{EX} = 0$

If (K_P = 0 and K_I = 0), then V_B = 1.

If T_E = 0, then EFD = E_0.

V_S = VOTHSG + VUEL + VOEL

PSS2A - CT 1-3

IEEE Dual-Input Stabilizer Model

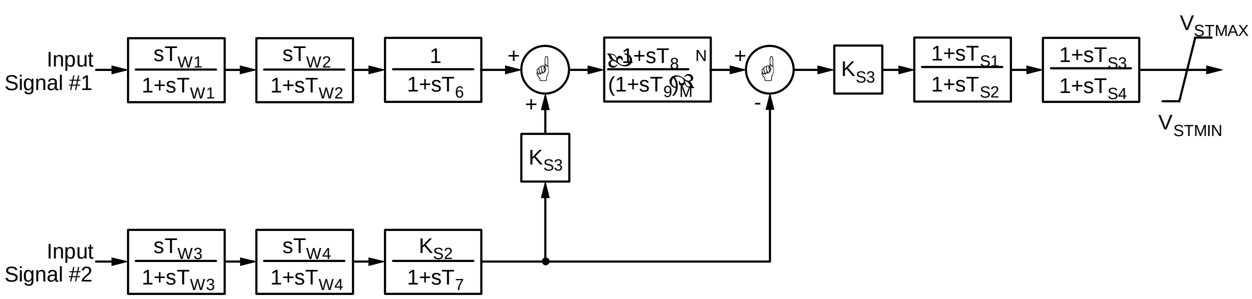
Value	Description
1	ICS1, first stabilizer input code: 1 - rotor speed deviation (pu) 2 - bus frequency deviation (pu) 3 - generator electric power on MBASE base (pu) 4 - generator accelating power (pu) 5 - bus voltage (pu) 6 - derivative of pu bus voltage
0	REMBUS1, first remote bus number
3	ICS2, second stabilizer input code: 1 - rotor speed deviation (pu) 2 - bus frequency deviation (pu) 3 - generator electric power on MBASE base (pu) 4 - generator accelating power (pu) 5 - bus voltage (pu) 6 - derivative of pu bus voltage
0	REMBUS2, second remote bus number
5	M, ramp tracking filter
1	N, ramp tracking filter

Value	Description
2	T_{w1} (>0)
2	T_{w2}
0	T_6
2	T_{w3} (>0)
0	T_{w4}
2	T_7
0.199	K_{S2}
1.0	K_{S3}
0.5	T_8
0.1	T_9 (>0)
10	K_{S1}
0.15	T_1
0.03	T_2
0.15	T_3
0.03	T_4
0.1	V_{STMAX}
-0.1	V_{STMIN}

IBUS, 'PSS2A', I, ICS1, REMBUS1, ICS2, REMBUS2, M, N, T_{W1}, T_{W2}, T_6, T_{W3}, T_{W4}, T_7, K_{S2}, K_{S3}, T_8, T_9, K_{S1}, T_1, T_2, T_3, T_4, V_{STMAX}, V_{STMIN}/

PSS2A - CT 1-3

IEEE Dual-Input Stabilizer Model



GENROU - ST

Round Rotor Generator Model (Quadratic Saturation)

Value	Description
450	Base MVA
0.0016	R_a
7.2	T'_{do} (>0) (sec)
0.03	T''_{do} (>0) (sec)
1.8	T'_{qo} (>0) (sec)
0.05	T''_{qo} (>0) (sec)
3.10	Inertia, H
0	Speed damping, D
2.08	X_d
2.04	X_q
0.274	X'_d
0.452	X'_q
0.226	$X''_d = X''_q$
0.162	X_l
0.108	S(1.0)
0.357	S(1.2)

X_d, X_q, X'_d, X'_q, X''_d, X''_q, X_l, H, and D are in pu, machine MVA base.

X''_q must be equal to X''_d.

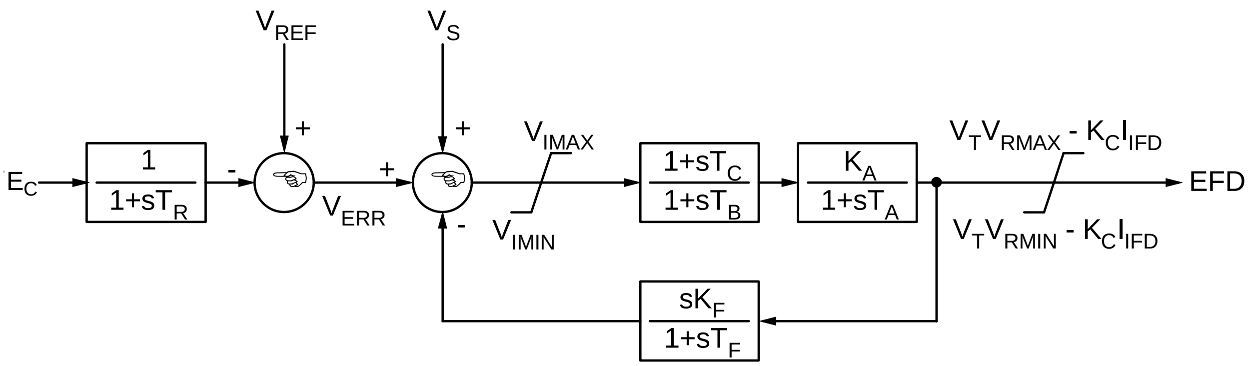
IBUS, ‘GENROU’, I, T'_{do}, T''_{do}, T'_{qo}, T''_{qo}, H, D, X_d, X_q, X'_d, X'_q, X''_d, X_l, S(1.0), S(1.2)/

EXST1 - ST

IEEE Type ST1 Excitation System

Value	Description
0.03	T_R
0.3	V_{IMAX}
-0.3	V_{IMIN}
0.7	T_C
5.6	T_B (sec)
400	K_A
0.01	T_A (sec)
5.7	V_{RMAX}
-4.1	V_{RMIN}
0.14	K_C
0	K_F
1	T_F (>0)(sec)

IBUS, 'EXST1', I, T_R, V_{IMAX}, V_{IMIN}, T_C, T_B, K_A, T_A, V_{RMAX}, V_{RMIN}, K_C, K_F, T_F/



V_S= VOTHSG + VUEL + VOEL

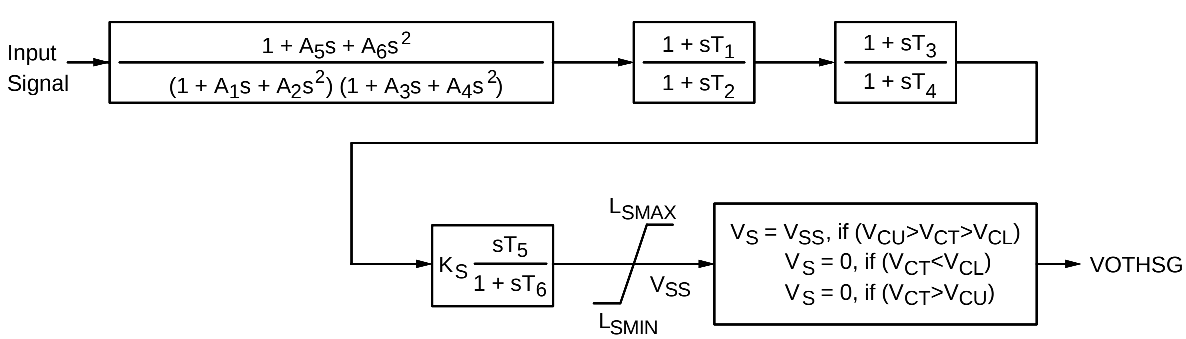
IEEEST - ST

IEEE Stabilizing Model

Value	Description
3	ICS, stabilizer input code: 1 - rotor speed deviation (pu) 2 - bus frequency deviation (pu) 3 - generator electric power on MBASE (pu) 4 - generator accelating power (pu) 5 - bus voltage (pu) 6 - derivative of pu bus voltage
0	IB, remote bus number 2, 5, 6

Value	Description
0.03	A_1
0	A_2
0	A_3
0	A_4
0	A_5
0	A_6
0.15	T_1 (sec)
0.25	T_2 (sec)
1.0	T_3 (sec)
1.0	T_4 (sec)
2.0	T_5 (sec)
2.0	T_6 (>0)(sec)
-0.8	K_S
0.05	L_{SMAX}
-0.05	L_{SMIN}
0	V_{CU} (pu) (if equal zero, ignored)
0	V_{CL} (pu) (if equal zero, ignored)

BUS, IEEEST, I, ICS, IB, A_1, A_2, A_3, A_4, A_5, A_6, T_1, T_2, T_3, T_4, T_5, T_6, K_S, L_{SMAX}, L_{SMIN}, V_{CU}, V_{CL}/



Attachment 3

Results -

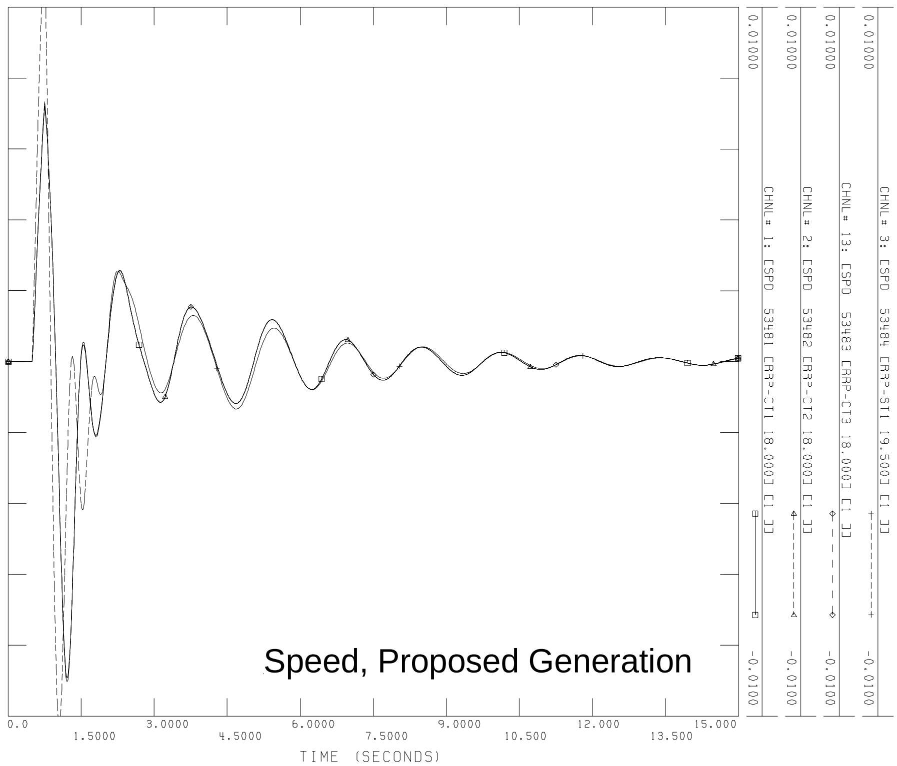
Individual Case Plots

Case No.	Prior Outage	Faulted Line/Transformer	Fault Type	Comments on Study Results	
				Transient	Oscillatory
Case 1	None	>omitted text<-Hart’s Island 138 kV, >omitted text<-S. Shreveport 138 kV	1 Phase, Delayed	Stable	Satisfactory
Case 2	None	>omitted text< 345/138 kV	3 Phase	Stable	Satisfactory
Case 3	>omitted text< 345/138 kV	>omitted text<-Hart’s Island 138 kV	3 Phase	Stable	Satisfactory
Case 4	>omitted text< 345/138 kV	>omitted text<-Hart’s Island 138 kV	No Fault	Stable	Satisfactory
Case 5	>omitted text< 345/138 kV	>omitted text<-S. Shreveport 138 kV	3 Phase	Stable	Satisfactory
Case 6	>omitted text<-Hart’s Island 138 kV	>omitted text< 345/138 kV	3 Phase	Stable	Satisfactory
Case 7	>omitted text<-S. Shreveport 138 kV	>omitted text<-Hart’s Island 138 kV	3 Phase	Stable	Satisfactory

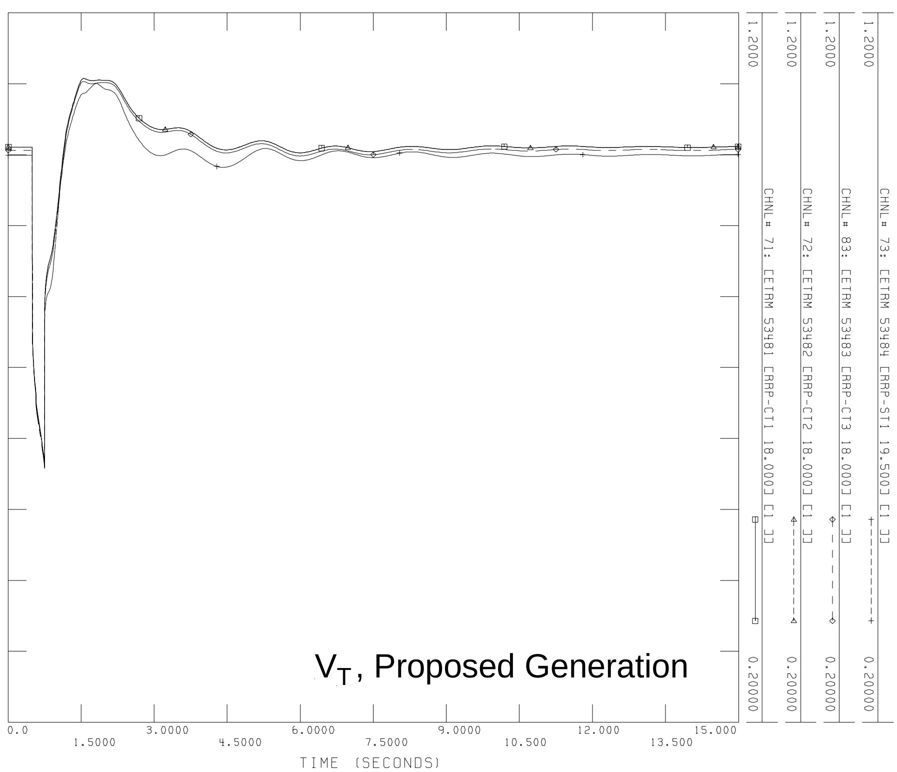
Stability Curve Bus Key

53481 RRP-CT1	>omitted text< >omitted text< “CT1” Unit Combustion Turbine
53482 RRP-CT2	>omitted text< >omitted text< “CT2” Unit Combustion Turbine
53483 RRP-CT3	>omitted text< >omitted text< “CT3” Unit Combustion Turbine
53484 RRP-ST1	>omitted text< >omitted text< “ST1” Unit Steam Turbine
50280 G1DOLHIL	CELE Dolet Hills Power Station Unit 1
53700 ARSHILL1	AEPW Arsenal Hill Power Station Unit 1
53710 WELSH1-1	SWEPCo Welsh Power Station Unit 1
53708 PIRKEY 1	AEPW Pirkey Power Station Unit 1
53007 TENGAS 1	Tenaska Rusk County Unit “1” Gas Turbine
53714 WILKE1-1	SWEPCo Wilkes Power Station Unit 1
53640 LEBR G1	Entergy LeBrock Power Station Unit 1
53701 FLINTCR1	AEPW Flint Creek Power Station Unit 1
55041 SEMINL2G	OGE Seminole Power Plant Unit 2

Case 1

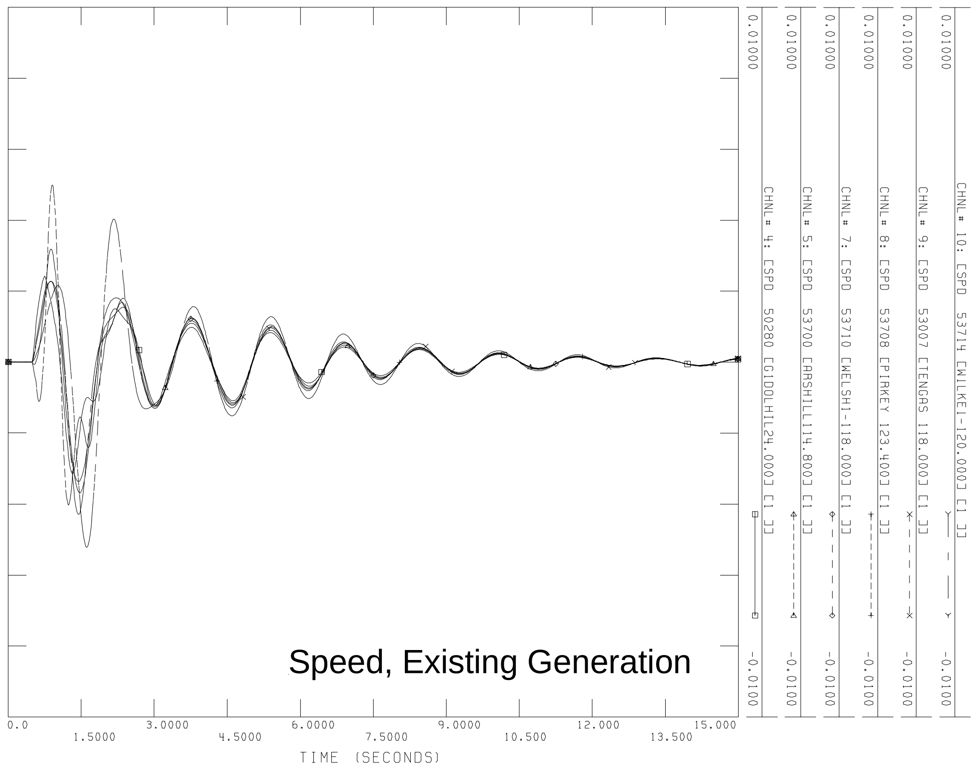


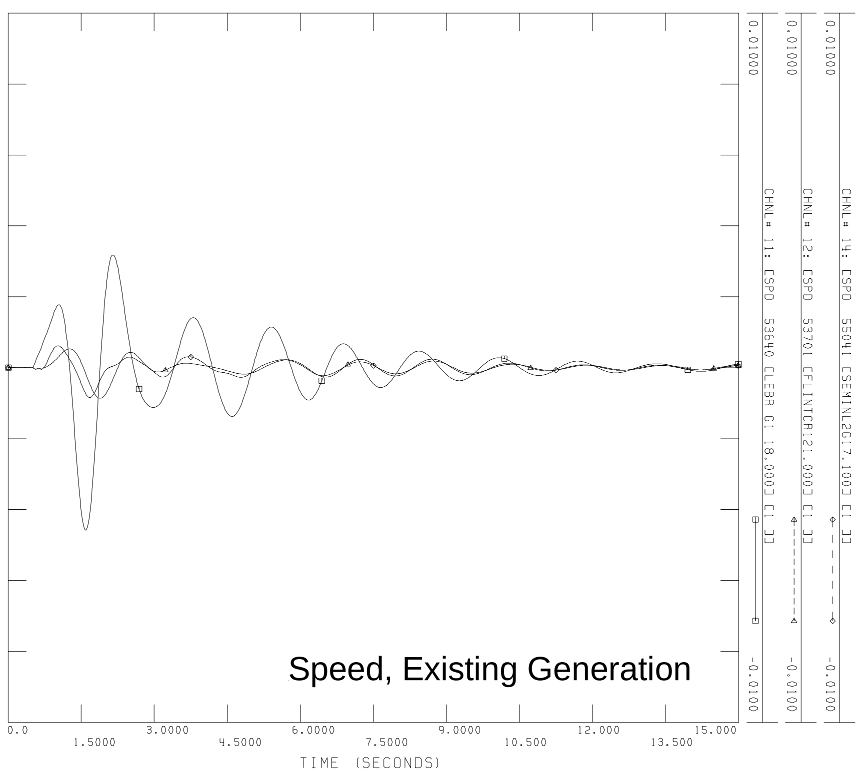
Speed, Proposed Generation
0.01000
-0.0100
CHNL# 1: [SPD 53481 [RRP-CT1 18.000] [1]]
CHNL# 2: [SPD 53482 [RRP-CT2 18.000] [1]]
CHNL# 13: [SPD 53483 [RRP-CT3 18.000] [1]]
CHNL# 3: [SPD 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)



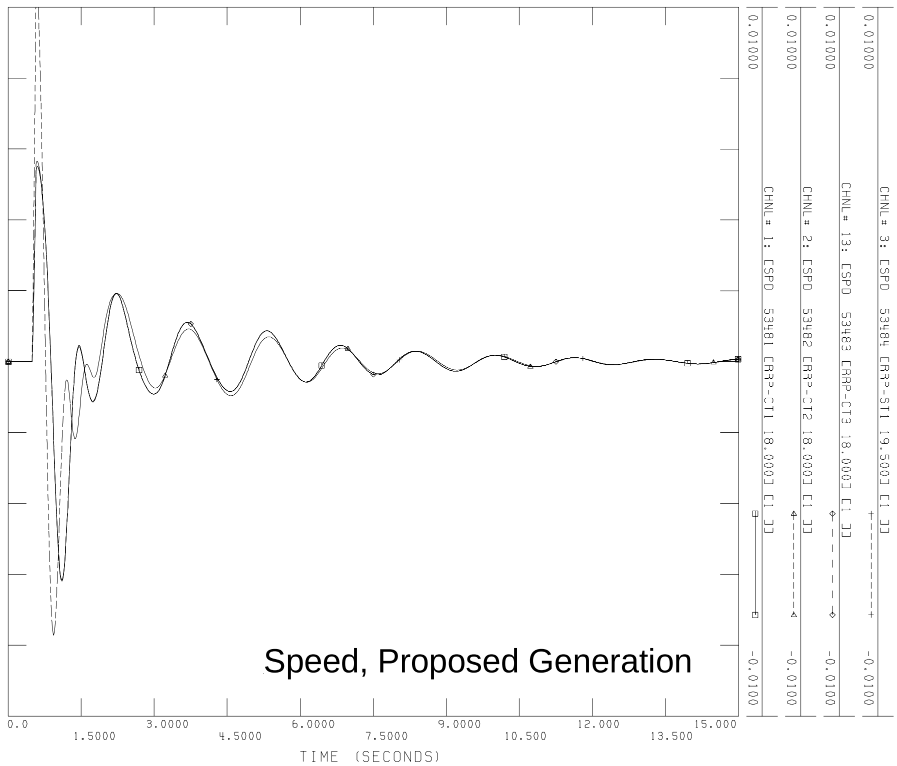
VT, Proposed Generation
1.2000
0.20000
CHNL# 71: [ETRM 53481 [RRP-CT1 18.000] [1]]
CHNL# 72: [ETRM 53482 [RRP-CT2 18.000] [1]]
CHNL# 83: [ETRM 53483 [RRP-CT3 18.000] [1]]
CHNL# 73: [ETRM 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)

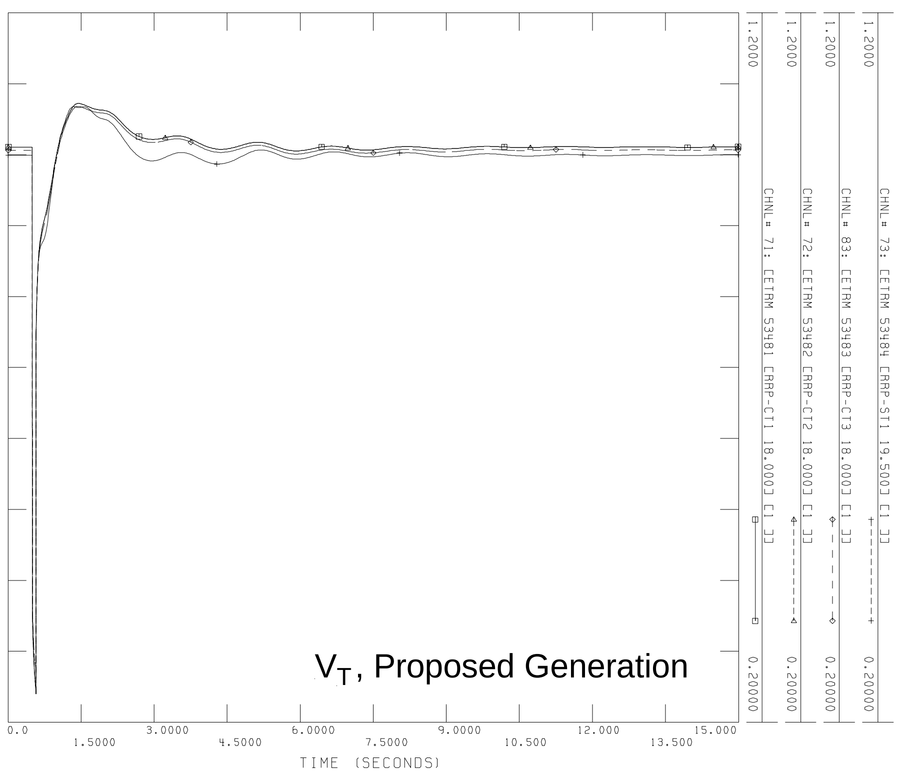
Case 1


Speed, Existing Generation
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)
0.01000
-0.0100
CHNL# 4: [SPD 50280 [GIDOLHIL24.000] [1]]
CHNL# 5: [SPD 53700 [ARSHILL14.800] [1]]
CHNL# 7: [SPD 53710 [WELSH1-118.000] [1]]
CHNL# 8: [SPD 53708 [PIRKEY 123.400] [1]]
CHNL# 9: [SPD 53007 [TENGAS 118.000] [1]]
CHNL# 10: [SPD 53714 [WILKE1-120.000] [1]]

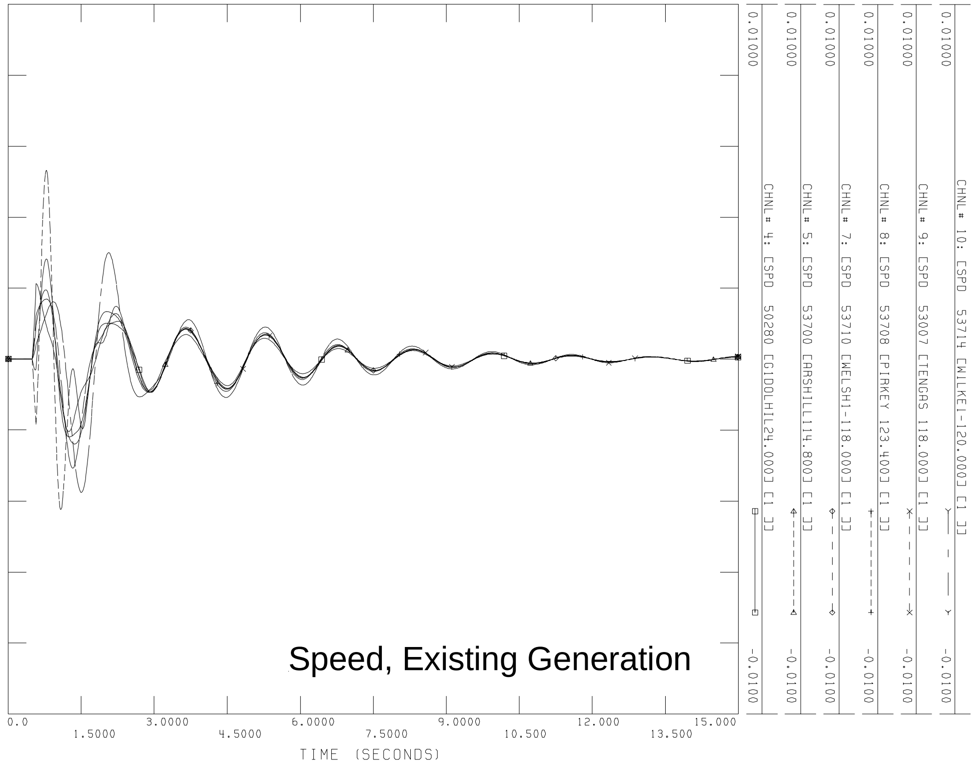

Speed, Existing Generation
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)
0.01000
-0.0100
CHNL# 11: [SPD 53640 [LEBR G1 18.000] [1]]
CHNL# 12: [SPD 53701 [FLINTCR121.000] [1]]
CHNL# 14: [SPD 55041 [SEMINL2G17.100] [1]]

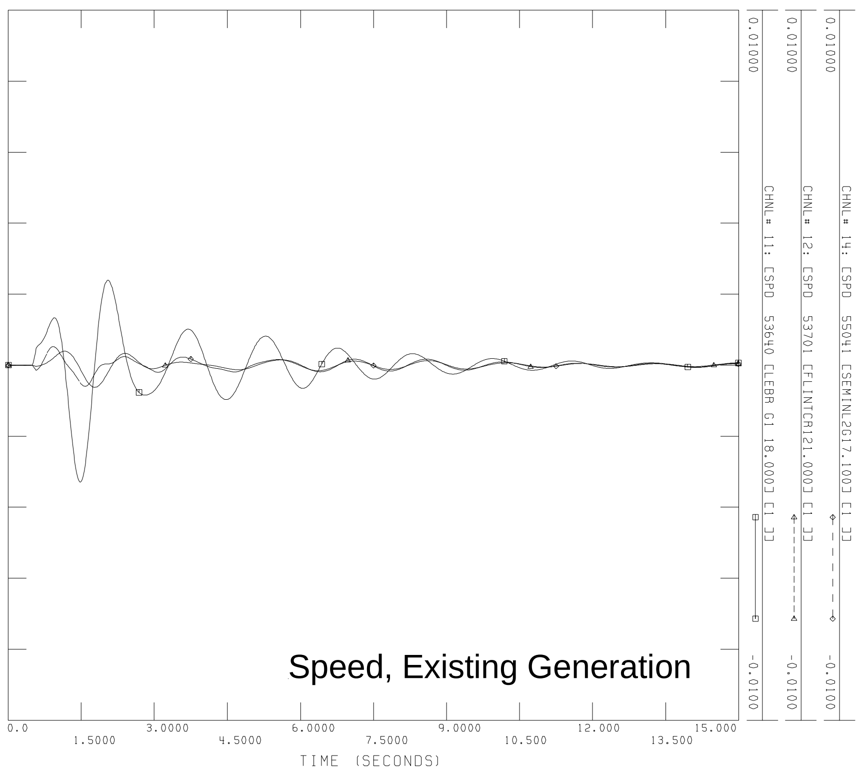
Case 2


Speed, Proposed Generation
TIME (SECONDS)
CHNL# 1: [SPD 53481 [RRP-CT1 18.000] [1]]
CHNL# 2: [SPD 53482 [RRP-CT2 18.000] [1]]
CHNL# 13: [SPD 53483 [RRP-CT3 18.000] [1]]
CHNL# 3: [SPD 53484 [RRP-ST1 19.500] [1]]

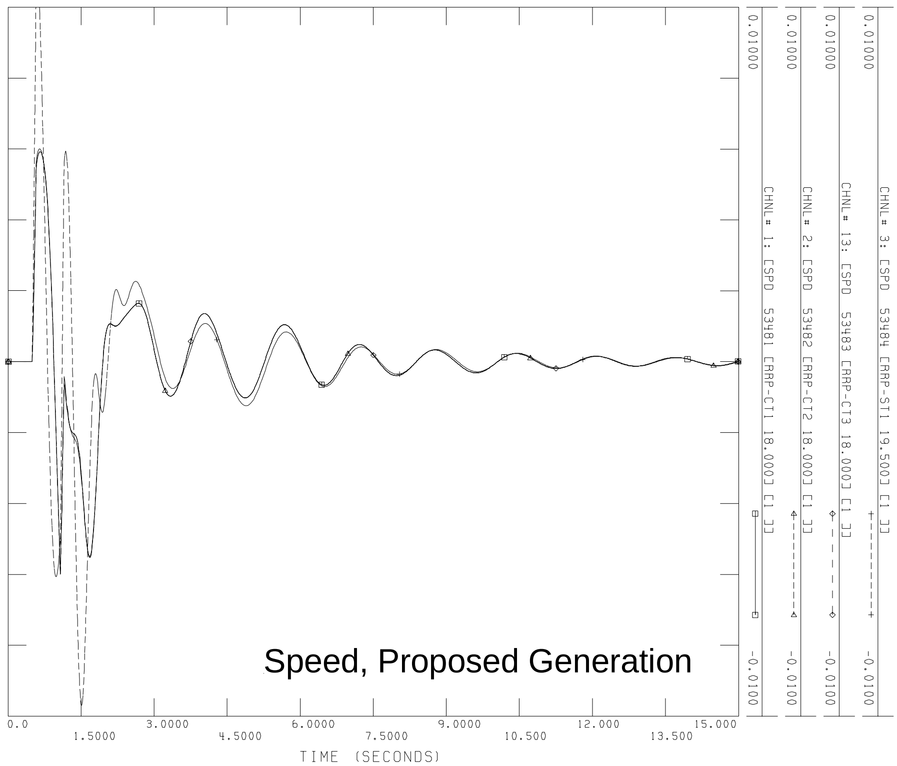

V_T, Proposed Generation
TIME (SECONDS)
CHNL# 71: [ETRM 53481 [RRP-CT1 18.000] [1]]
CHNL# 72: [ETRM 53482 [RRP-CT2 18.000] [1]]
CHNL# 83: [ETRM 53483 [RRP-CT3 18.000] [1]]
CHNL# 73: [ETRM 53484 [RRP-ST1 19.500] [1]]

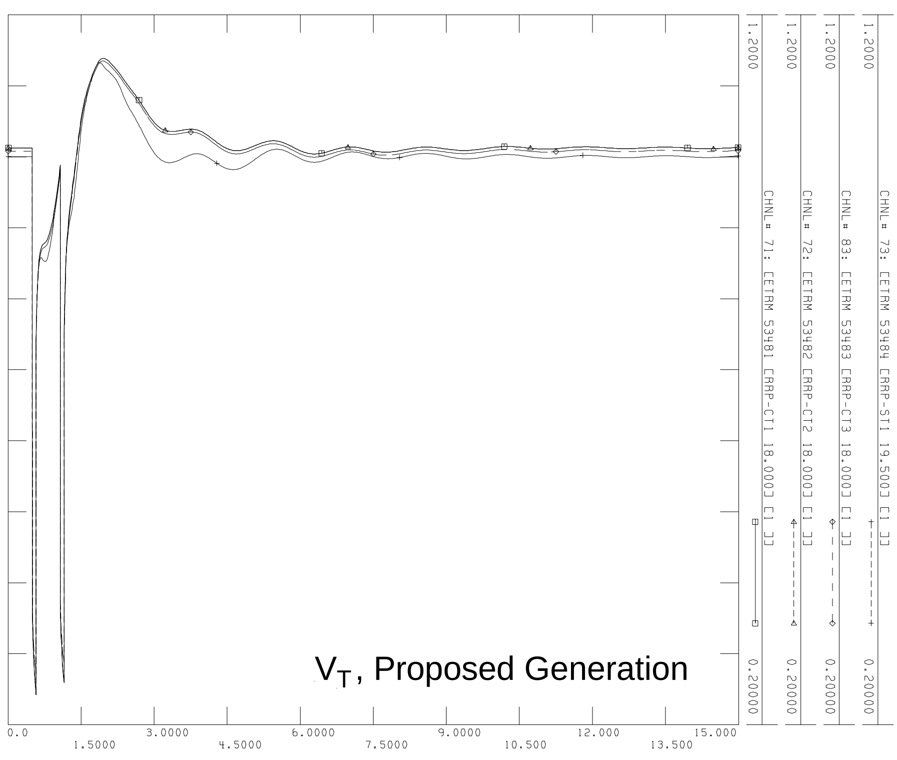
Case 2


Speed, Existing Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
0.01000
-0.0100
CHNL # 4: [SPD 50280 [GIDOLHIL24.000] [1]]
CHNL # 5: [SPD 53700 [ARSHILL14.800] [1]]
CHNL # 7: [SPD 53710 [WELSH1-118.000] [1]]
CHNL # 8: [SPD 53708 [PIRKEY 123.400] [1]]
CHNL # 9: [SPD 53007 [TENGAS 118.000] [1]]
CHNL # 10: [SPD 53714 [WILKE1-120.000] [1]]

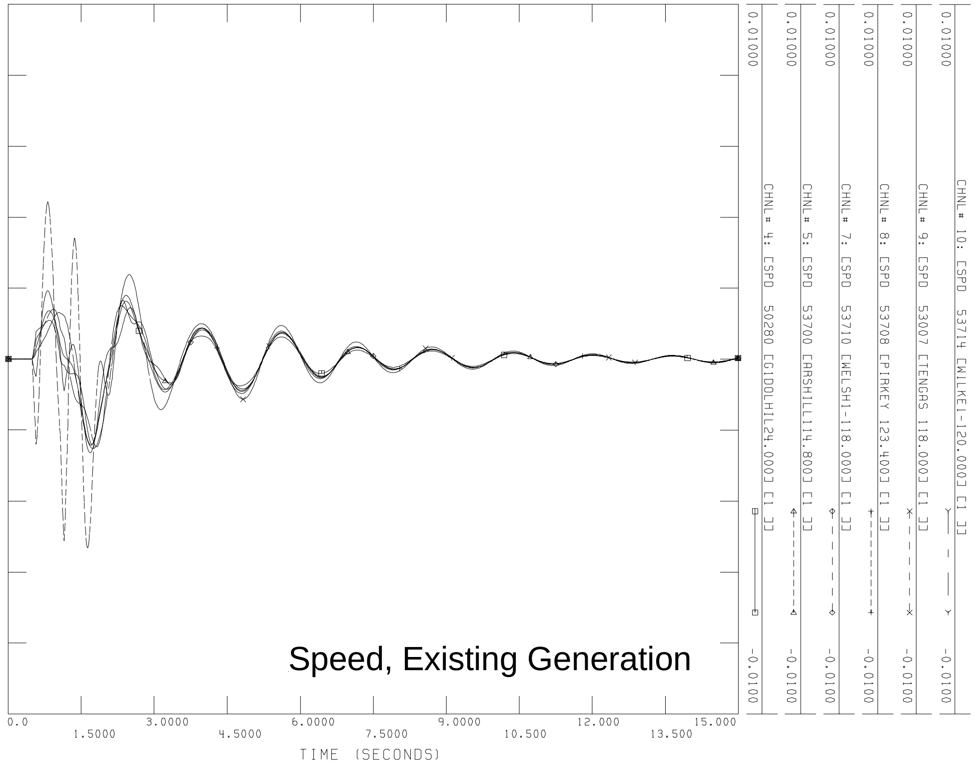

Speed, Existing Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
0.01000
-0.0100
CHNL # 11: [SPD 53640 [LEBR G1 18.000] [1]]
CHNL # 12: [SPD 53701 [FLINTCR121.000] [1]]
CHNL # 14: [SPD 55041 [SEMINL2G17.100] [1]]

Case 3

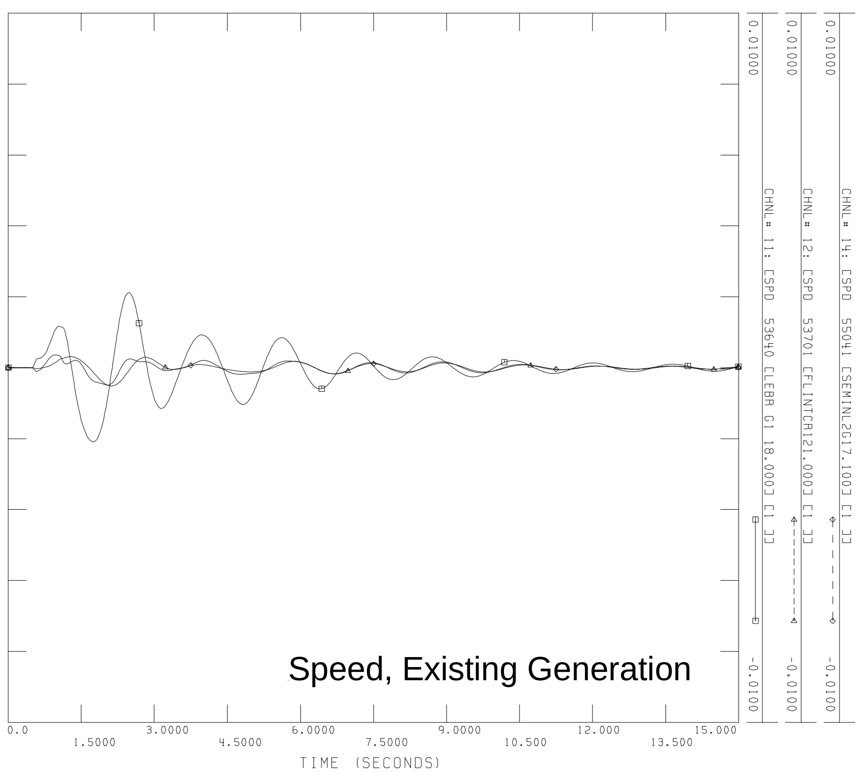

Speed, Proposed Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
0.01000
-0.0100
CHNL# 1: [SPD 53481 [RRP-CT1 18.000] [1]]
CHNL# 2: [SPD 53482 [RRP-CT2 18.000] [1]]
CHNL# 13: [SPD 53483 [RRP-CT3 18.000] [1]]
CHNL# 3: [SPD 53484 [RRP-ST1 19.500] [1]]


V_T, Proposed Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
1.2000
0.20000
CHNL# 71: [ETRM 53481 [RRP-CT1 18.000] [1]]
CHNL# 72: [ETRM 53482 [RRP-CT2 18.000] [1]]
CHNL# 83: [ETRM 53483 [RRP-CT3 18.000] [1]]
CHNL# 73: [ETRM 53484 [RRP-ST1 19.500] [1]]

Case 3

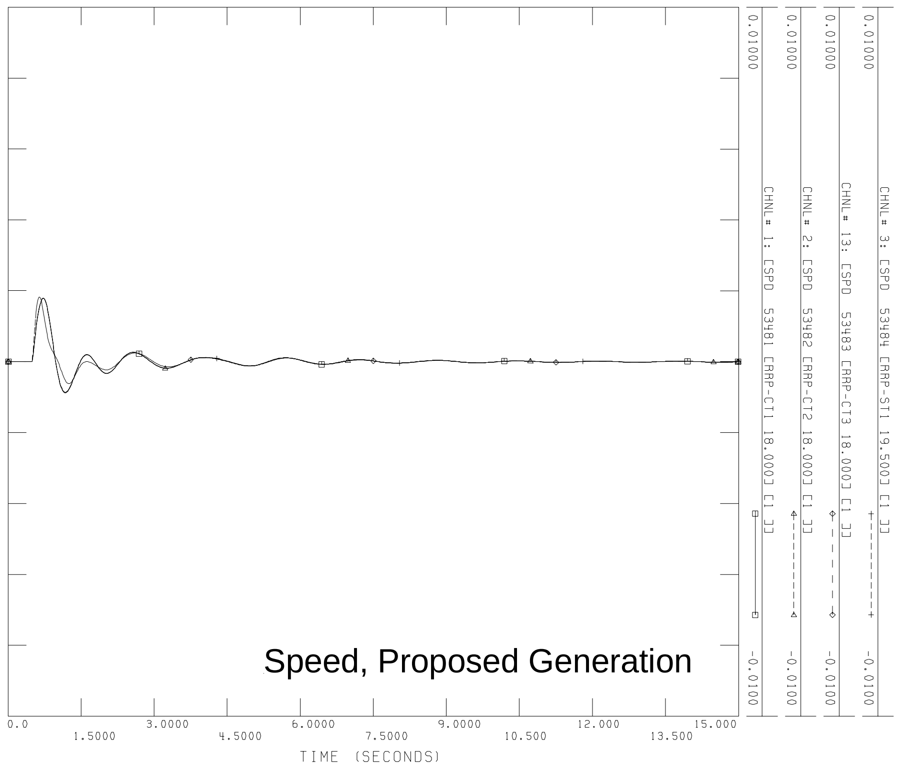


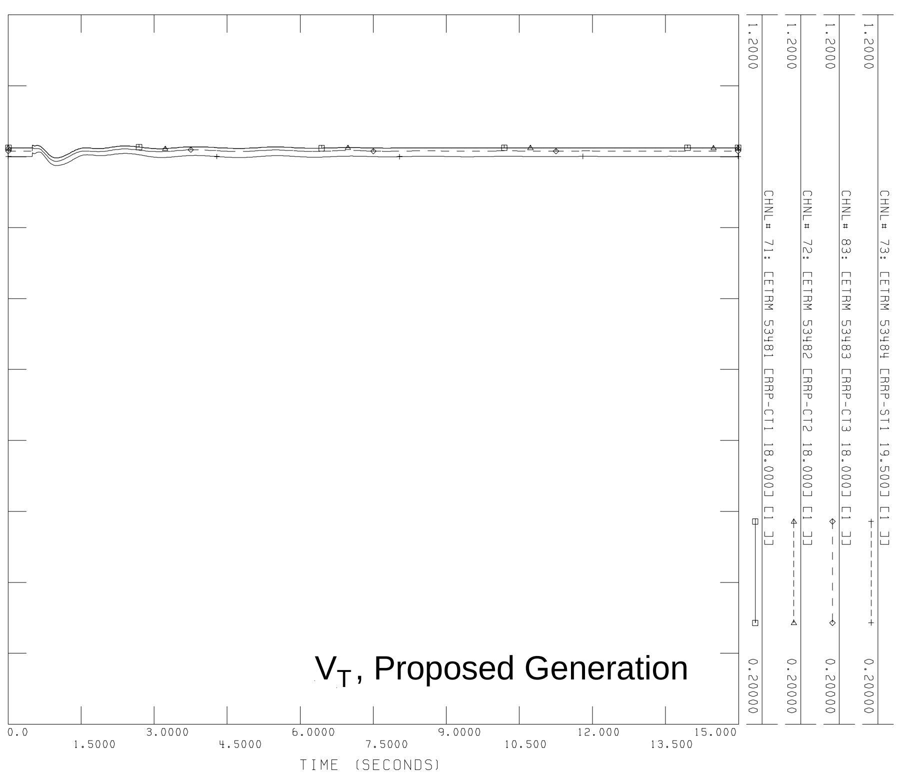
Speed, Existing Generation
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)
0.01000
-0.0100
CHNL# 4: [SPD 50280 [GIDDLHIL24.000] [1]]
CHNL# 5: [SPD 53700 [ARSHILL14.800] [1]]
CHNL# 7: [SPD 53710 [WELSH1-118.000] [1]]
CHNL# 8: [SPD 53708 [PIRKEY 123.400] [1]]
CHNL# 9: [SPD 53007 [TENGAS 118.000] [1]]
CHNL# 10: [SPD 53714 [WILKE1-120.000] [1]]



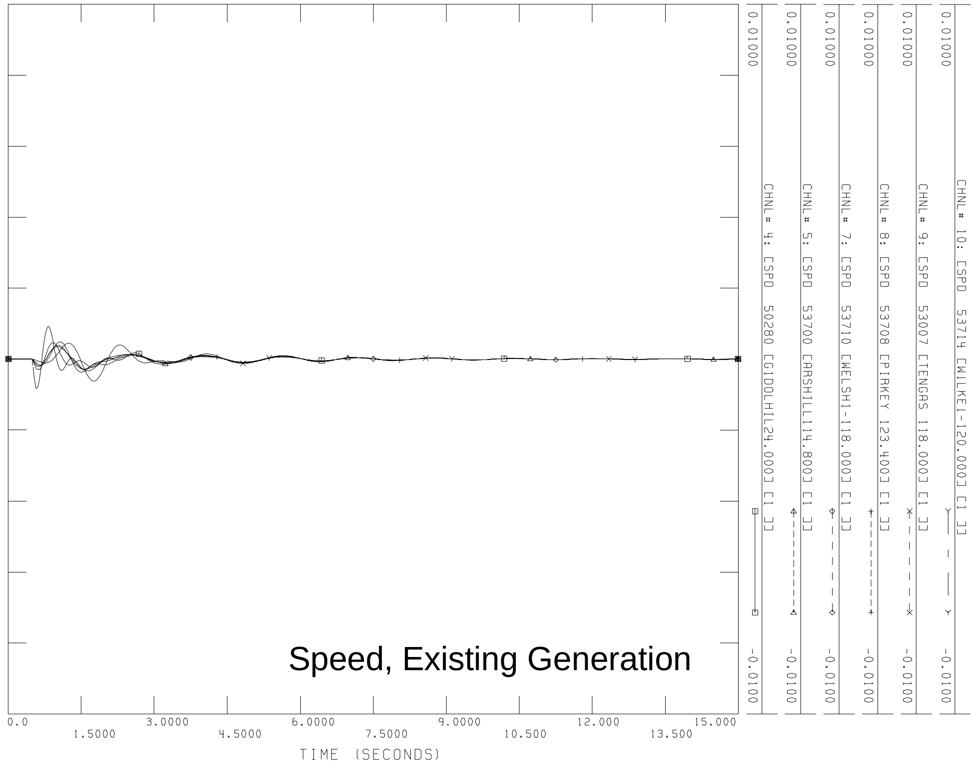
Speed, Existing Generation
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)
0.01000
-0.0100
CHNL# 11: [SPD 53640 [LEBR G1 18.000] [1]]
CHNL# 12: [SPD 53701 [FLINTCR121.000] [1]]
CHNL# 14: [SPD 55041 [SEMINL2G17.100] [1]]

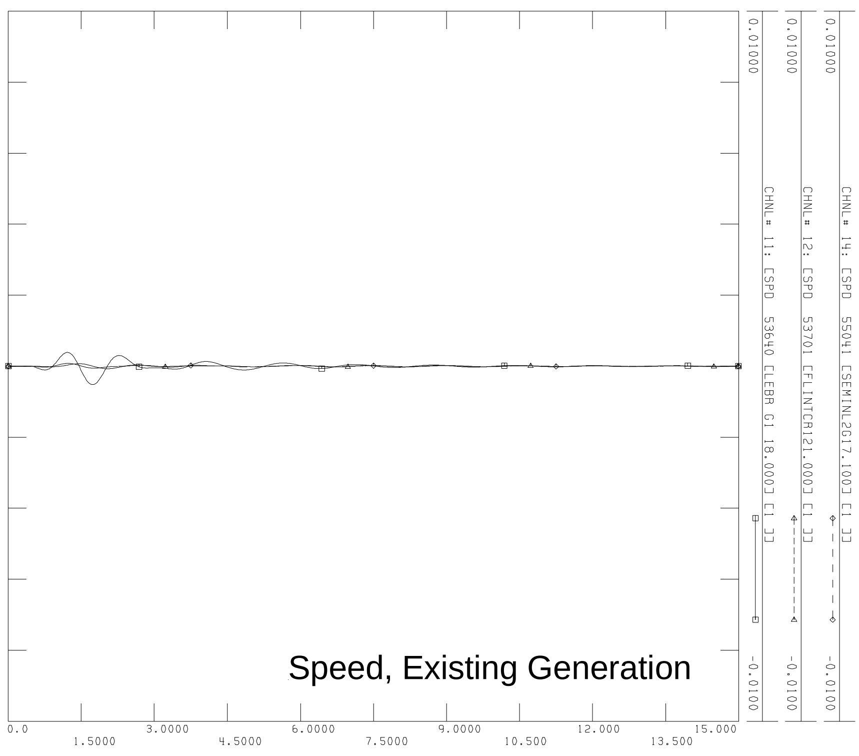
Case 4


Speed, Proposed Generation
0.01000
-0.0100
CHNL # 1: [SPD 53481 [RRP-CT1 18.000] [1]]
CHNL # 2: [SPD 53482 [RRP-CT2 18.000] [1]]
CHNL # 13: [SPD 53483 [RRP-CT3 18.000] [1]]
CHNL # 3: [SPD 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)

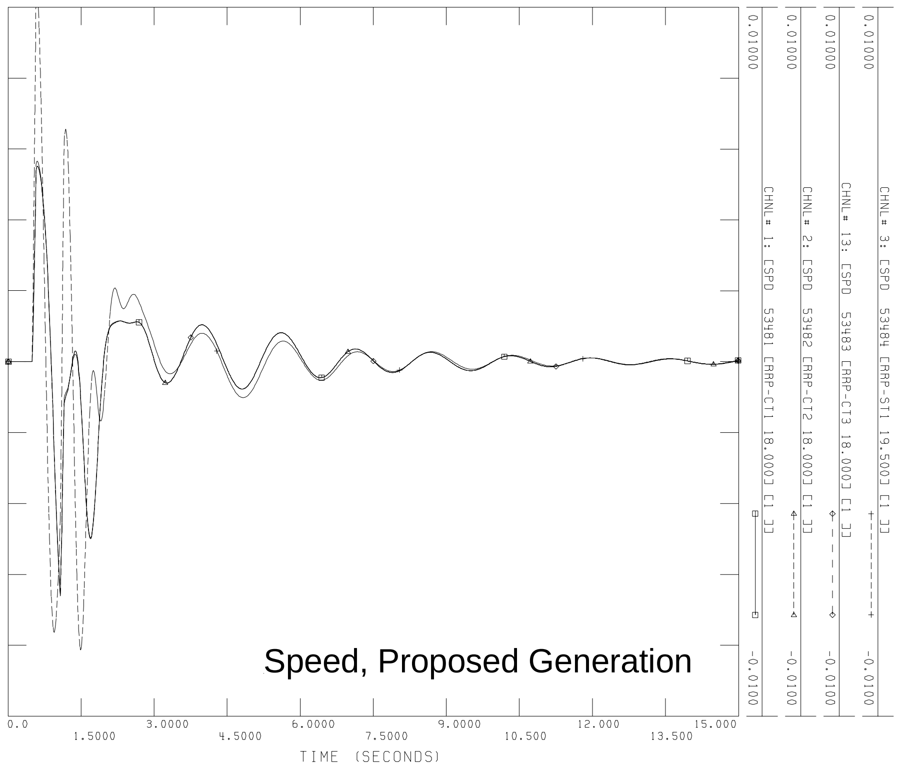

V_T, Proposed Generation
1.2000
0.20000
CHNL # 71: [ETRM 53481 [RRP-CT1 18.000] [1]]
CHNL # 72: [ETRM 53482 [RRP-CT2 18.000] [1]]
CHNL # 83: [ETRM 53483 [RRP-CT3 18.000] [1]]
CHNL # 73: [ETRM 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)

Case 4

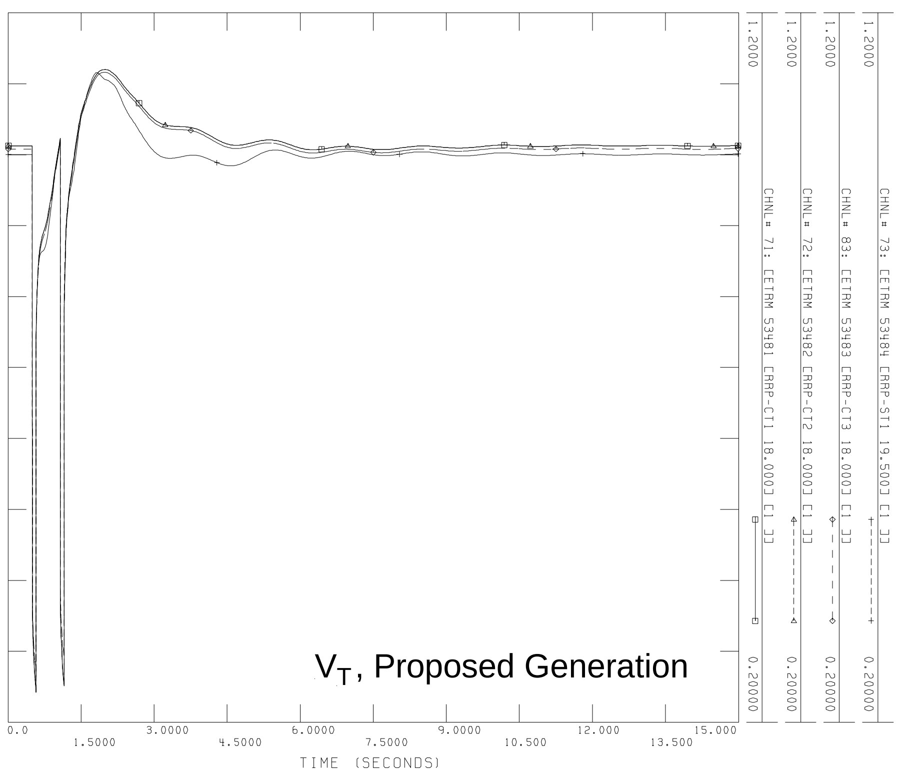

Speed, Existing Generation
TIME (SECONDS)
0.0 1.5000 3.0000 4.5000 6.0000 7.5000 9.0000 10.500 12.000 13.500 15.000
0.01000
-0.0100
CHNL # 4: [SPD 50280 [GIDDLHIL24.000] [1]]
CHNL # 5: [SPD 53700 [ARSHILL14.800] [1]]
CHNL # 7: [SPD 53710 [WELSH1-118.000] [1]]
CHNL # 8: [SPD 53708 [PIRKEY 123.400] [1]]
CHNL # 9: [SPD 53007 [TENGAS 118.000] [1]]
CHNL # 10: [SPD 53714 [WILKE1-120.000] [1]]


Speed, Existing Generation
TIME (SECONDS)
0.0 1.5000 3.0000 4.5000 6.0000 7.5000 9.0000 10.500 12.000 13.500 15.000
0.01000
-0.0100
CHNL # 11: [SPD 53640 [LEBR G1 18.000] [1]]
CHNL # 12: [SPD 53701 [FLINTCR121.000] [1]]
CHNL # 14: [SPD 55041 [SEMINL2G17.100] [1]]

Case 5

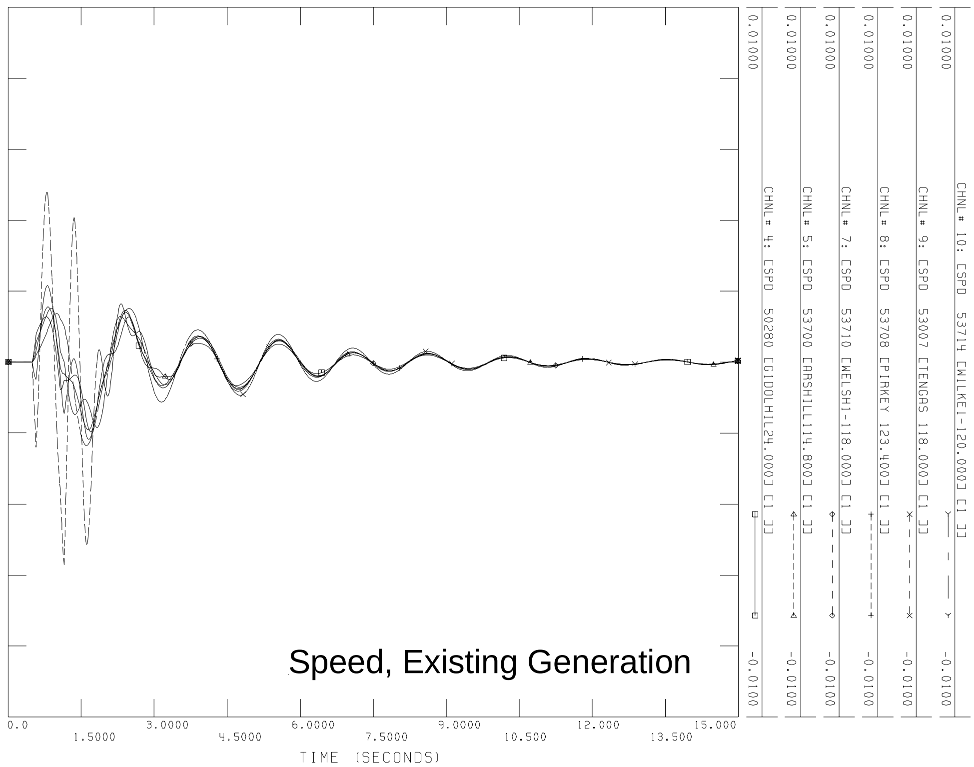


Speed, Proposed Generation
0.01000
-0.0100
CHNL# 1: [SPD 53481 [RRP-CT1 18.000] [1]]
CHNL# 2: [SPD 53482 [RRP-CT2 18.000] [1]]
CHNL# 13: [SPD 53483 [RRP-CT3 18.000] [1]]
CHNL# 3: [SPD 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)

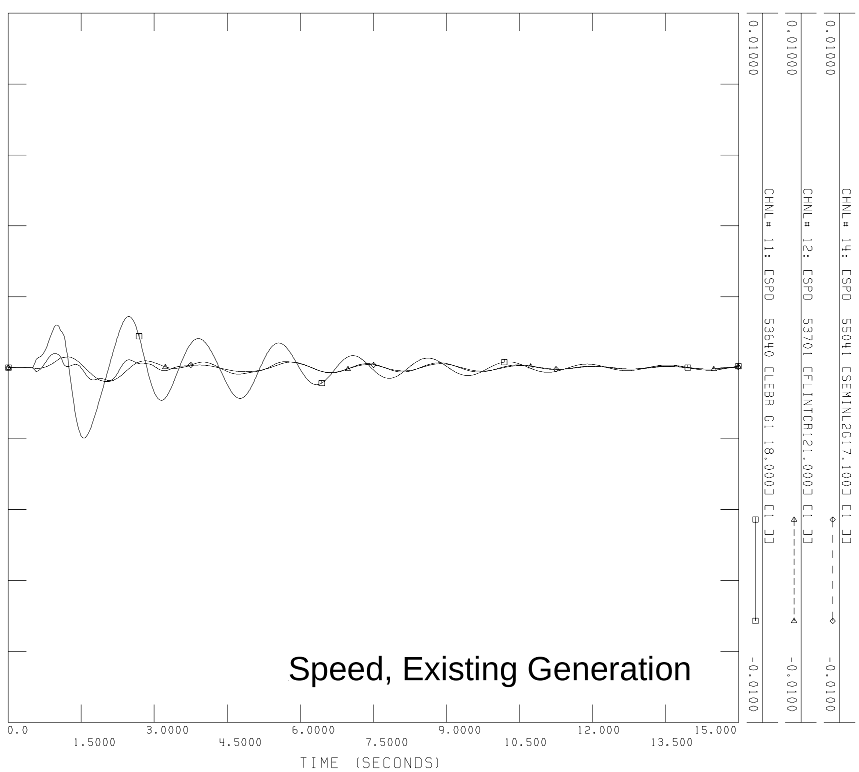


V_T, Proposed Generation
1.2000
0.20000
CHNL# 71: [ETRM 53481 [RRP-CT1 18.000] [1]]
CHNL# 72: [ETRM 53482 [RRP-CT2 18.000] [1]]
CHNL# 83: [ETRM 53483 [RRP-CT3 18.000] [1]]
CHNL# 73: [ETRM 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)

Case 5

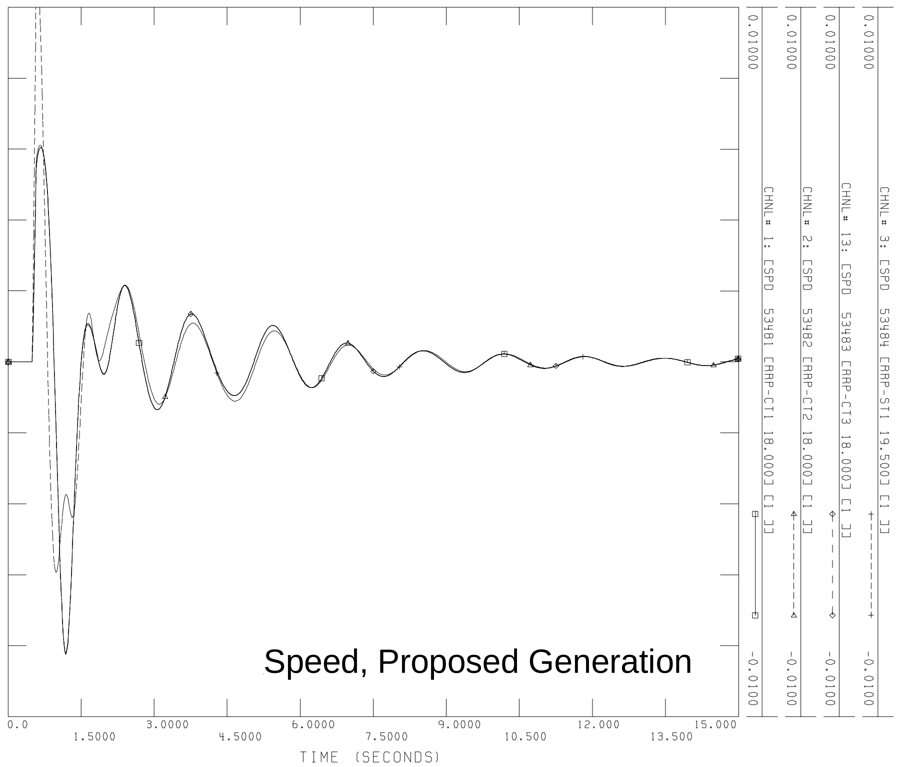


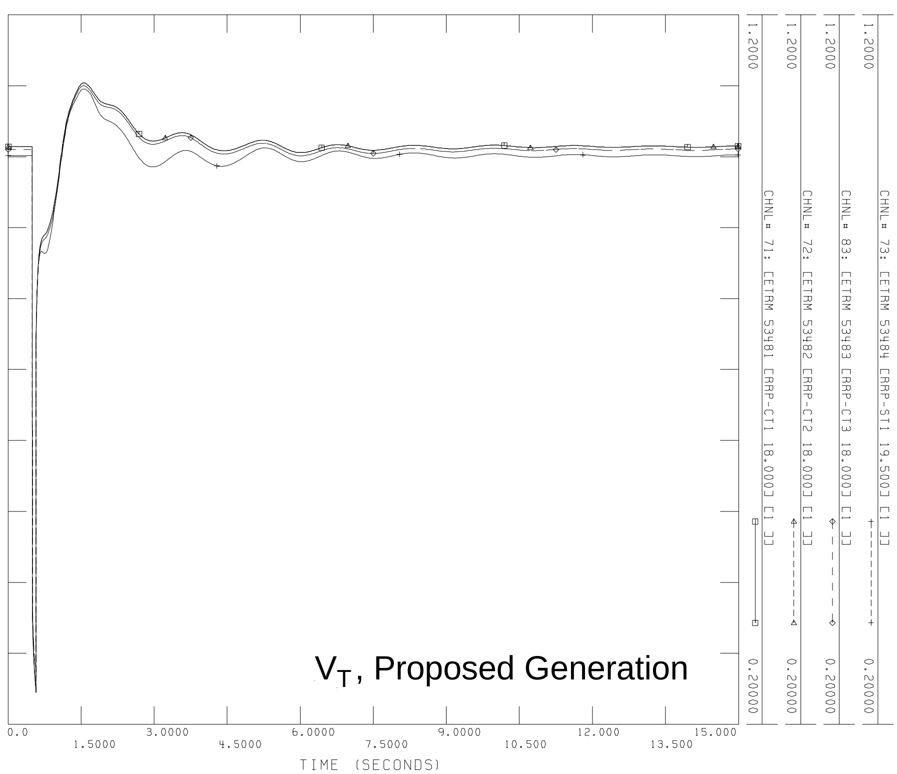
Speed, Existing Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
CHNL# 4: [SPD 50280 [GIDOLHIL24.000] [1]]
CHNL# 5: [SPD 53700 [ARSHILL114.800] [1]]
CHNL# 7: [SPD 53710 [WELSH1-118.000] [1]]
CHNL# 8: [SPD 53708 [PIRKEY 123.400] [1]]
CHNL# 9: [SPD 53007 [TENGAS 118.000] [1]]
CHNL# 10: [SPD 53714 [WILKE1-120.000] [1]]



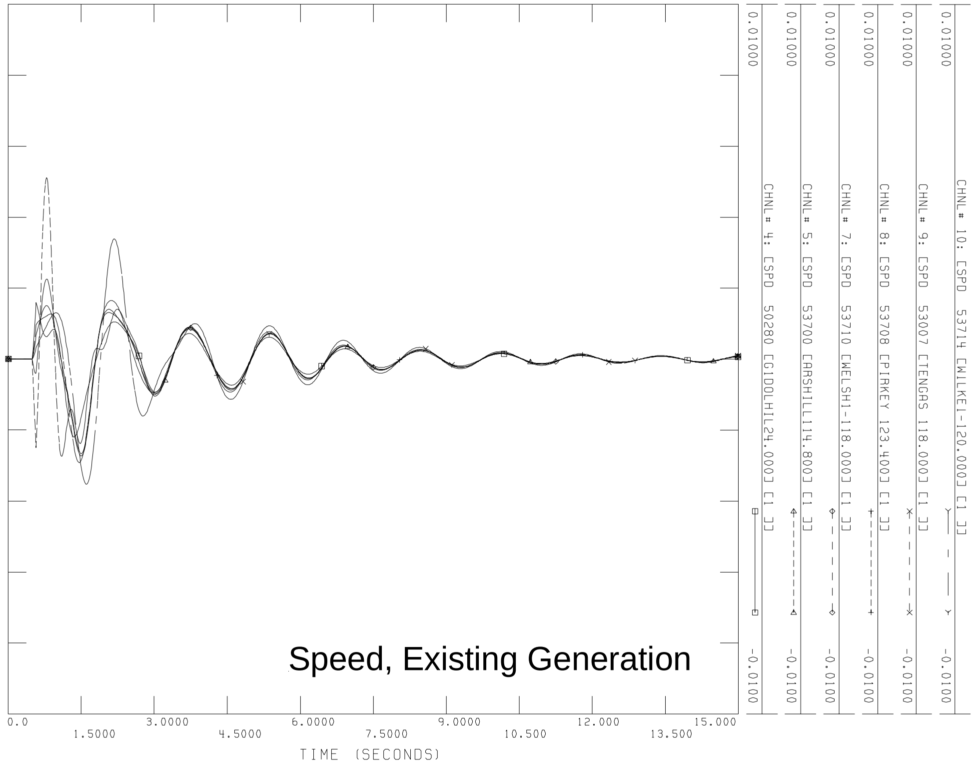
Speed, Existing Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
CHNL# 11: [SPD 53640 [LEBR G1 18.000] [1]]
CHNL# 12: [SPD 53701 [FLINTCR121.000] [1]]
CHNL# 14: [SPD 55041 [SEMINL2G17.100] [1]]

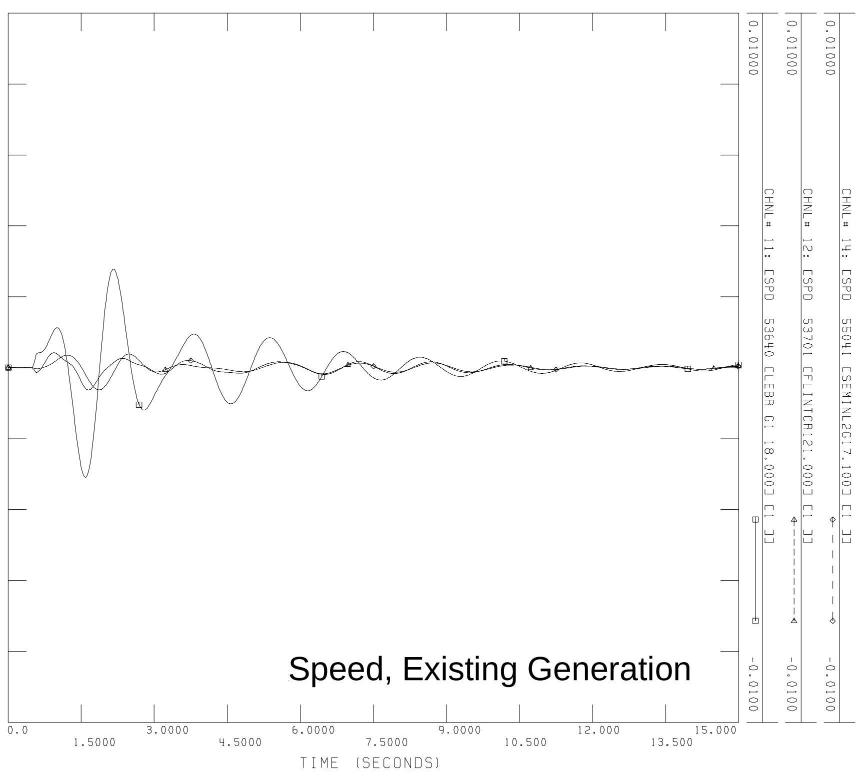
Case 6


Speed, Proposed Generation
0.01000
-0.0100
CHNL# 1: [SPD 53481 [RRP-CT1 18.000] [1]]
CHNL# 2: [SPD 53482 [RRP-CT2 18.000] [1]]
CHNL# 13: [SPD 53483 [RRP-CT3 18.000] [1]]
CHNL# 3: [SPD 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)

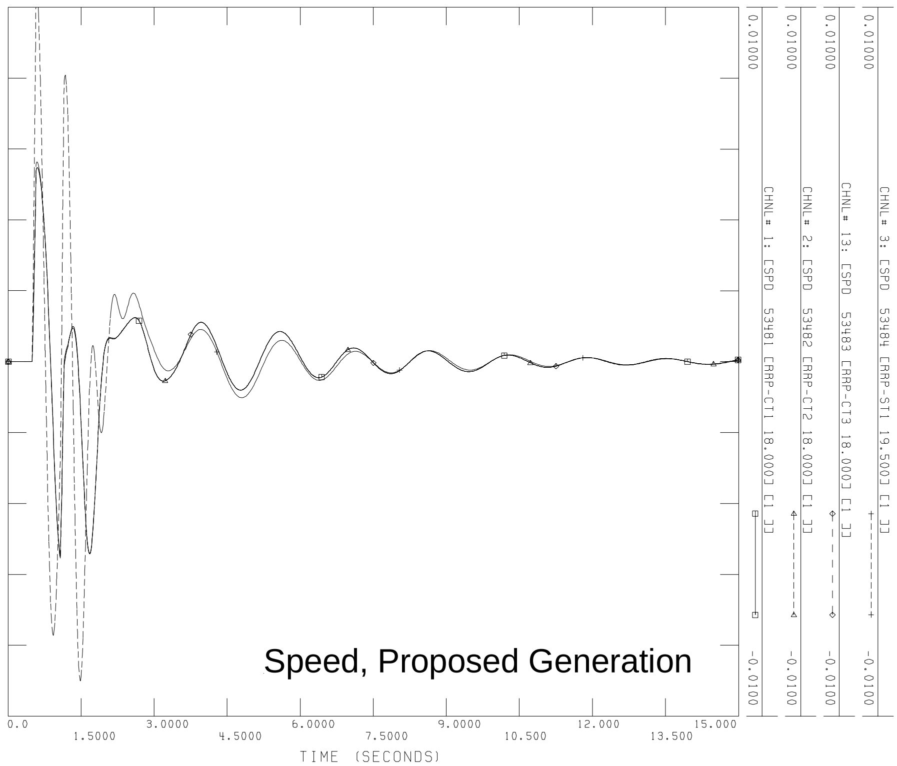

V_T, Proposed Generation
1.2000
0.20000
CHNL# 71: [ETRM 53481 [RRP-CT1 18.000] [1]]
CHNL# 72: [ETRM 53482 [RRP-CT2 18.000] [1]]
CHNL# 83: [ETRM 53483 [RRP-CT3 18.000] [1]]
CHNL# 73: [ETRM 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)

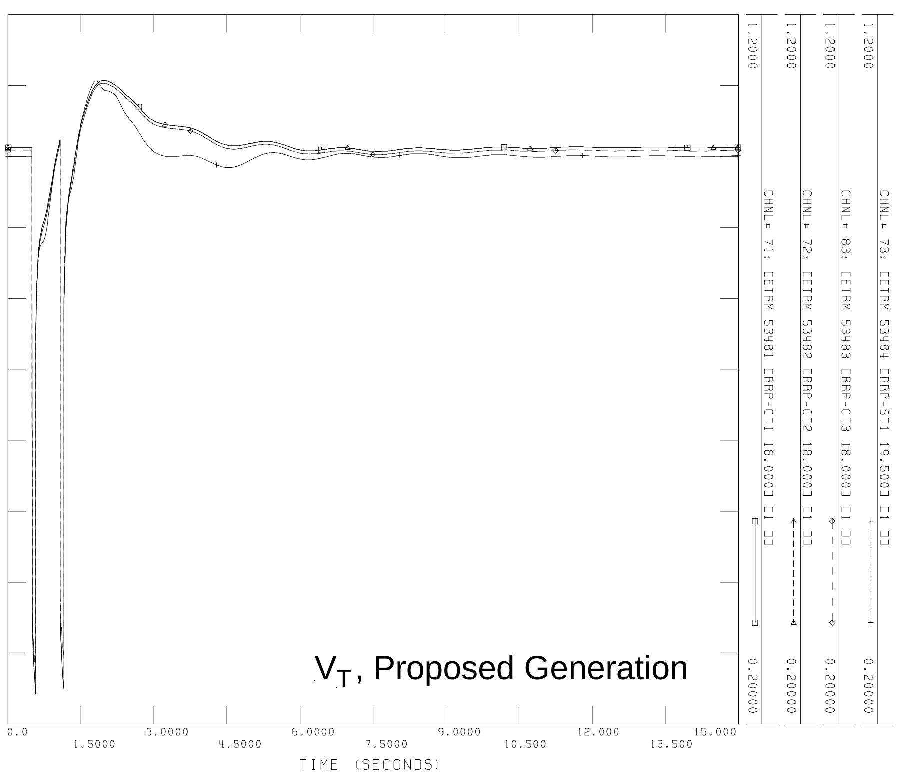
Case 6


Speed, Existing Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
0.01000
-0.0100
CHNL # 4: [SPD 50280 [GIDOLHIL24.000] [1]]
CHNL # 5: [SPD 53700 [ARSHILL14.800] [1]]
CHNL # 7: [SPD 53710 [WELSH1-118.000] [1]]
CHNL # 8: [SPD 53708 [PIRKEY 123.400] [1]]
CHNL # 9: [SPD 53007 [TENGAS 118.000] [1]]
CHNL # 10: [SPD 53714 [WILKE1-120.000] [1]]

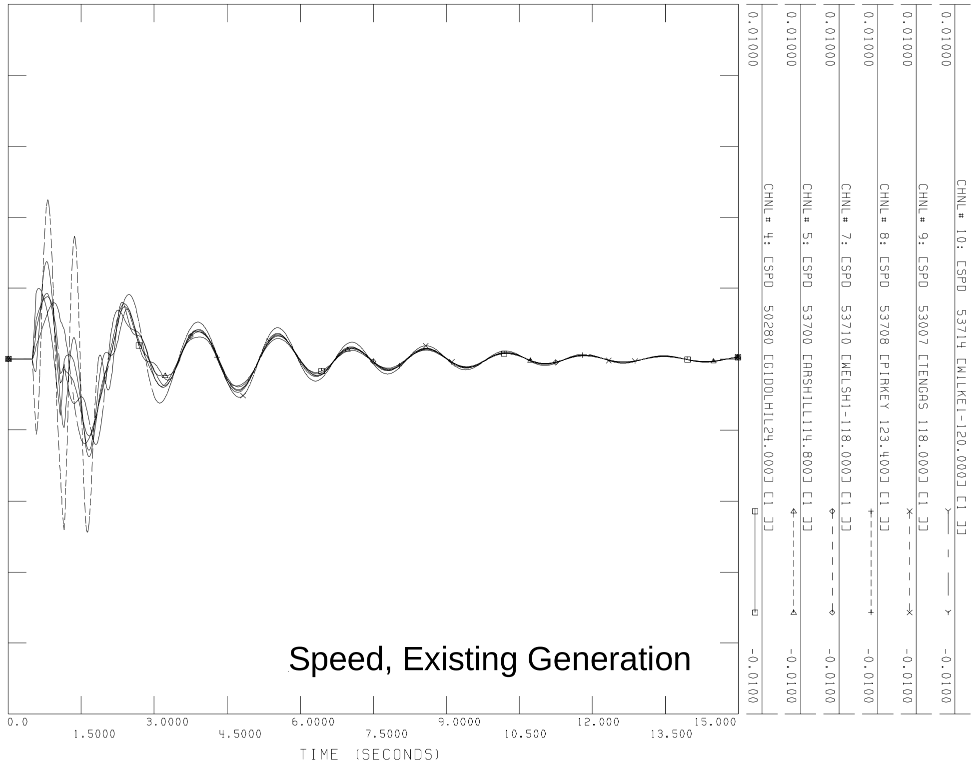

Speed, Existing Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
0.01000
-0.0100
CHNL # 11: [SPD 53640 [LEBR G1 18.000] [1]]
CHNL # 12: [SPD 53701 [FLINTCR121.000] [1]]
CHNL # 14: [SPD 55041 [SEMINL2G17.100] [1]]

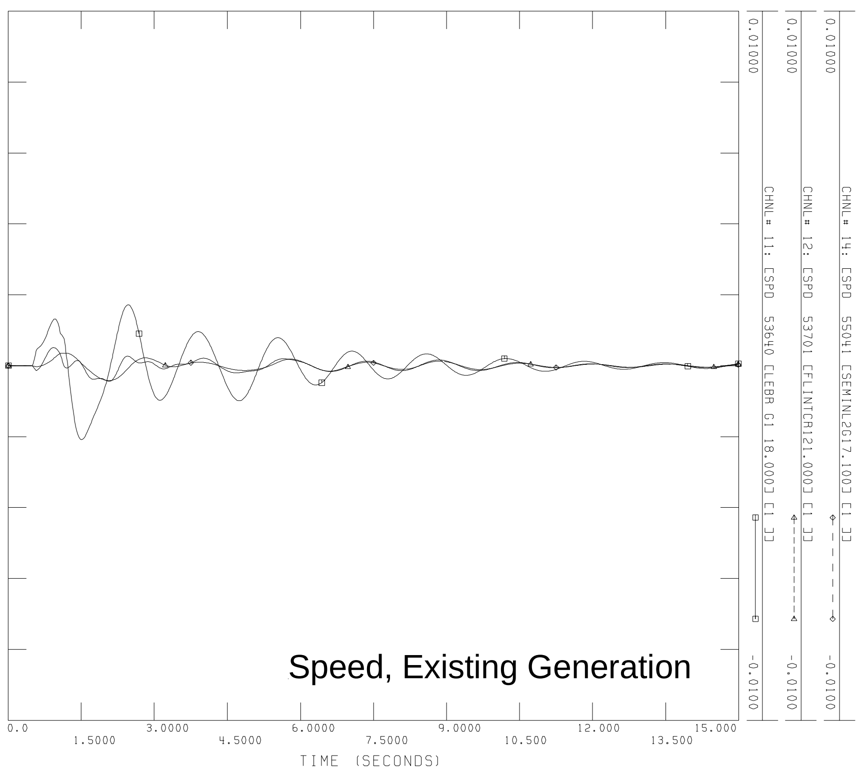
Case 7


Speed, Proposed Generation
0.01000
-0.0100
CHNL# 1: [SPD 53481 [RRP-CT1 18.000] [1]]
CHNL# 2: [SPD 53482 [RRP-CT2 18.000] [1]]
CHNL# 13: [SPD 53483 [RRP-CT3 18.000] [1]]
CHNL# 3: [SPD 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)


V_T, Proposed Generation
1.2000
0.20000
CHNL# 71: [ETRM 53481 [RRP-CT1 18.000] [1]]
CHNL# 72: [ETRM 53482 [RRP-CT2 18.000] [1]]
CHNL# 83: [ETRM 53483 [RRP-CT3 18.000] [1]]
CHNL# 73: [ETRM 53484 [RRP-ST1 19.500] [1]]
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)

Case 7


Speed, Existing Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
0.01000
-0.0100
CHNL # 4: [SPD 50280 [GIDOLHIL24.000] [1]]
CHNL # 5: [SPD 53700 [ARSHILL[14.800] [1]]
CHNL # 7: [SPD 53710 [WELSH1-1[18.000] [1]]
CHNL # 8: [SPD 53708 [PIRKEY 123.400] [1]]
CHNL # 9: [SPD 53007 [TENGAS 118.000] [1]]
CHNL # 10: [SPD 53714 [WILKE1-120.000] [1]]


Speed, Existing Generation
TIME (SECONDS)
0.0
1.5000
3.0000
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
0.01000
-0.0100
CHNL # 11: [SPD 53640 [LEBR G1 18.000] [1]]
CHNL # 12: [SPD 53701 [FLINTCR121.000] [1]]
CHNL # 14: [SPD 55041 [SEMINL2G17.100] [1]]

C. Short Circuit Analysis

Scope

The subject of this study is the >omitted text< proposed >omitted text< power plant at the >omitted text< near Shreveport, in Caddo Parish, Louisiana. This plant will connect into the Southwestern Electric Public Service Company (SWEPCO) local transmission system via three 138 kV lines to South Shreveport, Hart's Island and Red Point and a 345 kV line to Southwest Shreveport. The purpose of this study is to assess the impact of the addition of the proposed generation on the available fault current in the SWEPCO system, and to determine whether or not the interrupting rating of SWEPCO circuit breakers, circuit switchers, and power fuses would be exceeded as a result of the addition.

The software used to study the >omitted text< proposed plant near Shreveport has the ability to calculate ANSI X/R ratios for bus and close in faults and to perform a breaker rating study in batch mode for determining the short-circuit duty imposed on circuit-interrupting devices. The base short-circuit case used was a Southwest Power Pool (SPP) 2005 case. This case includes prior IPP generation and related system improvements. This case was modified for the additional system change requirements for the injection of >omitted text< of generation by >omitted text<, into the SWEPCO transmission system.

>omitted text< Case Model Data

The following facilities were modeled in the short circuit case to determine the impact of >omitted text< on available short circuit levels:

- The >omitted text< 138 kV generating facility comprised of a single >omitted text< stream turbine, one >omitted textT< combustion turbine, and two 164 MW combustion turbines. The Red River Port station would be configured in a breaker and a half arrangement with a single 345/138kV, 675 MVA autotransformer.

- One 345 kV line from the >omitted text< station to SWEPCO's Southwest Shreveport station. Three 138 kV lines from the >omitted text< station to SWEPCO's South Shreveport, Hart's Island, and Red Point stations.

Method

The batch short-circuit and breaker rating program was then used to place a three-phase-to-ground and a single-phase-to-ground close in fault on each transmission line connected to each breaker modeled in the short-circuit case. For each breaker, the worst case fault current level was compared to the breaker rating. This was performed with the above facilities excluded and then performed again with the above facilities included for comparative purposes.

Conclusion

It is standard practice for AEP to recommend replacing a circuit breaker when the current through the breaker for a fault exceeds 100% of its interrupting rating with recloser de-rating applied, as determined by the ANSI/IEEE C37.5-1979, C37.010-1979 & C37.04-1979 breaker rating methods.

In the SWEPCO system, the following breakers were found to exceed their interrupting capability after the addition of the >omitted text< 904 MW generation and related facilities:

Arsenal Hill Equipment	Base Case Without IPP % Of Interrupting Rating	Base Case with IPP % Of Interrupting Rating
69 kV Breaker 430	99.3	109.0
69 kV Breaker 480	99.2	109.0
69 kV Breaker 2360	92.0	100.5
69 kV Breaker 3720	99.3	109.0
69 kV Breaker 8230	98.4	108.1
69 kV Breaker 9760	91.7	101.1
138 kV Breaker 4980	96.4	120.2

South Shreveport Equipment	Base Case Without IPP % Of Interrupting Rating	Base Case with IPP % Of Interrupting Rating
138 kV Breaker 7260	99.0	135.0
138 kV Breaker 7270	99.7	148.3