

## **ERCOT Emergency Operation**

**December 21 - 23, 1989**

### **Introduction**

The cold weather that swept through Texas on December 21 - 23, 1989 placed severe operating conditions and heavy demands on the electric utilities which comprise the Electric Reliability Council of Texas (ERCOT) and which serve 85 % of the electrical demands in Texas. One of the many things utilities do in planning for severe cold weather operations is to schedule minimal generating unit maintenance from December 15 to March 1. However, some of the coldest temperatures Texas has experienced in over 100 years caused customer demands on all utility systems to approach or exceed all-time peaks. These demands, when coupled with gas curtailments and the large numbers of generating unit outages caused by weather-related problems, required, for the first time in ERCOT's history, the system-wide interruption of service to customers.

Weather-related emergencies of the 1989 Christmas weekend were not isolated to ERCOT. Nationwide, utilities were experiencing operating problems due the extreme weather conditions. In Florida, for example, 11 utilities interrupted customers with rolling blackouts which were sustained for up to three days.

ERCOT utilities have developed plans for emergency operations which were effectively used during this period to protect against widespread and prolonged blackouts.

### **Security Centers**

ERCOT has two Security Centers whose primary purpose is to continuously monitor the operation of the ERCOT interconnected system and to coordinate utility action during emergencies. Located in Dallas and Austin, the Security Centers declare alerts when impending weather or other conditions are likely to affect normal operations. In addition, the Security Centers jointly implement and coordinate emergency procedures when necessary. During the December 21-23 emergency the Security Centers fulfilled these responsibilities.

### **Emergency Plans in Place**

ERCOT utilities have developed a set of Operating Guides that are used for operating the interconnected system. These ERCOT Operating Guides have been in place for many years and are continually reviewed as conditions change. The Operating Guides include practices to be followed during normal and emergency situations. Two key components of the Operating Guides are "Adverse Weather Operation" and "Emergency Operating Procedures".

### **Adverse Weather Operation**

The purpose of the "Adverse Weather Operation" Guide is to ensure the continuation of reliable electric service during adverse weather conditions. Contained in this Guide are Cold Weather and Severe Cold Weather Alerts which outline actions that the ERCOT utilities take during such weather conditions. The ERCOT Security Centers will declare an alert whenever the expected weather or system conditions could potentially limit ERCOT's ability to serve the system load. One or both of these alerts are declared several times per year.

During periods of cold weather, gas supplies are likely to be curtailed and oil burning is required. Oil burning usually decreases the output capability of generating facilities. Also, generating units are at a higher risk of forced outages due to equipment malfunctions arising from sub-freezing temperature conditions.

### **Cold Weather Alert**

A Cold Weather Alert is declared by the Security Centers whenever temperatures in the mid-to-low 20's are likely and maximum temperatures are expected to remain near or below freezing. When a Cold Weather Alert is declared, each utility will increase its operating reserve to twice the normal requirement. Because gas curtailments are likely, each utility will also circulate and/or test fire fuel oil or burn minimum oil on curtailable units before freezing temperatures are reached.

### **Severe Cold Weather Alert**

A Severe Cold Weather Alert is declared by the Security Centers whenever temperatures in the lower teens are likely and the maximum temperatures are expected to remain in the mid-20's or below. When a Severe Cold Weather Alert is declared, each utility will prepare for fuel oil burning as well as bring into operation all available generating units with start-up times greater than one hour. The Security Centers monitor the capability of each utility as the units are brought on line.

### **Emergency Operating Procedures**

The Guide entitled Emergency Operating Procedures contains an Emergency Electric Curtailment Plan (EECP) which is implemented when operating reserves no longer meet minimum requirements. The objective of the EECP is to prevent cascading outages and provide for maximum possible continuity of service to customers. The Security Centers use the EECP to coordinate the actions of each utility and the sharing of resources throughout the State for the benefit of ERCOT customers.

Prior to the emergency on December 21-23, the last similar emergency of this kind was experienced during the Christmas season of 1983. At that time, the Alerts and EECP were implemented and the ERCOT interconnected system came close to the interruption of firm customer load, but conditions eased before this action had to be taken. Utilities gained valuable experience during that period and incorporated this knowledge into their operating procedures.

### **Adverse Weather Operation Begins**

At 12:00 noon on Wednesday, December 20th, the North Texas Security Center declared a Severe Cold Weather Alert for North Texas to become effective at 4:00 a.m. on Thursday, December 21st. The arctic front had been forecast to move into the region with temperatures expected to drop to the mid-teens and remain at or below the mid-20's throughout the weekend. As a result of the Severe Cold Weather Alert procedure, the northern utilities prepared for oil burning and started all available units with the exception of those with start-up times of less than one hour, such as combustion turbines. The Alert was called by the Security Center in

anticipation of high demand due to the extreme freezing weather and also to prepare for potential operating problems such as generating unit forced outages that can occur during this type of severe weather.

As the cold front moved southward and weather forecasts for South Texas predicted lower temperatures, the South Texas Security Center called a Cold Weather Alert for all South Texas utilities at 12:00 Noon on Thursday, December 21st. As a result of this action, utilities began preparing for fuel oil burning and increasing operating reserves.

Gas curtailments and loss of various spot and firm gas supplies were experienced starting Thursday, December 21st, and continued for several days. These curtailments caused considerable oil burning across the ERCOT interconnected system.

During the afternoon of Thursday, December 21st, the South Texas Security Center initiated a Severe Cold Weather Alert due to forecasted highs in the mid-20's for Friday, December 22nd. As a result of this action, by 6:00 p.m. on December 21st all utilities in ERCOT were on a Severe Cold Weather Alert and making preparations for the high demand that accompanies extremely low temperatures. The temperatures at this time ranged from 21° in Dallas to 44° in Houston.

### **Operating Reserves**

On Friday morning, December 22nd, the ERCOT system was unable to maintain the minimum operating reserve requirement due to unusually high loads and generating units forced out of service. At 8:40 a.m. on Friday, the Security Centers implemented the Emergency Electric Curtailment Plan (EECP). About this time, generation-deficient systems minimized their own electrical loads (mining operations, lighting, etc.), discontinued service to their interruptible loads, and implemented voltage reduction plans to reduce customer demand. With the EECP in effect, utilities continued efforts to return generation units to service which had been forced out of service because of the weather. Finally, reserves reached a critically low level. The Security Centers directed utilities to interrupt service to all remaining interruptible loads and redistributed



remaining operating reserves across the ERCOT system. In accordance with the Operating Guides, utilities were contacting the media to ask customers to voluntarily reduce load. At 10:00 a.m., the ERCOT load was approximately 38,300 MW and the generating capacity was approximately 39,800 MW. This load represented approximately 93% of the summer peak load, an 11% increase over the previous winter peak load of February 6, 1989, and was about 18% greater than the projected winter peak load. By noon on Friday, decreased loads and restored generating units brought the operating reserves back up to acceptable levels, and the EECF was cancelled.

### **Coldest Temperatures Reached**

The temperatures on the morning of Saturday, December 23rd were -7° in Abilene, -4° in Wichita Falls, -1° in Dallas, 6° in Austin, and 7° in Houston, with wind chill factors down to -35°. The Severe Cold Weather Alert was still in effect throughout the State, and utilities were maintaining all available units on-line. As of midnight Friday, December 22nd, approximately 3000 MW of generation was off line due to weather-related problems. This was in addition to approximately 1,500 MW of reduced capacity due to oil burning. Approximately 4,700 MW of generation was lost between 12:01 a.m. and 7:00 a.m. Saturday. At 6:00 a.m. the demand was about 34,000 MW and the ERCOT capability was approximately 35,800 MW.

Early Saturday increases in load combined with the loss of generating units again created generation deficiencies. All utilities again minimized their own electrical demands, shed the remaining interruptible load, and contacted the media to ask customers to again reduce their electrical demand. During the day, 53 MW of load was transferred to Mexico, and over 400 MW of generation at times was obtained from the Southwest Power Pool from Oklaunion Power Plant, the D-C tie from Oklahoma, and load transfers.

### **Firm Load Shedding**

At 6:40 a.m. on Saturday, December 23rd, the Security Centers once again called the Emergency Electric Curtailment Plan into effect. As additional generators were forced out of service, loads began to exceed total generation, and the system frequency dropped below 60 Hz.

Those utilities that were unable to meet their own customers demands initiated rotating outages after asking the media to alert customers. The pre-defined steps of the EECPP were coordinated by the Security Centers with all utilities participating in efforts to preserve system integrity.

Shortly after 10:00 a.m., five generators carrying 1,075 MW were lost. A few minutes later, two more units were lost, carrying 200 MW. The system frequency decreased rapidly. In order to prevent a cascading outage of the ERCOT system, the final step of the EECPP, system-wide firm load shedding, was implemented at 10:21 a.m. by the Security Centers.

The firm load shedding was performed using a pre-determined allocation by utility. On the order of the Security Center operators to interrupt a total of 500 MW, each utility immediately interrupted firm customer load. The system frequency recovered and stabilized as a result of this load shedding. Much of the firm load that was shed as a result of the EECPP was restored in approximately 30 minutes, and the EECPP was cancelled at 12:40 p.m. as reserves returned to acceptable levels. Reserve levels were manageable throughout the remainder of the weekend as temperatures began to rise, electrical demand decreased, and generating units were restored to service.

### **Implementation of Plan**

Because of voluntary participation by each utility in ERCOT, strategies for managing the utility system during emergency operations are in place. The emergency of the weekend of December 21-23 indicated that the plans the ERCOT utilities had in place prior to the emergency worked effectively in limiting the amount of customer interruptions and prevented widespread cascading outages.

### **Evaluation of Performance**

Because emergencies of this kind are anticipated, the ERCOT Operating Guides were written and are constantly updated. All available options are considered prior to the emergency and are part of the creation and maintenance of the Operating Guides. ERCOT plans were in place, and they worked.

In order to improve ERCOT planning where possible, data is being gathered and meetings have already begun to evaluate the events and actions during the emergency to determine if Operating Guides revisions are appropriate. Individual utilities are reviewing specific problems related to severe freezing weather to improve performance under similar conditions in the future. In addition, ERCOT through its committees and individual members will study items necessary to promote improved operational performance, such as:

- a review of the ERCOT Emergency Electric Curtailment Plan
- a review of generator maintenance scheduling
- a review of fuel resources during emergencies
- a review of procedures to provide timely information to proper authorities

ERCOT utilities had predetermined emergency operating procedures in place to respond to extreme operating conditions such as those that occurred on December 21- 23. Although it was necessary to temporarily utilize emergency load reductions, the plan worked as designed.

ERCOT  
OPERATING GUIDE NO. 12

ADVERSE WEATHER OPERATION

The purpose of this Guide is to provide more uniform reliability during adverse weather conditions. This guide is to be used for scheduling generation to serve the load during times when contingencies are most likely and it should not limit the decision of the control center operator in minute-by-minute operation. The operator's judgement, based on current information, should result in prudent operation of the system.

ALERT

- A. Any Control Area having information on significant weather changes, oil burning possibilities or any fuel shortages should notify the appropriate Security Center. The appropriate Security Center will advise each Control Area and the other Security Center of the pending adverse operating conditions.
- B. The Security Center(s); either North, South or jointly, will declare a Wet Weather, Cold Weather, or Severe Cold Weather Alert, as outlined below, with the effective time of implementation whenever the expected weather or system conditions may significantly limit ERCOT's ability to serve the system load.
- C. Each Control Area will maintain spinning reserve obligations in accordance with ERCOT Operating Guides No. 3 and No. 6. Additional reserve need not be responsive reserve nor maintained with emergency help.
- D. Types of Alerts are listed below with specific additional requirements:
  - 1. Wet Weather Alert - declared whenever rain storms or anticipated hurricanes may result in significant capability loss due to coal/lignite handling limitations, loss of other power plants or loss of bulk power transmission lines.

Each Control Area will increase its spinning reserve by an amount at least equal to its responsive spinning reserve obligation as soon as possible (this additional reserve need not be responsive).

- 2. Cold Weather Alert - declared whenever temperatures in the mid-to-low 20's are likely and maximum temperatures are expected to remain near or below freezing or significant oil burning is imminent.
  - a. Each Control Area will increase its spinning reserve by an amount at least equal to its responsive spinning reserve obligation as soon as possible (this additional reserve need not be responsive).
  - b. Actual capabilities will be used for ERCOT Information reporting.
  - c. Oil will be circulated and/or test fired or minimum oil burned on curtailable units before freezing temperatures are reached.
  - d. Oil capabilities will be used for capacity planning in each Control Area when oil burning is imminent or in effect.

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ADVERSE WEATHER OPERATION  
(cont.)

3. Severe Cold Weather Alert - declared whenever temperatures in the lower teens are likely and the maximum temperatures are expected to remain in the mid 20's or below or significant oil burning is imminent.
  - a. Each Control Area will increase its spinning reserve by an amount at least equal to its responsive spinning reserve obligation as soon as possible (this additional reserve need not be responsive).
  - b. Actual capabilities will be used for ERCOT Information reporting.
  - c. Oil will be circulated and/or test fired or minimum oil burned on curtailable units before freezing temperatures are reached.
  - d. Oil capabilities will be used for capacity planning in each Control Area when oil burning is imminent or in effect.
  - e. All units available for service within the anticipated time frame of the emergency but having start-up times greater than one hour, shall be brought on-line without regard to spinning reserve requirements.
  - f. Control Areas will inform their Security Center of hardships incurred or anticipated in maintaining all units on line during minimum load hours. Control Areas will attempt solutions worked out on an informal basis through Security Centers.
- E. Each Control Area will report back to their respective Security Center when they are in compliance with the alert.
- F. Security Centers will cancel Wet Weather, Cold Weather or Severe Cold Weather Alerts as soon as weather conditions permit.

ERCOT  
OPERATING GUIDE NO. 3

EMERGENCY OPERATING PROCEDURES

A. GENERAL

The Control Area operators, in coordination with the ERCOT Security Centers, have the authority to make and carry through decisions which are required to operate the ERCOT System during emergency or adverse conditions. Each Control Area will have sufficiently detailed operating procedures for emergency or short supply situations and for restoration of service in the event of a partial or complete system shutdown. These procedures will be distributed to the personnel responsible for performing specified tasks to handle emergencies, remedy short supply situations, or restore service. The ERCOT Emergency Electric Curtailment Plan (Appendix H) shall be followed during ERCOT short supply conditions. ERCOT Operating Guide No. 16, ERCOT Black Start Guide, and Appendix L, ERCOT Black Start Information, specify individual and cooperative activities for major system restoration.

Each Control Area will endeavor to maintain transmission ties intact if at all possible. This will: (1) permit rendering the maximum assistance to a utility experiencing a deficiency in generation, (2) minimize the possibility of cascading loss to other parts of the system, and (3) assist in restoring operation to normal.

These emergency operating procedures will contain information for the following:

- (1) Utilization and redistribution of spinning reserve to the extent permitted by system conditions.
- (2) Maximum utilization of system capability.
- (3) Maintain station service for nuclear generating facilities.
- (4) Securing startup power for power generating plants.
- (5) Operating power generating plants isolated from ERCOT without communication.
- (6) Restoration of service to critical loads such as:
  - Military facilities.
  - Facilities necessary to restore the electric utility system.
  - Law enforcement organizations and facilities affecting public health.
  - Communication facilities.
  - Larger groups of customers.
- (7) Restoration of service to all customers following major system disturbances.

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OPERATING GUIDE NO. 3

EMERGENCY OPERATING PROCEDURES  
(cont.)

- B. IMPLEMENTATION GUIDE FOR EMERGENCY ELECTRIC CURTAILMENT PLAN (APPENDIX H)  
THE SECURITY CENTERS SHALL BE RESPONSIBLE FOR MONITORING THE SYSTEM, DECLARING THE EMERGENCY AND NOTIFYING ALL CONTROL AREAS, AND COORDINATING THE IMPLEMENTATION OF THE FOLLOWING STEPS WITHIN THE MAXIMUM TRANSFER LIMITATIONS. IT IS UNDERSTOOD THAT THE DEFICIT SYSTEM(S) WILL TAKE THE LEAD IN IMPLEMENTING THE APPLICABLE STEPS AND IN SHEDDING FIRM LOAD. IT IS ALSO UNDERSTOOD THAT THERE MAY BE INSUFFICIENT TIME TO IMPLEMENT ALL STEPS.

PLANNED SPINNING RESERVE

- a. Order needed and/or available units on line.
- b. Distribute ready reserves among ERCOT Control Areas limited only by maximum transfer capability.
- c. Redistribute available reserves among ERCOT Control Areas up to maximum transfer capability or until each company has only one-half its spinning reserve requirement remaining.

MAINTAIN SPINNING RESERVE EQUAL TO LARGEST UNIT IN OPERATION

- d. Voluntarily remove increments of interruptible load that are not controlled by high-set underfrequency relays.
- e. Reduce customer loads of the deficit Control Areas by reducing distribution voltage or other load management measures.
- f. Reduce in-house non-essential loads in the System Control Areas.
- g. Appeal by media for voluntary load reduction by all customers of the deficit Control Areas.
- h. Redistribute available reserves among ERCOT Control Areas up to maximum transfer capability.

MAINTAIN SPINNING RESERVE EQUAL TO 1% OF ERCOT ANNUAL PEAK (400 MW)

- i. Remove all additional increments of interruptible loads, limited only by the amount of load required to prevent damage to customers' equipment.
- j. Request voluntary curtailment by large industrial customers.
- k. Reduce distribution voltage or use other direct load management programs when feasible and appropriate and time permits.

BETWEEN 60 - 59.8 HZ AND ZERO SPINNING RESERVE

- l. Appeal by media for voluntary load reduction by all customers.
- m. All Control Areas, working with their Security Center, will observe conditions and be prepared to take corrective action to keep the frequency above 59.8 Hz.

MAINTAIN 59.8 HZ OR GREATER AND MAXIMUM TRANSFER LIMITATIONS

- \* n. The deficit Control Areas will shed as much firm load as possible, keeping in mind the need to protect the safety and health of the community and the essential human needs of the citizens.
- \* o. Shed 100 MW blocks of firm load distributed as listed below in order to maintain steady state system frequency of 59.8 Hz or to prevent infringement on maximum power transfer limitations.  
COA = 3.9, COB = 0.3, CPL = 7.0, CPS = 6.7, HLP = 26.9,  
LCRA = 3.8, STEC = 0.6, TUE = 43.6, TMPP = 4.4, WTU = 2.8  
If frequency is at or below 59.4 Hz, the Security Centers will immediately implement step o.

\*For Restoration, See Guide No. 5 and Appendix H.



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APPENDIX H

EMERGENCY ELECTRIC CURTAILMENT PLAN

At times it may be necessary to reduce electrical demand on one or more of the ERCOT member systems because of a temporary decrease in available electricity supply. The drop in supply could be caused by emergency outages of generators, transmission equipment, or other critical facilities; by short-term unavailability of fuel or generation; or by requirements or orders of government agencies. To provide an orderly, predetermined procedure for curtailing demand during emergencies, ERCOT has established this Emergency Electric Curtailment Plan (EECP). As many steps of the EECP will be implemented as necessary to reduce electrical demand to a level that ERCOT can supply under the existing conditions. The objective of the EECP is to provide for maximum possible continuity of service while maintaining the integrity of the ERCOT bulk power transmission system in order to reduce the chance of cascading outages.

1.0 PROCEDURES TO BE IMPLEMENTED BY CONTROL AREA(S) EXPERIENCING DEFICIENCIES

The following procedures will be implemented by the individual Control Area(s) which experiences or anticipates inability to provide sufficient electric capacity to serve its load prior to firm load reduction by other Control Areas.

- 1.1 Start up any available system generating units.
- 1.2 Import available power as needed from other Control Areas limited only by the maximum power transfer capability at time of disturbance. It is understood that economy energy transfers would be subordinate to the needs of the deficit area.
- 1.3 Reduce customer loads in accordance with interruptible contract provisions.
- 1.4 Reduce customer loads with implementation of available direct load management measures.
- 1.5 Curtail all non essential load within system facilities.
- 1.6 Request large industrial customers to reduce load.
- 1.7 Request via the media that all customers voluntarily reduce load. (Note: This request is not required in remaining systems.)

2.0 PROCEDURES TO BE IMPLEMENTED BY OTHER ERCOT CONTROL AREAS UNDER THE DIRECTION OF THE SECURITY CENTERS

In the event that the operating integrity of ERCOT is still endangered after the Control Area(s) in trouble have taken as many of the above steps as are applicable, or there is not sufficient time for the Control Area to take all of the steps, then ERCOT will implement



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EMERGENCY ELECTRIC CURTAILMENT PLAN  
(cont.)

the EECF. The deficient area(s) should continue implementing actions to relieve the burden on the non-deficient Control Areas.

2.1 Security Centers Responsibility

The Security Centers shall be responsible for monitoring any actual or anticipated emergency condition. When, in their judgement, the Control Area(s) with deficient generation cannot obtain adequate relief through the steps taken in 1.0 above, all Control Areas will be so notified.

The Security Center in whose group the deficiency occurs will be responsible for requesting implementation of the EECF. The two Security Centers will then coordinate the step-by-step implementation of the EECF. They will direct the following steps to be taken by all Control Areas to assist the area(s) deficient and to maintain the integrity of the ERCOT bulk power system to reduce the possibility of cascading outages.

2.2 Monitor Line Loadings

The Security Centers, with the assistance of all Control Areas, will monitor line loadings and maintain power transfers below levels which jeopardize reliability of the bulk power system. This may require specific designations of which Control Areas will or will not participate and the extent of participation in the Plan depending on tie line loadings.

2.3 Monitor Spinning Reserve

2.3.1 Maintaining normal spinning reserve.

2.3.1.1 The Security Centers will request needed available units to be brought on line.

2.3.1.2 The Security Centers will distribute available reserves among ERCOT Control Areas.

2.3.2 Total ERCOT spinning reserve drops below the largest available capacity on any generating unit in operation.

2.3.2.1 Each Control Area will remove interruptible load not controlled by high set underfrequency relays.

2.3.2.2 Each Control Area will curtail all non essential loads within the area's own facilities upon request of the Security Centers.

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EMERGENCY ELECTRIC CURTAILMENT PLAN  
(cont.)

2.3.2.3 The Security Centers will redistribute available reserves among ERCOT Control Areas as required.

2.3.3 Total ERCOT spinning reserve drops below the value of 1% of estimated ERCOT annual peak, while still maintaining 60 Hz.

At the request of the Security Centers, each Control Area will:

2.3.3.1 Remove all additional increments of interruptible loads, limited only by the amount of load required to prevent damage to customer's equipment.

2.3.3.2 Request curtailment by large industrial customers. ✓

2.3.3.3 Implement direct load management programs for load reduction when feasible and appropriate and time permits.

2.4 Monitor Frequency

System frequency drops below 60.0 Hertz.

2.4.1 The Security Centers will request each Control Area to take any remaining corrective action available from Step 2.3 and be on standby to curtail firm load.

2.4.2 Maintain frequency at or above 59.8 Hz without exceeding maximum transfer capability.

The Security Centers will request each Control Area to disconnect firm load as required according to the following sequence in order to maintain steady system frequency at or above 59.8 Hz. Such firm load shedding may include rotating outages of distribution circuits.

2.4.2.1 The Control Area(s) in trouble will shed as much firm load as possible, keeping in mind the need to protect the safety and health of the community and the essential human needs of the citizens.

2.4.2.2 Firm load shedding by other ERCOT Control Areas will be requested by the Security Centers provided such action does not infringe on the maximum power transfer capability or the adequate reliability of the community and the essential human needs of the citizens.

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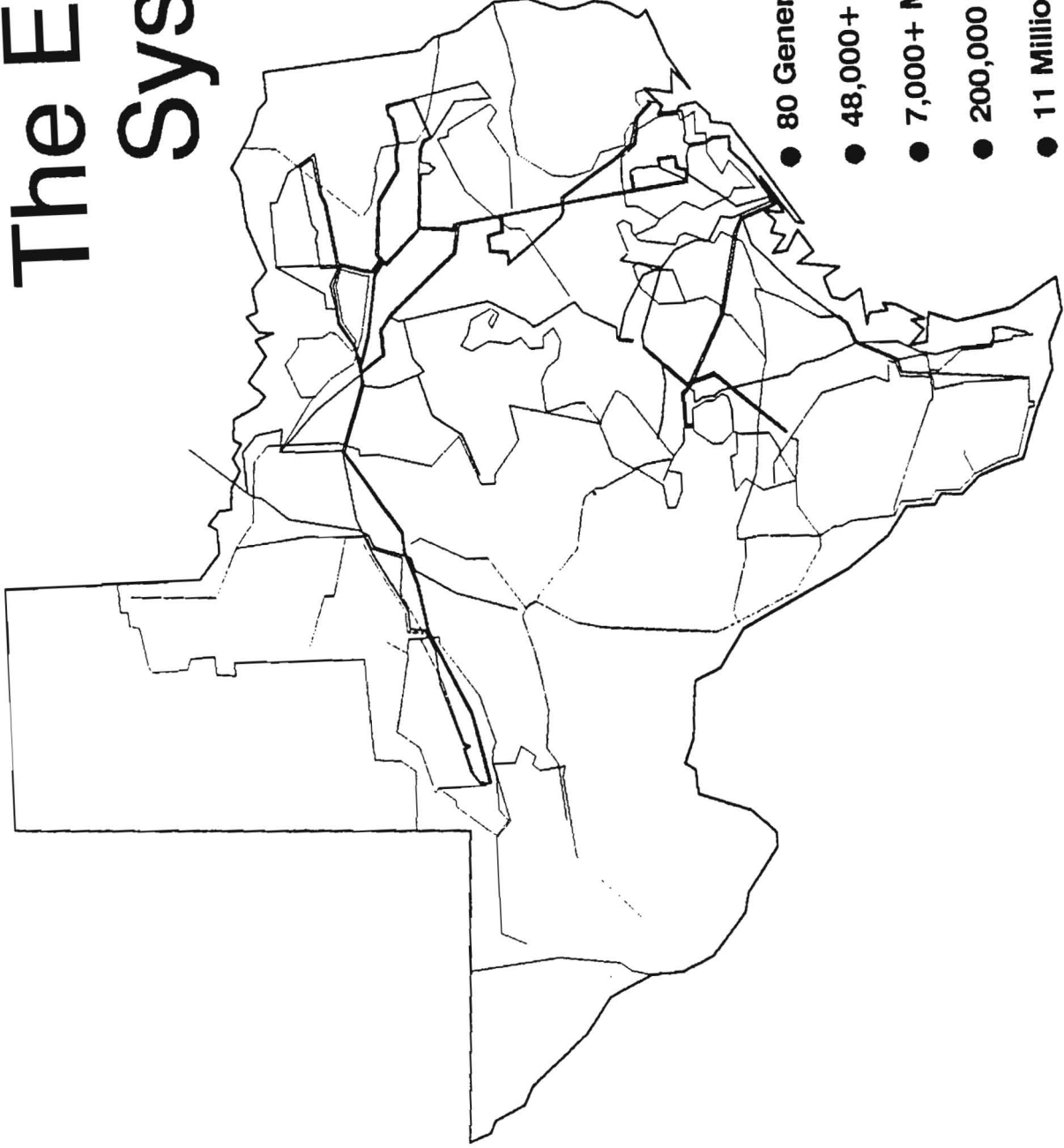
EMERGENCY ELECTRIC CURTAILMENT PLAN  
(cont.)

2.4.2.3 Control Areas will participate in the load shedding process according to the following percentages which include previously curtailed load, exclusive of interruptible loads. COA-3.9%, COB-0.3%, CPL-7.0%, CPS-6.7%, HLP-26.9%, LCRA-3.8%, STEC-0.6%, TUE-43.6%, TMPP-4.4%, WTU-2.8%. Percentages will be based on annual ERCOT peak load estimates and will be reviewed by the Security Centers and modified annually.

3.0 ENERGY EXCHANGED

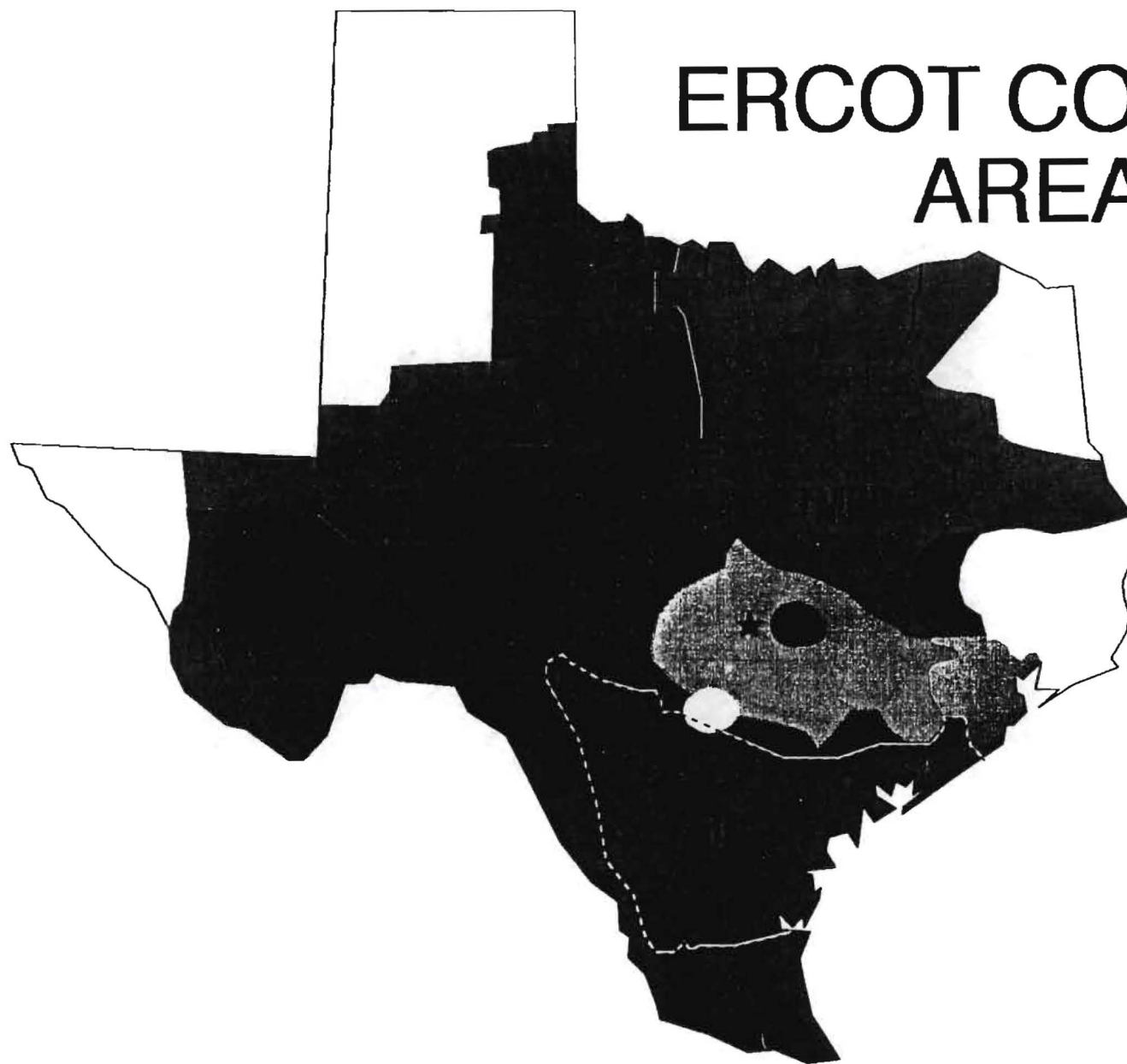
All energy exchanged while under the EECPP shall be treated as emergency energy and handled in accordance with ERCOT Operating Guide #9.

# The ERCOT System



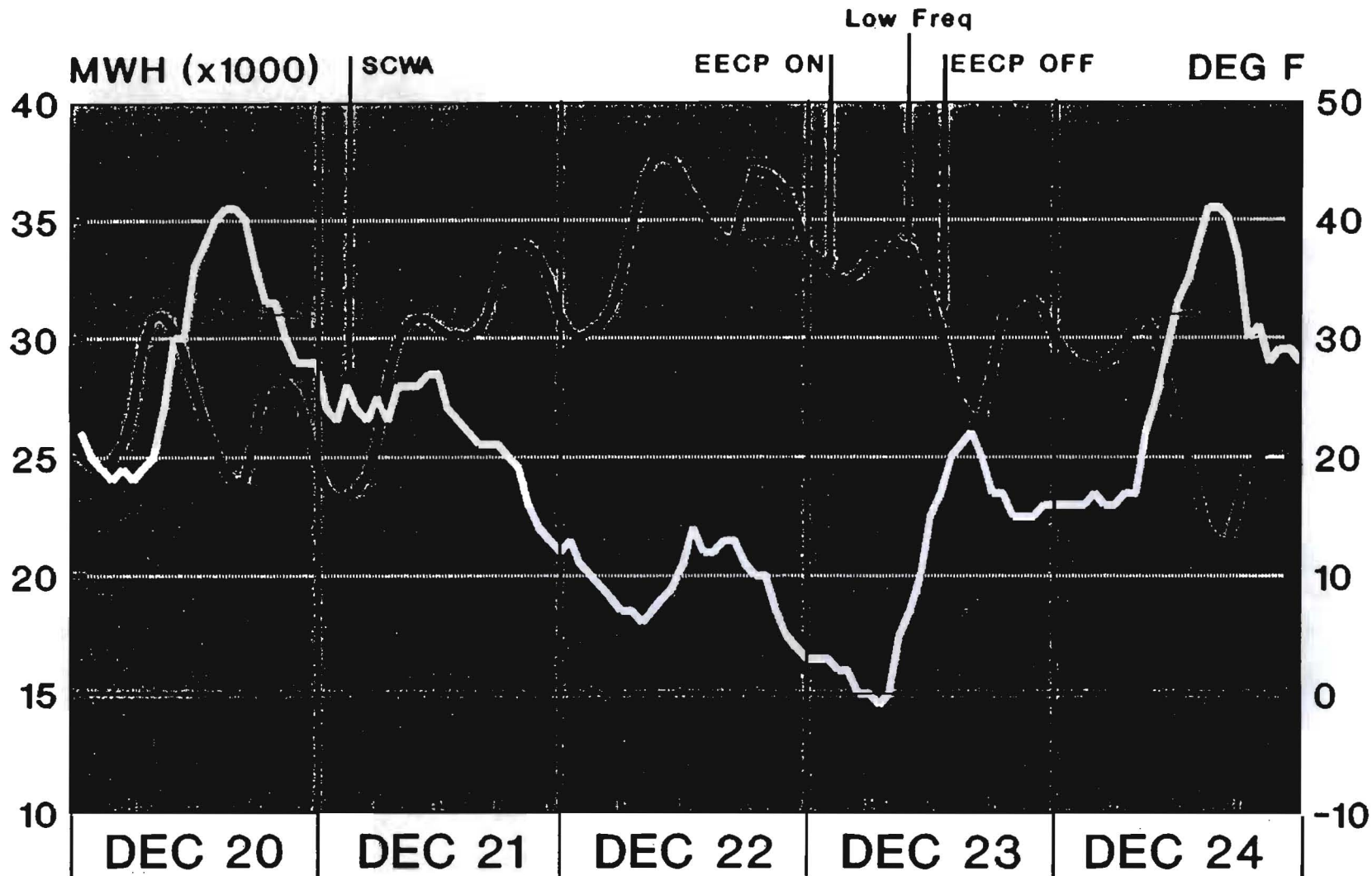
- 80 Generating Plants
- 48,000+ MW Generating Capability
- 7,000+ Miles of 345KV Lines
- 200,000 Square Miles of Texas
- 11 Million Customers

# ERCOT CONTROL AREAS



- COA
- COB
- CPL
- CPSB
- HLP
- LCRA
- TMPP
- TUEC
- WTU
- STEC
- ★ SC

# ERCOT LOAD



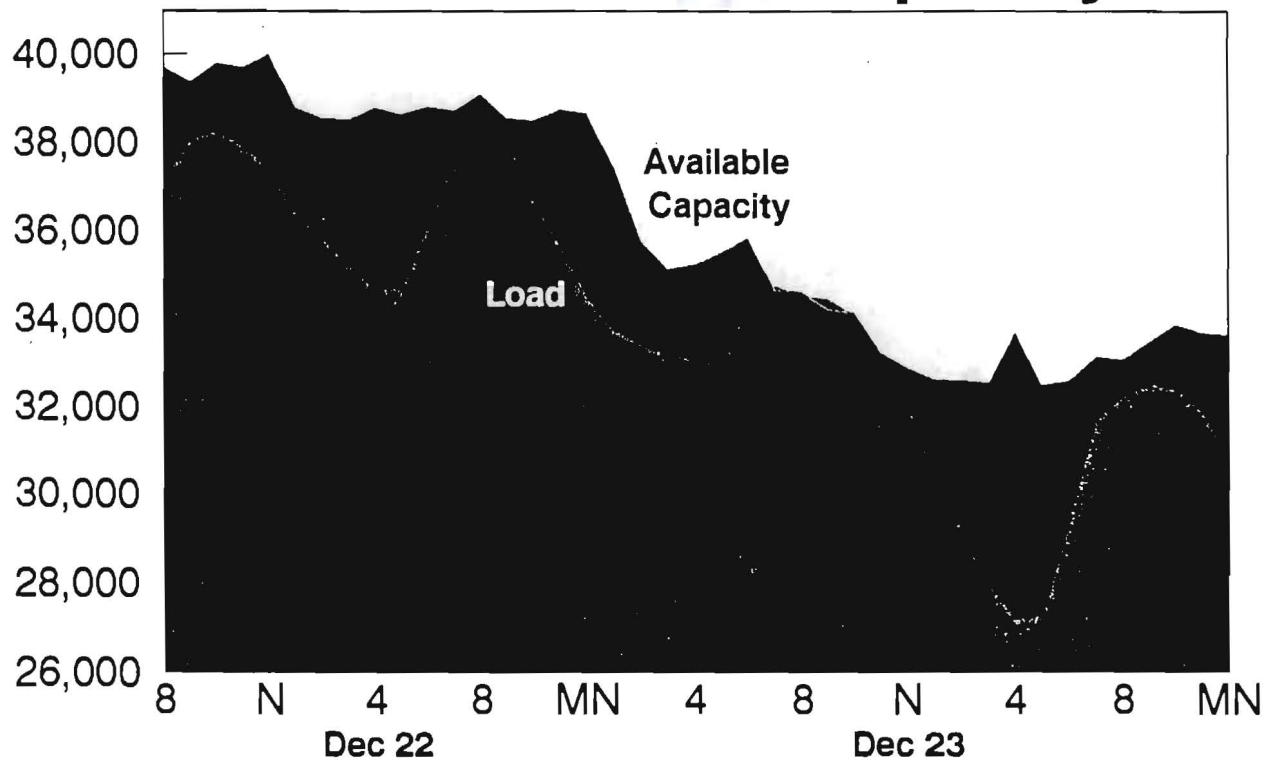
ERCOT LOAD



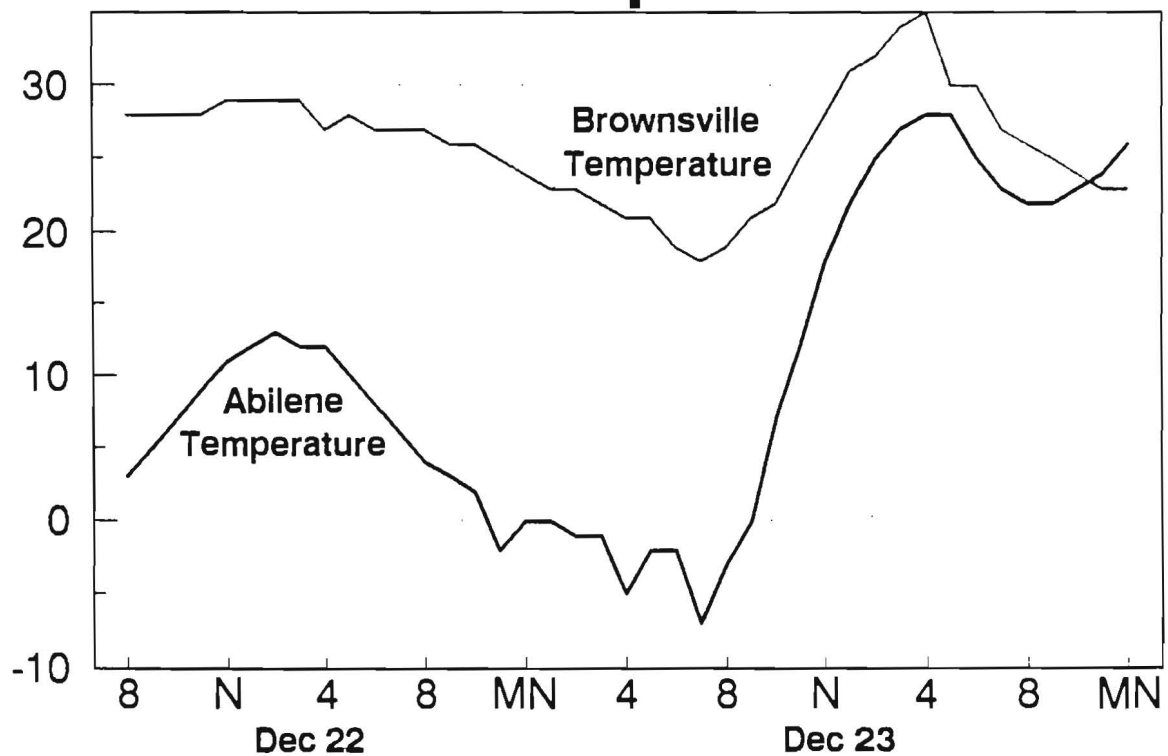
TEMPERATURE

TEMPERATURES ARE FROM DFW AIRPORT

# ERCOT Load and Capacity



# ERCOT Temperatures



1200

59.5	59.6	59.7	59.8	59.9	60	60.1	60.2	60.3
53	54	55	56	57	58	59	60	61

1100

# ERCOT FREQUENCY December 23, 1989

59.5	59.6	59.7	59.8	59.9	60	60.1	60.2	60.3
53	54	55	56	57	58	59	60	61

1000

0900

59.5	59.6	59.7	59.8	59.9	60	60.1	60.2	60.3
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