**Analysis of Electrical Power System
Disturbance and Outage in Garland
and Greenville, Texas
June 26, 1980**

January 1981

U.S. Department of Energy
Economic Regulatory Administration
Division of Power Supply and Reliability

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FOREWORD

This analysis report was accomplished under the provisions of Section 311 of the Federal Power Act. The Department of Energy is concerned with the adequacy and reliability of the electric power supply, thus it has a vital interest in customer outages of extended duration.

On June 26, 1980, the municipal electric systems of Garland and Greenville, Texas, both experienced total system outages. The incident began at 2:01 p.m. and total customer service was not restored until 10:15 p.m. that evening. In order to understand more fully the causes of this disturbance, a technical analysis was initiated to consider:

- (1) the status of each of the involved utility systems prior to initiation of the disturbance;
- (2) the sequence of events which occurred between the initial event precipitating the interruption and the total system outages;
- (3) the restorative procedures implemented by the involved systems; and
- (4) any procedural changes or facility modifications that should be considered by the involved systems.

The Economic Regulatory Administration's (ERA), Division of Power Supply and Reliability conducted this analysis and prepared the report.

Following the completion of the analysis, a draft report was prepared. Copies of this report were forwarded to the utilities of the cities of Garland and Greenville and the Chairman of the Technical Advisory Committee of the Electric Reliability Council of Texas requesting their review and comments. All parties forwarded comments. The comments received have been analyzed and changes have been made in the report where appropriate. Appendices B, C, D and E contain the DOE letter requesting these comments and the responses.

This report begins with an Executive Summary which contains the most significant recommendations of this analysis. Supporting materials for these recommendations can be found in subsequent chapters.

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EXECUTIVE SUMMARY

On Thursday, June 26, 1980, the total electric load of the Municipal Electric Systems of Garland and Greenville, Texas, was lost. The blackout affected more than 100,000 people for varying periods of time up to a maximum of five hours. Although there was no loss of life associated with the blackout and economic losses appear to be minimal, there was probably considerable discomfort experienced by the municipal customers since the occurrence of the outage happened on the day on which the highest temperature on record for the area occurred. This official temperature as recorded at the Dallas-Forth Worth Airport was 113°F.

The Garland disturbance was caused by a combination of natural events, electric power facilities out of service due to delays in completing some system improvements and judgmental decisions on the part of the utility management officials. The city of Greenville's blackout was a direct result of the problems experienced by Garland and could only have been prevented if Greenville had been electrically islanded from Garland before their own generation was lost.

At 2:01 p.m. on June 26 a tree limb apparently became entangled in a 138-kV transmission line owned by the city of Garland. Protective equipment on the line sensed this condition and operated correctly with the circuit breaker opening, reclosing, opening again and locking out when the fault failed to clear. At 2:22 p.m. a successful attempt was made to remotely close the circuit breaker that had locked out and a helicopter was dispatched to patrol the line and locate the problem. At 3:11 p.m. the helicopter located a tree which had a limb in the proximity of the line. This tree was located in the transmission right-of-way and the backwash from the helicopter caused the limb to contact the line. Again the protective equipment operated correctly and the line locked out when the fault failed to clear.

At this time the Garland utility management decided not to attempt reclosure of the line until the tree had been removed from the right-of-way. A work crew was dispatched to accomplish this task and concurrently the utility management made a decision to remove the over-load protective equipment from its 69-kV transmission line network. This decision was apparently made when it was recognized that the 138 kV line outage would cause high loads on the 69-kV lines in operation. At approximately 5:05 p.m. the continuing overloads resulted in the melting and separating of a phase conductor on two different 69-kV transmission lines. A connecting wire on a 69-kV switch failed due to the heavy loads. At yet another location a heavily loaded 69-kV transmission line sagged into a 13-kV distribution circuit. These events caused the total loss of generation on Garland's system, an outage of the Garland system's control center and the loss of all customer load (290 MW at that time).

The second contact between the tree limb and the transmission line occurred at 3:11 p.m. At this time Garland's Olinger Unit No. 1 became electrically isolated from its system and began operating in parallel with the Greenville Municipal Electric System. Olinger Unit No. 1 was generating 75 MW which was 16 MW more than the Greenville system load at that time. This overgeneration caused the frequency on the Greenville system to exceed 62 hertz and automatic protection equipment caused Greenville's generating units to trip off the line. The 69-kV line connecting Greenville's system with Garland tripped due to overload at 3:22 p.m. and the entire city of Greenville was blacked out.

The Department of Energy recommends the following actions be initiated and/or continued as appropriate.

Garland Municipal Utility

- o Establish a program for transmission line right-of-way maintenance
- o Develop an Emergency Operation Plan with specific requirements regarding the bypassing of any protective relay schemes or equipment.
- o Develop a detailed System Restoration Plan.
- o Plan and schedule operator training exercises in the implementation of the above plans.

Greenville Municipal Utility

- o Develop an Emergency Operations Plan.
- o Develop a detailed Service Restoration Plan.
- o Evaluate the advisability of automatically isolating its system from Garland when a significant system frequency excursion occurs.
- o Conduct a technical and economic study to determine the feasibility of effecting an interconnection with the Texas Power & Light Company or another utility.

Texas Municipal Power Pool

- o Evaluate the development of uniform Power Pool Operating Criteria.
- o Consider the establishment of a Power Pool Contingency Plan.

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Chapter 1

System Description

A. City of Garland

The Municipal Electric System of Garland, Texas, was started on April 1, 1923. One month later the municipal system was providing electricity to 200 of the 1,500 population with the Texas Power & Light Company (TEPL) serving the remainder. At present the Municipal System serves 38,000 customers which represents approximately 85 percent and TEPL serves the remaining 15 percent under an existing franchise which will expire in 1989.

Garland is located just northeast of Dallas, Texas, in the northeast portion of Dallas County. Figure No. 1 provides a general location with respect to other large cities in Texas, Oklahoma, Arkansas and Louisiana and Figure No. 2 gives a more detailed location with respect to the city of Dallas.

The City presently has two generating stations with a total net capability of 435-MW. One, the C.E. Newman Plant, is located within the city limits and the second, the Ray Olinger Plant, is located on the northeast shore of the Lator Reservoir in Collin County. (See Figures Nos. 3, 4 and 5.) The two plants consist of eight steam-electric generators with a capability of producing 435-MW and burn natural gas as the primary fuel with oil as an alternate. In 1979 Garland generated 96.7 percent of its energy output from natural gas.

Figures Nos. 3, 4 and 5 show the location of Garland's 69-kV and 138-kV transmission network. The City has four interconnections, excluding the interconnection with the municipal electric system of Greenville, Texas. There is a 138-kV tie with TEPL at the Apollo substation and another 138-kV connection with TEPL at the Oates substation. Two 69-kV interconnections are maintained with the Brazos Electric Power Cooperative, Inc. (BREP); one at Apollo and one at Fairdale.

In 1979 the Municipal Electric System of Garland delivered 1,200,967 Mwh of energy to 37,036 retail customers. Of this total, 758 were industrial customers, 2,036 commercial and the remainder non-farm residential. The 1979 peak demand was 283-MW which occurred in September. Garland's projected 1980 summer peak was 317-MW. The 1980 system peak load up to the day of the interruption was 295-MW which occurred on that day.

Garland is a member of the Texas Municipal Power Agency (TMPA) along with the cities of Greenville, Denton and Bryan, Texas. The majority of its future capacity and generation will be provided via this agency. At present the TMPA has under construction Gibbons Creek unit No. 1, a 400-MW lignite-fired generating unit, located in Grimes County, Texas. Gibbons Creek No. 1 is scheduled for operation in June 1982. The TMPA has also contracted for 71.3 MW from each of the Comanche Peak Nuclear units being constructed by the Texas Utilities Company System. Unit No. 1 is planned for operation in 1982 and unit No. 2 in 1984.

B. City of Greenville

The City of Greenville, Texas, is located approximately 50 miles northeast of Dallas, Texas. Figure No. 1 provides a general location of Greenville with respect to large cities in Texas and surrounding states.

In 1979 the Municipal Electric System of Greenville experienced a peak demand of 56-MW and delivered a total of 209,117 MWh of energy to its 9,386 customers. The distribution of these customers was 8,083 non-farm residential, 1,194 commercial, 17 industrial and 92 street and highway lighting. On the day of the total system interruption Greenville experienced a peak load of 58.8 MW which was below the 1980 peak projection of 62 MW.

Greenville's existing generation consists of a 15-MW diesel plant and a three unit gas-fired, steam-electric generation plant rated at 82-MW. Future capacity and energy will be obtained through the TMPA. (See discussion under city of Garland.) At the time of the power failure, Greenville had in operation approximately 42.5 miles of 69-kV transmission circuits including a 22 mile 69-kV interconnection with the Municipal System of Garland. The 69-kV tie with Garland has an average capability of 25-MW. A 138-kV tie line, also 22 miles in length, between Greenville and Garland was scheduled but not in-service at the time of the interruption. This is the only interconnection maintained by Greenville. Figure No. 4 provides a general location of Greenville's generating capacity and its tie with Garland.

Chapter II
Summary of Interruption

A. City of Garland

A total power system outage was experienced by the city of Garland, Texas, on Thursday, June 26, 1980, at approximately 5:05 p.m. C.D.T. The loss of load at the time of the outage was 290 MW and affected approximately 38,000 customers. The outage also resulted in the total system outage of the Greenville Municipal Power & Light system which will be discussed separately.

The sequence of events leading to the outage started at 2:01 p.m. when a tree limb was blown into the conductors on the Brand to Olinger 138-kV transmission line (see Figure No. 6). Protective relaying isolated the fault by opening Oil Circuit Breakers (OCB) 8130 and 8220. Several breaker trippings occurred on the 69-kV system due to this fault and within 15 minutes Garland's system load had dropped from 295-MW to 35-MW. System generation dropped from 325-MW to 250-MW also within 15 minutes due to the loss of Garland's Newman Plant. Control center emergency backup generation at Newman started successfully at 2:07 p.m.

At 2:22 p.m. company personnel decided to reclose the faulted 138-kV line. They did and the line held closed. Breakers were then closed throughout the Garland system restoring load and generation. System load was back to the pre-fault level by 3:00 p.m.

A helicopter was dispatched to try and locate the cause of the 138-kV line fault. A tree growing in the right-of-way was located but the backwash from the helicopter blew the tree limb back into the 138-kV circuit causing a new fault which resulted in tripping OCB's 8130 and 8220 at 3:11 p.m.

Utility officials, now with knowledge of the cause of the fault, decided not to reclose the 138-kV line but to send work crews to remove the tree. Overload relays were made inoperative by Garland personnel on the 69 transmission networks in an attempt to maintain total customer service.

At 3:16 p.m. Olinger units Nos. 2 and 3 were lost due to circuit breaker operations on the 138-kV system, reducing total system generation from 295-MW to 55-MW. System load dropped from 295-MW to 85-MW. Emergency generation at the Newman Control Center started at 3:17 p.m. Olinger unit No. 1 became isolated from the Garland system, thus supplying all of its 75-MW generation across the 69-kV tie to the city of Greenville. This line tripped at 3:22 p.m. causing total loss of power in Greenville.

Manual switching was done at 3:28 p.m. in order to resynchronize the Olinger unit No. 1 generator with the Garland system. This was accomplished and by 3:46 p.m. system load had been restored to a level of 295-MW, generation was 85-MW and Garland was importing a net of 210-MW from Texas Power & Light Company (TEPL) and Brazos Electric Power Cooperative (BEPC). At 3:46 p.m. breakers tripped throughout the system (because of computer problems, the reasons for which are not known) losing the TP&L and BEPC ties at the Apollo Sub and the Newman unit No. 4 generation. One minute later Newman Nos. 3 and 5 tripped-off line. System load was again lost down to a net of 70-MW. System generation went to 0-MW.

Between 3:48 p.m. and 5:05 p.m. switching was done to again restore system load. Newman units Nos. 3, 4 and 5 were brought back on line generating 60 MW. By 5:05 p.m. system load was back to 290-MW.

At 5:05 p.m. extreme overloads were experienced on the 69-kV system causing the following events to occur: (As stated earlier protective relays on the 69-kV system had been removed from service.)

1. The 69-kV line between the Jupiter and Apollo Substations melted and separated.
2. The 69-kV line between the Wynn Joyce and Miller Substations melted and separated.
3. A 69-kV jumper at the Newman Substation on switch 6072 melted and separated.
4. The 69-kV line between Fairdale and Newman sagged into the 13-kV distribution feeder taking out power to the Garland Control Center computer at the Newman plant.
5. All generation, all tie lines, and all system load were lost.

Table No. 1 provides a list of transmission breaker operations during the time period 2:01 p.m. through 5:05 p.m., except for two periods; 2:14 p.m. to 2:18 p.m. and 3:30 p.m. when the computer printer overprinted on one line.

B. City of Greenville

A total system outage was experienced by the city of Greenville on Thursday, June 26, 1980, at 3:22 p.m. C.D.T. The loss of load at the time of the outage was 58.8-MW and affected about 9,000 customers. The outage was caused by problems on the Garland system but preceded Garland's total blackout by an hour and 43 minutes.

The city of Greenville had all three steam generators on the line pushing 10-MW over the 69-kV tie to Garland and supplying the 58.8-MW of system load.

Beginning at 3:11 p.m., due to the outage of Garland's 138-kV line and other circuit breaker operations, Garland's Olinger unit No. 1, generating 75-MW, was isolated from its system and operated in parallel with the Greenville generation. The frequency on Greenville's system went above 62 hertz. The No. 2 unit and No. 3 unit boilers tripped on low drum level. Attempts to purge and relight these boilers were unsuccessful.

At 3:22 p.m. the No. 2 and No. 3 generators tripped off line, the tie to Garland tripped due to overload and the No. 1 generator tripped on overcurrent, blacking out the entire system.

Chapter III

Conditions Prior to Outage

A. City of Garland

On the date of the outage the official temperature at the Dallas-Ft. Worth Airport was an all time record figure of 113°F. The record temperature was causing a substantial increase in the air conditioning load in the area.

At the time of the initial outage (2:01 p.m. C.D.T.) the Garland peak demand was 295-MW which was 4.2 percent higher than the 1979 peak. This peak, however, was still considerably lower than the projected 1980 summer peak of 317-MW. Net capability at the time of the outage was 435-MW of which 325-MW was on line.

The city of Garland was in the process of rearranging their 138-kV and 69-kV transmission system at the time of the outage. Figure No. 6 shows the system as planned and also shows the system as it was on June 26. As can be seen, the Centerville Substation was sitting on the end of a radial 69-kV line. Also a 138-kV tie to Greenville was not completed.

B. City of Greenville

The city of Greenville also experienced a record temperature. The peak load on June 26 of 58.8-MW was 5 percent higher than its 1979 peak but also less than the 1980 summer forecasted peak demand of 62-MW. All of its 97-MW of net generating capability was available and net system output was 68.8-MW.

There were no outages on the Greenville system and no unusual occurrences prior to Greenville's outage other than those on the Garland system.

Chapter IV

Restoration of Service

A. City of Garland

For an hour after the total system blackout at 5:05 p.m. no power system information was available to system operating personnel due to loss of power to the Garland Control Center computer. As stated previously, this was due to a 69-kV line overheating and sagging into the 13-kV supply to the computer. The computer has an emergency backup generator which started satisfactorily but due to a blown inverter fuse the power was not available to the computer. It has not been determined whether the fuse was blown before or during the disturbance.

While the Garland Control Center was without power, the two 138-kV interconnections with TEPL were closed to obtain outside assistance during service restoration. The thermal capacity of the Apollo tie is 187-Mva, however due to the internal lines out of service on the Garland system, full capability could not be utilized. Capacity from TEPL over the Apollo tie was used to restart the Olinger Plant, but could not be used for total system restoration due to Garland's transmission failures.

An 85-Mw limitation had been set by TEPL on the Oates tie based on the difference between the thermal capacity of the line and the sum of the TEPL substations served from that line. Garland could only utilize 40-MW of the available capacity due to its internal transmission.

The 69-kV tie with BEPC was closed at 7:26 p.m. in order to get assistance, but Garland began exporting instead of importing so the tie was reopened. With no help from BEPC and the inability to use all the capacity available from TEPL, Garland was forced to bring its system back on line in smaller sections than had been anticipated.

Newman No. 4 was brought back on line at 8:12 p.m. Olinger No. 2 was running at 8:47 p.m. Garland started Newman No. 3 at 9:37 p.m. Exact times when the other units were brought back on line are not known due to computer failure, but by 10:15 p.m. all needed generation was running and all load restored. Table No. 2 shows breaker operations during service restoration.

B. City of Greenville

Greenville plant personnel attempted to restore power to the steam plant by starting one unit in the 15-MW diesel plant. Problems were encountered in re-establishing auxiliary power to the steam plant. The 69-kV tie with Garland was closed and the Garland dispatcher indicated that they could furnish enough power to make a start-up. Diesel units Nos. 5, 7 and 8 (totaling 9.75-MW) were started.

The frequency of the combined Garland and Greenville Systems surged causing an overspeed condition on the diesel generators three different times. Garland notified Greenville that they were opening the tie between them and Greenville again attempted to start the steam units from their diesel generators. Steam unit No. 1 was attempted to be started using the No. 8 diesel unit. The in-rush current to the boiler feed water pump caused the No. 8 diesel unit to trip.

Garland was able to supply 5-MW of auxiliary power to start the Greenville steam units. The tie was closed at 4:15 p.m., the No. 1 boiler was filled with water and the unit was started. Steam unit No. 1 was put on line at 8:00 p.m. Unit No. 3 was put on line at 9:12 p.m. The load at that time did not warrant putting unit No. 2 on line.

Chapter V

Impact of Incident on Customers

The impact of the incident on customers on both the Garland and Greenville systems was minimal. The greatest hardship encountered was the loss of air conditioning on the hottest day in history. As far as can be determined all hospitals had emergency backup generators which worked properly. The city of Greenville even delayed reconnecting the Greenville hospital until very late in the evening because their generator was running adequately. A major food store in Greenville had to ship their perishables to a neighboring location, but no other problems or lasting impacts have been reported.

Chapter VI

Damages Associated with Incident

A. City of Garland

The major damages sustained by the Garland electric system were the cause of the total power loss rather than the result. These were the melt-down of 69-kV conductors between the Jupiter and Apollo Substations and the Wynn Joyce and Miller Substations and the melt-down of a 69-kV jumper on switch 6072 located at the Newman Substation. A city-owned communication line, which is attached to the same structure as the distribution circuits, was damaged when the Fairdale to Newman 69-kV circuit sagged into a 13-kV distribution feeder. This resulted in the loss of supervisory control to several circuit breakers throughout the system requiring manual reclosure during service restoration.

During the disturbance it was found that a fuse in the control room power supply inverter was blown which resulted in loss of control room power at 5:05 p.m. It is not known whether the fuse was blown during or before the disturbance. The inverter is not needed unless the bus becomes deenergized at the Newman Station and this did not occur until 5:05 p.m.

There was no generator damage reported. Garland also reported that critical services such as hospitals maintained their electric service with on-site emergency generation.

B. City of Greenville

Greenville officials reported that there were no damages associated with the power interruption and that the hospital successfully started its emergency generation to maintain uninterrupted electric service.

Chapter VII

Remedial Measures Planned by Cities

A. City of Garland

On June 27, the day following the incident, the city initiated an extensive right-of-way clearing program. Up until the time of the incident there had not been sufficient funds budgeted to allow on-going right-of-way clearing; since the incident an additional \$60,000 has been provided by the city council for this purpose.

Except for the above measure the city has no definite plans, although they are considering the development of an Emergency Operations Plan. Officials also stated that protective relays would not be removed from service in the future.

B. City of Greenville

There are no definite remedial measures planned by Greenville. The Director of Electric Utilities had been employed by the city for only one month prior to the disturbance and was still in the process of learning the system. He did state that an Emergency Operation Plan and Service Restoration Plan should be developed.

The city was constructing an additional tie to Garland at the time of the incident. The second tie, operating at 138-kV, was placed in service on August 5, 1980. The 69-kV transmission line interconnection remains in service, thus there are currently two ties between the cities.

Chapter VIII

Recommended Remedial Action

The resulting recommendations listed in the following sections relate primarily to the conditions that existed on June 26, 1980. Although some of these conditions have been corrected either by system action or completion of construction in progress at that time, this discussion includes all corrective measures deemed necessary to minimize the probability of a recurrence of the June 26 power failure.

A. City of Garland

The following list of contingencies contributed to the total service interruption experienced by the municipal electric system of Garland, Texas, on June 26. The contingencies are listed in sequence, but not necessarily in the order of severity.

1. Two sections of their 69-kV transmission system were out-of-service due to construction of new 138-kV facilities, and relocation of a 138/69-kV auto-transformer resulting in radial feeds to two areas of the system. The lines out of service were Centerville to Miller and McCree Substation to McCree Switching Station.
2. A tree limb came into contact with conductors on the Brand to Olinger 138-kV line, causing phase to ground fault, two separate times. The first time was caused by nature and the second by a city helicopter.
3. A decision was made by operating personnel not to attempt reclosure after the second time the tree limb contacted the conductor, but to dispatch a work crew to cut down the tree.
4. A decision was made by operating personnel to remove over-current protective relays on the remainder of the 138-kV and 69-kV transmission system. City officials explained that this was done in an attempt to maintain service to all customers.
5. Two 69-kV circuits melted (Jupeter to Apollo and Wynn Joyce to Miller), one 69-kV circuit (Fairdale to Newman) sagged into a 13-kV distribution feeder and a 69-kV jumper (on Newman switch 6072) melted.

The following list provides DOE recommendations which we believe will minimize the possibility of a recurrence of the June 26 power failure. System action to date is also included.

Recommendation No. 1	- Institute a program for transmission line right-of-way maintenance.
Garland Action	- An extensive right-of-way clearing program has been initiated.
Recommendation No. 2	- Develop an Emergency Operation Plan (none was in existence on June 26) and provide operator training for the plan.
Garland Action	- None, although officials agree that such a plan would be desirable.

Recommendation No. 3

- Protective equipment should never be removed from service during system emergencies. Although a total system outage might still have occurred with the over-current relays in service, system damage would have been minimized and service restoration accelerated. (This should be included in an Emergency Operation Plan.)

Garland Action

- Indications are that protective relays will not be pulled in the future.

Recommendation No. 4

- Develop a Service Restoration Plan. Restoration of service after the incident was accomplished in a systematic fashion although no written plan exists.

Garland Action

- None

B. City of Greenville

The total interruption on Greenville's system was caused by problems experienced by Garland and could only have been prevented if Greenville had islanded before their generation was lost. The major problem experienced at Greenville was associated with restarting their steam generators to begin service restoration.

The following recommendations would minimize the change of a recurrence of the incident and expedite service restoration should a similar incident occur.

Recommendation No. 1

- Develop an Emergency Operation Plan and Service Restoration Plan. Service restoration might have been completed in a more timely fashion if a written plan had been available stating each steam units auxiliary power requirements for black start.

Greenville Action

- Recent information indicates that such plans have been developed.

Recommendation No. 2

- Study the feasibility of installing a protective relay scheme that will cause the Greenville system to separate from the Garland system when significant frequency excursions occur. Due to the breaker configuration at Garland's Olinger generating plant at the time of the incident (see Figure No. 6), Garland's Olinger unit No. 1 (75 MW) could be isolated from Garland and remain connected to Greenville's system (as was the case on June 26).

Greenville Action

- Indicates that problem will be addressed.

Recommendation No. 3

- Greenville and/or TMPA should initiate studies in cooperation with TEPL to determine the technical and economic feasibility of effecting an interconnection between Greenville and TEPL. At present Greenville is connected to TMPA and also the Electric Reliability Council of Texas only by a 69-kV line and a 138-kV line from Garland. An interconnection with TEPL would not only provide Greenville with an additional source of power during emergencies but also a second avenue to receive its portion of the Gibbons Creek generating plant being constructed by TMPA and its share of the Comanche Peak Nuclear Plant being constructed by the Texas Utilities Generating Company.

Greenville Action

- Participating with TMPA in study of project. Current status of plans is dormant.

Table 1

Sequence of Events Leading to Total Loss of Power

A. City of Garland

<u>Time</u>	<u>Event</u>
2:01 pm	Line-to-ground and/or phase-to-phase faults on Brand-Olinger 138-kV line caused by tree limb blown into conductors. Breaker 8130 opened, automatically closed, and reopened. Breakers 8220, 6110, 6610, and 6860 opened. Breakers 6010 and 6030 opened and reclosed. Breaker 1040 opened at Newman Plant losing No. 4 generator.
2:03 pm	Breaker 6110 and 6610 closed and 6830 opened.
2:04 pm	Breaker 6830 closed and reopened. Breaker 6410 opened and automatically reclosed.
2:05 pm	Breaker 6110 opened and 6860 and 6830 closed.
2:07 pm	Breakers 6710 and 6720 opened due to transformer differential relay at Castle Substation (false trip). Breaker 6610 opened and emergency generation started.
2:08 pm	Breaker 6020 opened losing No. 5 generator at Newman Plant.
2:10 pm	Breaker 6820 opened.
2:13 pm	Breaker 6610 closed.
2:14-2:18 pm	Computer printer problems caused loss of all breaker operation data during this time period.
2:19 pm	Breakers 6710 and 6720 closed.
2:20 pm	Breakers 6510 opened and 6820 closed.
2:22 pm	Breakers 8130, 8220, and 6510 closed.
2:45 pm	Breakers 6710 and 6720 opened.
2:46 pm	Breakers 6710 and 6720 closed.
2:51 pm	Breaker 6020 closed restoring Newman No. 5 generation.
2:54 pm	Breaker 1040 closed restoring Newman No. 4 generation.
2:56 pm	Emergency generation stopped.
3:11 pm	Breakers 8220 and 8130 opened, automatically reclosed, and reopened.
3:14 pm	Breakers 6710 and 6720 opened due to transformer differential relay at Castle Substation (false trip). Breakers 6610 and 6850 opened. Breakers 6010 and 6030 opened and automatically reclosed. Breaker 6860 opened, automatically reclosed, and reopened.

3:15 pm Breaker 6860 closed manually, reopened, closed manually again, and again reopened.
Breaker 6610 closed and reopened.

3:16 pm Breakers 8620, 8020, 8060, 8110, 7010, 8010, and 6310 opened.
Breaker 9130 opened and automatically reclosed.
Breakers 8040, 8120, 8010 opened losing Olinger Nos. 2 and 3 generators.

3:17 pm Emergency generation started.

3:18 pm Breakers 6710 and 6720 closed.

3:19 pm Breaker 6820 opened and 6610 closed.

3:20 pm Breaker 6860 opened.

3:22 pm Breaker 7120 opened, automatically reclosed, and reopened losing the interconnection to Greenville. Garland exporting 40 MW.

3:23 pm Breaker 8620 opened.

3:25 pm Breaker 6850 closed and 6860 opened and automatically reclosed.

3:27 pm Breaker 8020 closed.

3:28 pm Breakers 8110 and 8060 closed and 6510 opened.

3:29 pm Breaker 6820 closed.

3:30-3:40 pm Computer printer problems caused loss of all breaker operation data during this time period.

3:41 pm Breaker 1030 closed restoring Newman No. 3 generation.

3:46 pm Breakers 6010, 9110, 8020, 6030 and 6070 opened.
Breaker 1040 opened losing Newman No. 4 generation.
Breaker 205 opened losing Brazos Electric Power Cooperative (BEPC) 69-kV tie.
Breaker 1319 opened losing Texas Power & Light Company (TEPL) 138-kV tie.

3:47 pm Breakers 1030 and 6020 opened losing Newman Nos. 3 and 5 operation.
Breaker 6820 opened.

3:53 pm Breaker 1319 closed and reopened.

3:54 pm Breakers 6610 and 6620 opened and 9110 closed.

3:55 pm Breakers 1319 and 205 closed.

3:58 pm Breaker 6070 closed.

3:59 pm Breakers 1319 and 6070 opened and 6610 and 6620 closed.

4:00 pm Breakers 6720 and 6620 opened.

4:04 pm Breaker 6860 opened.

4:08 pm Breakers 8020 and 8060 closed.

Breaker 7110 opened losing Olinger No. 1 generation.
Breaker 8110 opened and automatically reclosed.

4:09 pm Breaker 6610 opened.

4:10 pm Breaker 1319 closed.

4:12 pm Breaker 6610 closed.

4:14 pm Breaker 6020 closed restoring Newman No. 5 generation.

4:15 pm Breaker 7120 closed restoring 69-kV tie to Greenville.

4:21 pm Breaker 6510 opened and 6820 closed.

4:22 pm Breakers 6510 and 6620 closed.

4:23 pm Breaker 1040 closed restoring Newman No. 4 generation.

4:40 pm Breaker 6840 opened.

4:41 pm Breaker 8130 closed.

4:42 pm Breakers 8220 and 6860 closed.
Breaker 1030 closed restoring Newman No. 3 generation.

4:43 pm Breaker 6010 closed.

4:44 pm Breaker 6030 closed.

4:53 pm Breaker 6840 closed.

4:55 pm Breaker 205 opened and automatically reclosed.

4:56 pm Breakers 6720 and 6070 closed.

5:05 pm The entire Garland load was lost due to line meltdowns. The Garland control center computer was out of service for approximately an hour.

B. City of Greenville

<u>Time</u>	<u>Event</u>
3:22 pm	Due to outages on the Garland system the entire generation from Garland's Olinger Unit No. 1 began flowing into the Greenville system overloading the 69-kV tie line. Exact readings are unknown since the line is rated at 30 MW and the meter peaked at the upper range of 30 MW. System frequency went above 62 hertz tripping Greenville Units Nos. 2 and 3 - attempts to restart failed. Breaker 7120 opened isolating Garland from Greenville. The tie line tripped on over-current totally blacking out Greenville.

Table 2

Restoration of Service

A. City of Garland

<u>Time</u>	<u>Event</u>
5:05-6:03 pm	Loss of power to system control center computer resulted in no breaker operation information in this time period. Also the following times may not be accurate.
6:03 pm	Breaker 1323 opened.
6:05 pm	Breaker 7010 opened.
6:08 pm	Breaker 9130 opened.
6:14 pm	Breaker 6710 opened.
6:15 pm	Breakers 6070, 6720, 6930 opened.
6:19 pm	Breaker 6080 opened and 1323 closed.
6:20 pm	Breaker 9130 closed and 8410 opened.
6:21 pm	Breaker 1323 opened.
6:22 pm	Breaker 9110 opened.
6:38 pm	Breaker 1323 closed.
6:43 pm	Breaker 8410 closed.
6:46 pm	Breakers 6110, 9120 and 9130 opened.
6:48 pm	Breaker 9110 closed.
6:49 pm	Breaker 9120 closed.
6:50 pm	Breaker 6110 closed.
6:51 pm	Breaker 1323 opened.
6:45 pm	Breakers 9110, 8010, 8020, 8040, 8120, 8130 and 7110 opened. Breaker 8020 closed.
6:55 pm	Breakers 6110 and 9120 opened.
6:56 pm	Breakers 9130 closed.
6:57 pm	Breaker 9120 closed.
6:58 pm	Breaker 9120 opened.
7:05 pm	Breaker 8420 opened and 9110 closed.
7:08 pm	Breaker 8420 closed.
7:12 pm	Breaker 1323 closed.

7:17 pm Breakers 6030 and 6010 opened.
7:18 pm Breaker 6860 opened.
7:24 pm Breakers 8210 and 8230 opened.
7:25 pm Breakers 8130 and 8210 closed.
7:26 pm Breakers 6820 and 6830 opened and 6840 and 6850 closed.
7:27 pm Breaker 6040 opened and 6860 closed.
7:28 pm Breakers 6030 and 6040 closed.
7:29 pm Breaker 6920 opened.
7:30 pm Breaker 6010 closed.
7:31 pm Breakers 6070 and 6720 closed.
7:34 pm Breaker 6080 closed.
7:35 om Breaker 6920 closed.
7:36 pm Breaker 6610 opened.
Breakers 6620 and 8630 opened and automatically reclosed.
7:39 pm Breaker 6210 opened and 6820 closed.
7:40 pm Breakers 6220 and 6510 opened and 6210 closed.
7:41 pm Breaker 6520 opened and 6220 closed.
7:42 pm Breaker 6310 opened.
7:43 pm Breaker 6710 closed.
7:46 pm Breaker 6840 opened.
7:54 pm Breaker 6410 opened and 6830 closed.
7:55 pm Breaker 6510 closed and opened manually.
Breaker 6410 closed.
7:56 pm Breaker 6510 closed.
7:57 pm Breaker 6510 opened.
8:09 pm Breaker 6510 closed.
8:12 pm Breaker 1040 closed restoring Newman No. 4 generation.
8:31 pm Breaker 6510 closed.
8:34 pm Breaker 6840 closed.
8:36 pm Breakers 6220, 6520 and 6310 closed.
8:47 pm Breaker 8010 closed restoring Olinger No. 2 generation.
8:54 pm Breaker 7010 closed.

8:55 pm	Breaker 7010 opened.
8:56 pm	Breaker 7010 closed.
9:04 pm	Breaker 8230 closed.
9:15 pm	Breaker 8110 closed.
9:31 pm	Breaker 1030 closed restoring Newman No. 3 generation.
9:32 pm	Breaker 1030 opened.
9:33 pm	Breaker 1030 closed and opened manually.
9:36 pm	Breaker 1030 closed and opened manually.
9:37 pm	Breaker 1030 closed.

9:30pm-1:05am Due to computer malfunctions, data during this time period is incomplete.

Company personnel stated that all customers were back on-line by 10:15 pm and the last breaker was closed at 1:05 a.m. on June 27.

B. City of Greenville

The information from Greenville is sketchy. The following times are all that are available.

<u>Time</u>	<u>Event</u>
8:00 pm	No. 1 generator put on-line.
9:12 pm	No. 3 generator put on-line.
10:00 pm	All load restored.

FIGURE 1
LOCATION MAP

FIGURE 2
HIGHWAY MAP
DALLAS, TEXAS, AND VICINITY

To
Greenville

PRINCIPAL ELECTRIC FACILITIES MAP NORTH CENTRAL TEXAS

BASED ON INFORMATION TO JUNE 30, 1977

FIGURE 5

ELECTRIC FACILITIES MAP
NORTH - DALLAS AREA

H - DALLAS AREA

ATTACHMENT TO FIGURE 4
AND FIGURE 5

OWNERSHIP LIST

Utility Code	Type of Owner	Utility
TEXAS		
BREP	COOP	Bratos Electric Power Coop., Inc.
COPS	PRI	Community Public Service Company
DAPL	PRI	Dallas Power & Light Co.
DENT	MUN	Denton
GARL	MUN	Garland
GRUD	MUN	Greenville
HOLP	PRI	Houston Lighting & Power Company
LOCR	STATE	Lower Colorado River Authority
TEES	PRI	Texas Electric Service Company
TEPL	PRI	Texas Power & Light Company
TUSI	PRI	Texas Utilities Company System
USAR	FED	United States Army

TYPE OF OWNERSHIP

PRI	Private
COOP	Cooperative
MUN	Municipal
STATE	State or Territory
FED	Federal
IND	Industrial

PLANT LIST

Plant No.	Name of Plant	MW Capacity and Type	Utility Code
TEXAS			
35	Collin	166.3 St	TEPL
37	Dallas	223.8 St	DAPL
36	Denison	70.0 Hy	USAR
38	Denton	189.3 St	DENT
44	Eagle Mountain	706.2 St	TEES
47	Newman, C. E.	96.5 St	GARL
62	Greenville (2 plants)	17.9 IC	GRUD
		43.8 St	GRUD
		42.0 St*	GRUD
66	Hardley	878.4 St	TEES
		455.0 St*	TEES
78	Lake Creek	315.6 St	TEPL
		6.0 IC	TEPL
100	Mountain Creek	989.7 St	DAPL
105	North Lake	708.6 St	DAPL
106	North Main	116.3 St	TEES
111	Parkdale	340.6 St	DAPL
144	Trinidad	412.1 St	TEPL
		4.0 IC	TEPL
153	North Texas	76.0 St	BREP
167	Whitney	30.0 Hy	USAR
168	Wichita Falls	26.0 St	TEES
168	Valley	1176.8 St	TEPL
182	Trading House Creek	1379.7 St	TEPL
183	Miller, R. W.	404.0 St	BREP
184	Olmer, Ray	345.7 St	GARL
190	Big Brown	1186.8 St	TUSI ⁶
191	Lake Hubbard	927.5 St	DAPL
198	Decordova	789.2 St	TEPL
206	Comanche Peak	2430.0 Nu ⁴	TUSI ⁶

⁴ Operated by Texas Utilities Generating Company.

⁶ Holding company consisting of DAPL, TEES and TEPL.

²⁵Hz, etc.—indicates frequencies other than 60 hertz; St—Steam; Nu—Nuclear; IC—Internal Combustion; Hy—Hydro; CT—Combustion Turbine; CC—Combined Cycle; *Under construction.

FIGURE D

DEPARTMENT OF ENERGY
ECONOMIC REGULATORY ADMINISTRATION

NOTICE OF PROPOSED TECHNICAL INVESTIGATION
OF POWER OUTAGE BY MUNICIPAL ELECTRIC SYSTEMS
OF GARLAND AND GREENVILLE, TEXAS

AGENCY: Department of Energy
Economic Regulatory Administration

ACTION: Notice of a proposed technical investigation
concerning recent power outages experienced by the
municipal electric systems of Garland and Greenville,
Texas.

SUMMARY: Economic Regulatory Administration (ERA) proposes
to conduct a technical investigation into the
total system blackout experienced by the municipal
electric systems of Garland and Greenville,
Texas. The investigation will center on the
events which caused the blackout; the systems'
restorative efforts; and the systems' emergency
operation plans.

FOR FURTHER INFORMATION CONTACT:

James M. Brown, Jr.
System Reliability and Emergency Response Branch
Department of Energy
Room 4110
2000 M Street, N.W.
Washington, D.C. 20461
(202) 653-3825

Lise Courtney Howe
Office of General Counsel
Department of Energy
Room 5E-064
Forrestal Building
1000 Independence Avenue, S.W.
Washington, D.C. 20585
(202) 252-2900

SUPPLEMENTARY INFORMATION:

On June 26, 1980, the municipal electric systems supplying the cities of Garland and Greenville, Texas suffered a total system blackout, affecting more than 53,000 customers. The outage began as a limited blackout, became a total blackout by mid-afternoon, and ended by ten o'clock p.m. that evening.

In order to understand more fully the causes of this blackout, ERA will conduct a technical investigation of the blackout. At the conclusion of the investigation a report concerning the findings made by ERA will be published and submitted to Congress, pursuant to Section 311 of the Federal Power Act.

Specifically, the investigation will consider:

- (1) the status of the systems immediately before the event(s) which caused the blackout;
- (2) the sequence of events which occurred between the initial event precipitating the blackout and the total blackout;
- (3) the restorative efforts made by the utilities;
- (4) the adequacy of the systems' emergency operation and restoration plans prior to the blackout; and
- (5) any actions or new emergency procedures which should be implemented by the utilities.

Any person desiring to submit information concerning this investigation should do so to the System Reliability and Emergency Response Branch, Economic Regulatory Administration, Room 4110, 2000 M Street, N.W., Washington, D.C. 20461, in accordance with Part I of the Rules of Practice and Procedure (18 C.F.R. 1.1 et seq.).

Any such information should be filed on or before September 26, 1980; such information will be considered by ERA in determining the appropriate action to be taken.

Dated: July 29, 1980.

Jerry L. Pfeffer
Assistant Administrator
for Utility Systems
Economic Regulatory Administration

Department of Energy
Washington, D.C. 20461

Mr. Gerson Berman
Chairman - Technical Advisory
Committee
Electric Reliability Council of Texas
c/o Texas Power and Light Co.
P.O. Box 226331
Dallas, Texas 75266

Dear Mr. Berman:

The purpose of this letter is to request your review and comments on the draft of the U.S. Department of Energy's technical investigation of the electric power outages which occurred on the Garland and Greenville Texas systems on June 26, 1980. This analysis has been accomplished primarily by the Economic Regulatory Administration's Fort Worth Power Supply and Reliability Field Office.

It is the intention of the Department to publish this report as a public document such that other utility systems may take appropriate actions to minimize the probability of a similar occurrence on their systems. In accordance with our past practices, the involved utilities are provided an opportunity to review the report and provide comments. Such comments will be included as an appendix in the final report. The Department of Energy will review the comments received and make corrections where factual errors have occurred. In addition, the foreword and Executive Summary will be revised to reflect the theme of the comments.

Your cooperation in providing your comments by November 20, 1980, will be appreciated.

Sincerely,

A handwritten signature in dark ink, appearing to read "James M. Brown, Jr.", is written over the typed name and title.

James M. Brown, Jr.
Chief, System Reliability
and Emergency Response Branch
Economic Regulatory Administration

cc: City of Garland
City of Greenville

Department of Energy
Washington, D.C. 20461

Mr. W. Wilcox
Superintendent
Greenville Municipal
Light & Power Dept.
City of Greenville
P.O. Box 1049
Greenville, Texas 75401

Dear Mr. Wilcox:

The purpose of this letter is to request your review and comments on the draft of the U.S. Department of Energy's technical investigation of the electric power outages which occurred on the Garland and Greenville Texas systems on June 26, 1980. This analysis has been accomplished primarily by the Economic Regulatory Administration's Fort Worth Power Supply and Reliability Field Office.

It is the intention of the Department to publish this report as a public document such that other utility systems may take appropriate actions to minimize the probability of a similar occurrence on their systems. In accordance with our past practices, the involved utilities are provided an opportunity to review the report and provide comments. Such comments will be included as an appendix in the final report. The Department of Energy will review the comments received and make corrections where factual errors have occurred. In addition, the foreword and Executive Summary will be revised to reflect the theme of the comments.

Your cooperation in providing your comments by November 20, 1980, will be appreciated.

Sincerely,

James M. Brown, Jr.
Chief, System Reliability
and Emergency Response Branch
Economic Regulatory Administration

cc: Electric Reliability Council
City of Garland

Department of Energy
Washington, D.C. 20461

Mr. R. A. Corder
Director Electric Utilities
Garland Electric Department
City of Garland
P.O. Box 401889
Garland, Texas 75040

Dear Mr. Corder:

The purpose of this letter is to request your review and comments on the draft of the U.S. Department of Energy's technical investigation of the electric power outages which occurred on the Garland and Greenville Texas systems on June 26, 1980. This analysis has been accomplished primarily by the Economic Regulatory Administration's Fort Worth Power Supply and Reliability Field Office.

It is the intention of the Department to publish this report as a public document such that other utility systems may take appropriate actions to minimize the probability of a similar occurrence on their systems. In accordance with our past practices, the involved utilities are provided an opportunity to review the report and provide comments. Such comments will be included as an appendix in the final report. The Department of Energy will review the comments received and make corrections where factual errors have occurred. In addition, the foreword and Executive Summary will be revised to reflect the theme of the comments.

Your cooperation in providing your comments by November 20, 1980, will be appreciated.

Sincerely,

A handwritten signature in dark ink, appearing to read "James M. Brown, Jr.", is written over the typed name and title.

James M. Brown, Jr.
Chief, System Reliability
and Emergency Response Branch
Economic Regulatory Administration

cc: Electric Reliability Council
City of Greenville

TEXAS POWER & LIGHT COMPANY

1511 Bryan Street • P. O. Box 226331 • Dallas, Texas 75266

G. BERMAN
VICE PRESIDENT

November 20, 1980

Mr. James M. Brown, Jr.
U. S. Department of Energy
Economic Regulatory Administration
Division of Power Supply and Reliability
Washington, D. C. 20461

Dear Mr. Brown:

The purpose of this letter is to provide comments of the Electric Reliability Council of Texas-Technical Advisory Committee to U. S. Department of Energy's draft report on the June 26, 1980, outages in Garland and Greenville, Texas.

Comments which follow will attempt to (1) correct errors of fact in the draft report, (2) provide missing data not contained in the report of facts, and (3) clarify some of the matters related to these incidences.

1. In the Executive Summary (page ii) no mention is made that the Oates autotransformer was out of service for construction, or that service restoration was hampered considerably by the fact that there was a loss of power to the Garland control center.
2. The report lists recommended actions (page iii) which should be taken by various entities. The Texas Municipal Power Pool (TMPP), Texas Municipal Power Agency (TMPA), and Texas Power & Light Company (TPL) as members of ERCOT, operating as the Texas Interconnected Systems Planning Subcommittee, have made studies regarding delivery of power from the remote Gibbons Creek generating plant while the Texas Power & Light Company and Brazos Electric Power Cooperative ties are closed simultaneously. The present import capabilities of Garland will be increased in the near future with the installation of a 345 kv tie line from TPL Royse Switching Station. Base cases established by the Planning Subcommittee serve as the basis for more detailed studies by the member systems of ERCOT.
3. The portion of Comanche Peak units (page 1) contracted for by TMPA should be 71.3 MW instead of 115 MW shown. Also, planned operation of Comanche Peaks units is 1982 and 1984 respectively rather than 1983, 1984 shown in draft report.

4. The general location of Greenville's generating capacity (page 2) is shown on Figure No. 4 rather than No. 5 as stated.
5. In Chapter III (page 5) a reference is made to Figure No. 1 but according to text Figure No. 3 should have been used.
6. In Chapter IV (page 6), Restoration of Service, additional facts regarding the City of Garland interconnections with Texas Power & Light Company should be noted. Two 138 kv interconnections presently are in service--one at Apollo and the other at Oates Drive.

The interconnection between the TPL East Richardson Substation and the Garland Apollo Substation was automatically disconnected by protective relays due to a ground fault, at 5:05 p.m. Thermal capacity of this interconnection from East Richardson is 187 mva; however, the internal configuration of the Garland system limited the amount which could be imported.

The other interconnection at Oates Drive is served from the TPL Royse-Western Electric-East Mesquite 138 kv line. TPL had placed an 85 MW load limitation on the interconnection based on the difference between the thermal capacity of the line and the sum of the TPL substations served from the line. On three separate occasions, each time Garland attempted to pick up load on the Oates Drive interconnection TPL customers were interrupted. At 5:14 p.m., 1,950 customers served from the Forney Road Substation were interrupted for 18 minutes and 2,150 customers served from the Rowlett Substation were interrupted for four minutes. The customers served from the Rowlett Substation were interrupted again at 5:47 p.m. for three minutes and at 6:18 p.m. for two minutes. The Royse-Western Electric-East Mesquite 138 kv line should have been protected from faults on the Garland system by the Oates Drive Substation circuit breaker No. 1323; however, the back-up protective relays at Royse and Western Electric recognized ground faults and isolated the Oates interconnection and the TPL substations.

In summary this incident was precipitated by an accumulation of unfortunate circumstances occurring during a time the transmission network integrity was reduced by temporary arrangements necessary while construction of new facilities was underway. Restoration of service was delayed by some of the same factors but compounded significantly by loss of power to the Garland control center.

Mr. James M. Brown, Jr.
Page 3
November 20, 1980

If we can be of any further assistance please let us know.

Very truly yours,

G.Berman/vgc

Chairman, ERCOT-TAC

cc: R. K. Campbell - TPL
T. Leon Loveless - ERCOT Representative
NERC Oper. Comm.
ERCOT-TAC Members
Harold Tynan - ERCOT
H. T. Sites - Chairman TIS Operating Subcommittee
L. O. Heizer - Chairman TIS Planning Subcommittee

City of Garland

Post Office Box 401889 / Garland, Texas 75040

November 18, 1980

Mr. James M. Brown, Jr.
Chief, System Reliability & Emergency Response Branch
Economic Regulatory Administration
Department of Energy
Washington, D. C. 20461

Dear Mr. Brown:

We have reviewed the draft of the report of our June 26th outage prepared by the ERA Field Office in Fort Worth. Our review did not reveal any factual error of significance. However in Chapter IV regarding the restoration of service and the assistance available from TEPL a clarification should be made. It is correctly noted that the capacity of TEPL's facilities limited the power available at Oates to 85MW. It should also be noted that at the time the limitation was imposed the impaired Garland transmission system had the capacity to utilize only 40MW of this capacity due to the line failures which had occurred. Additionally, note should be made that considerably more TEPL capacity was available at Apollo. This capacity was utilized to restart the Olinger Plant, but could not be used for total system restoration again due to the internal transmission failures which had occurred. It should be made clear in the report that the lengthy period required for service restoration was caused not by the unavailability of power from the interconnected utilities but rather by the inability of Garland's transmission system to receive that power and distribute it within its system.

The remainder of our comments will hopefully clarify the circumstances leading to the outage, respond to your Agency's recommendations and the actions the City has and will take in response to the event of the outage.

We have included as exhibits load flow diagrams to indicate several system configurations, load conditions and line contingencies we feel demonstrative of the circumstances which led to the events of June 26, 1980.

As you noted in the Executive Summary and in Chapter III, conditions prior to outage, the system was in the process of re-configuration at the time of the outage and a key portion of the transmission system was out of service.,

Mr. Brown
Nov. 18, 1980
Page 2

The first exhibit which is identified as case 7950 shows the system as it existed during the 1979 peak and the normal load flows corresponding to the 1980 anticipated peak. Note that base case loadings show no overloaded facilities; however also note that the normal loading of the 69KV circuit between Oates and Centerville is 92% of the line's thermal capacity.

The following exhibits identified as 7950-2 & 7950-5 show the load flows on a 1979 system which would have resulted from two line contingencies; outage of the 69KV line between Fairdale and Shiloh and outage of the 138KV line between Olinger and Brand (the same contingency which subsequently caused the outage). Note that each of these result in one or more sizeable line overloads. It was these known conditions that the reconfiguration which was in progress was designed to avert.

The next exhibit which is labeled June 26 normal shows the system configuration and loads as they existed just prior to the outage. The 69KV line between Oates & Centerville was in the process of being reconfigured to be a 138KV line between Oates and McCree and the 69KV/138KV autotransformer which had been in service at Oates was being relocated to McCree. The original schedule called for this work to be complete prior to May 1, 1980, before the system would experience summer loading conditions.

A delay in the project start together with delays in the construction had caused numerous revisions in the completion date. At the time of the outage, the transmission work was completed, the autotransformer was in place and was being serviced prior to energizing. Our work schedule called for the facilities to be placed into service on Saturday June 28, 1980.

The next exhibit which is identified as June 26, outage of Olinger-Brand line shows the load flows on the system following the line outage. The excessive loadings which resulted in the line failures are clearly indicated.

The final exhibit (8051-G) indicates the load flows which would have resulted for the same line outage had it occurred two days later following the completion of the work which was in progress.

As you will note, all loadings are within tolerable limits for a contingency occurrence.

Further comments regarding the 5 contingency conditions and four recommendations in Chapter VIII follow below.

Mr. Brown
Nov. 18, 1980
Page 3

In A1. the line out of service is more properly identified as Oates to McCree.

With regard to recommendation #1, we can now state that the Right-Of-Way clearing has been completed and arrangements have been made for on-going inspection and maintenance.

With regard to recommendation #2 load flow computations have been done for all foreseeable line and generation contingencies and work is well under way to translate each of these into specific operator actions required. These will include the full range of actions which might be taken up to and including selective load shedding.

With regard to recommendation #3, your comment regarding our future plans regarding protective devices is not complete. We have instituted a complete study of our system protection to insure that all relay settings are correct and will function to limit system disturbances to the minimum. Any future alteration to the status of protective devices will be made only if called for in a well documented Emergency Operations Plan.

Your fourth recommendation which dealt with service restoration, indicated we had no plans for a service restoration plan. This is correct insofar as it applies to a written plan. Because of our size, limited service area and the high level of familiarity our operations personnel have of the system, our service restoration plan is within the scope of individual operator knowledge. Each of our operators was chosen for his background knowledge of the system and we feel that when this is combined with the forthcoming Emergency Operations Plan system restoration will be as professionally accomplished as it might following a written plan.

One last comment regarding a recommendation your Agency did not make also seems appropriate. The events and outage of June 26 all relate to the failure of our system to complete a system reconfiguration, the need for which was well documented, in a timely fashion. If there is a central fact to this outage and a fundamental concept demonstrated it must be that systems who allow needed system improvements to slip past their scheduled completion date, do so at the risk of system security.

While the occurrence of the outage pinpointed numerous deficiencies in operating procedure and highlighted many areas of needed improvement, these are secondary to the central issue: how the outage might have been avoided.

Mr. Brown
Nov. 18, 1980
Page 4

Your Agency would do the most to minimize the probability of future similar occurrences, if it would point out to all within and without the industry the necessity of comprehensive system planning and the relationship of the timely accomplishment of the system improvements this planning reveals to the reliability of electric service.

Good utility management dictates that system improvements be deferred until it can be demonstrated that the absence of that improvement will degrade the reliability of the system. An equally valid corollary to this criteria is, however, that the failure to make such improvements in a timely manner will increase the risk of an event such as that which occurred in Garland.

While we are sure that Greenville will comment on this report, Garland is also involved in the 138KV intersection between Garland's Olinger Plant and the Greenville Steam Plant. The report correctly notes that the outage in Greenville could not have been avoided in the face of Garland's situation. Service in Greenville could have, however, been restored hours sooner had this full system capacity tie been completed on its originally scheduled date of May 1980. This again points out the hazards of allowing the completion of critical facilities to slip into high load periods.

Yours truly,

R.E. Corder, P.E.
Director of Electric Utility

REC: rt

6 Attachments

cc: Gerson Berman
John Tarpley

1979 GP&L TRANSMISSION SYSTEM (7950)
SYSTEM AS OF DECEMBER 1979 - 1980 SP LOADS
LOAD = 312 MW . GEN = 325 MW

1979 SP4L TRANSMISSION SYSTEM (7950-2)
SYSTEM AS OF DECEMBER 1979 - 1980 SP² LOADS
OUTAGE OF FAIRDALE-SHILOH 69 KV LINE

1979 GP&L TRANSMISSION SYSTEM (7950-5)
 SYSTEM AS OF DECEMBER 1979 - 1980 SP LOADS
 OUTAGE OF GLINGER-BRAND 138 KV LINE

IRLAND POWER & LIGHT JUNE 26, 1980 3:11 PM
NORMAL CONDITIONS W/O OATES-MCCREE 138 KV LINE
LOAD = 288 MW , GEN. = 325 MW

22L SYSTEM JUNE 26, 1980 3:11 PM
OUTAGE OF OLINGER-BRAND 138 KV
FIXED TAPS AT FAIRDALE & W. JOYCE

1380 SP (8051-G) GP&L SYSTEM AS OF JULY 1980
 STAGE OF OLINGER-BRAND 138KV LINE
 LOAD = 312 MW , GEN = 325 MW

City Attorney
DEBRA L. ADAMI
City Clerk
IRENE WILSON

City of Greenville

Growing GREENVILLE

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December 9, 1980

Mr. James M. Brown, Jr.
Chief, System Reliability & Emergency Response Branch
Economic Regulatory Administration
Department of Energy
Washington, D. C. 20461

Dear Mr. Brown:

Your draft dated October 30, 1980 of the technical investigation of the power outages to the Greenville and Garland, Texas systems has been reviewed. The report is essentially correct.

In Chapter IV, Restoration of Service, the statement is made that the frequency surged and oversped the diesel generators three times. This was as reported by our Plant Superintendent, but he attributed the frequency surge to the Garland system, not to the frequency control of the diesel units. We have not experienced any difficulty with the frequency control of the diesel units. We do not believe the recommendation on page iii for the Greenville Municipal Utility to "Improve the frequency control on the system's diesel units" to be applicable. It is believed that the tripping experienced was caused either by frequency surges from Garland or by the combination of inrush starting current to the steam auxiliaries with load currents due to distribution loads already connected to the diesel units.

In Chapter VII, Remedial Measures Planned by the Cities, reference is made to a second 138 KV tie to Garland. That tie has been in operation since August 5, 1980, and we operate with both the 138 KV tie and the 69 KV tie closed. The 138 KV tie has prevented several outages to Greenville since it was put into service.

In Chapter VIII, Recommended Remedial Action, three recommendations are made for Greenville. Recommendation No. 1 concerns an Emergency Operation Plan and Service Restoration Plan. These suggested plans have been formulated, reduced to writing, and put into force. Recommendation No. 2 concerns over frequency relays. We are still investigating this application.

Recommendation No. 3 concerns making an interconnection between TEPL and Greenville. This is needed very badly. TMPA is presumably working on

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such an interconnection, but the plans are dormant. We have tried to get these plans into an active stage, but have been unsuccessful to date. Your statement is true and is worth repeating:

At present Greenville is connected to TMPA and also the Electric Reliability Council of Texas only by a 69-kV line from Garland (and soon a 138-kV line from Garland). An interconnection with TEPL would not only provide Greenville with an additional source of power during emergencies but also a second avenue to receive its portion of the Gibbons Creek generating plant being constructed by TMPA and its share of the Comanche Peak Nuclear Plant being constructed by the Texas Utilities Generating Company.

I am in total agreement with Mr. R. E. Corder of Garland, in his comments on your report, when he emphasizes the necessity of comprehensive system planning and the timely accomplishment of system improvements. In this instance, the City of Greenville was a victim of contractors and managers outside its own organization who have allowed plans and scheduled completion dates to slide to the point that ability to provide electric service has been seriously hampered.

Yours truly,

John W. Tarpley, P.E.
Director of Electric Utilities

JWT/jt

cc. Gerson Berman
R. E. Corder
Ray Johnson

United States
Department of Energy
Washington, D.C. 20585

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