INCIDENT ANALYSIS

Incident description:
A Why-Because Analysis of the Disruption in the European Power Grid in the night between the 4 and 5 November 2006. A high-voltage line had to be turned off to let a cruise ship pass underneath. The following load redistribution caused many other lines to trip, splitting the European power grid into three parts with a generation/consumption imbalance. In areas with under-generation, consumers had to be disconnected from the grid. During the peak up to 15 million people in Europe were without electricity.
## Legend of Factorshapes

<table>
<thead>
<tr>
<th>Factortype</th>
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<tbody>
<tr>
<td>Unspecified Factortype</td>
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<tr>
<td>Event</td>
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<td>Contraindication</td>
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Changing of power flows simulation or N-1-calculations are forbidden after E.ON does not perform end of auction for earlier time.

RWE and TenneT of earlier E.ON does not notify shutdown time until 04-nov-2006 1800h. E.ON expects higher time as more favourable load on cross-boundary. E.ON's DACF for 04-nov-2006 contains the load situation by 3 hours to 4 Nov 2200h to bring shutdown forward from E.ON.

Current on line Landesbergen-Wehrendorf is close to limit (1795A). Load on line Landesbergen-Wehrendorf exceeds warning value of 1800A. E.ON does not find violation of limit values of N-1 criterion in eastern parts. Insufficient specification of N-1 criterion in south-eastern European grid during electricity supply. The number of people in Europe are cut off from electricity supply.

Frequency in the north-eastern part drops to around 49.6Hz. E.ON switches off HV line Conneforde-Diele among other lines. Frequency in the north-eastern part rises to 50.4Hz. Load flow redistributes back to around 49.8 Hz. E.ON does not perform an empirical evaluation of grid trips and co-ordination between carriers.

RWE calls E.ON to request urgent intervention of N-1 criterion is met to restore safe operation. Additional generators have to be started and connected to the grid. Pump stations are turned off in western parts and consumers have to be cut off in a controlled manner. Pumps are turned off and shut down in quick succession by E.ON. Frequency in the south-eastern part drops to around 49.6Hz. E.ON switches off HV line Conneforde-Diele to pass safely under HV line. Cruise ship is too tall to pass under HV line. E.ON assumes that coupling the busbars at Landesbergen side would reduce current 3 hours to 4 Nov 2200h. Cruise ship is scheduled to pass under HV line. E.ON leaves N-1 calculations to check for N-1 criterion.

Insufficient communication to their dispatchers' discretion. Operations Handbook Decentral Generation. Too little power generation to be cut off in a controlled and too much consumption of power generation of N-1 criterion in north-eastern side.

Current on HV line Landesbergen-Wehrendorf increases by 100MW at E.ON control centre. Several other lines are automatically shut down in quick succession. Current on line Landesbergen-Wehrendorf increases by 100MW at E.ON control centre. Several other lines are automatically shut down in quick succession. Current on line Landesbergen-Wehrendorf increases by 67A at Landesbergen.

Wind turbines automatically disconnect from the grid, too much power generation exceeds limit at RWE. Insufficient specification of N-1 criterion in south-eastern European grid during electricity supply. The number of people in Europe are cut off from electricity supply. E.ON and RWE use different curtailment methods. The busbar-coupling at Landesbergen side.

Decentral Generation. Too little power generation to be cut off in a controlled and too much consumption of power generation of N-1 criterion in north-eastern side.

Decentral Generation.
Changing of power flows simulation or N-1-calculations are forbidden after E.ON does not perform end of auction for earlier time.

RWE and TenneT of earlier E.ON does not notify 04-nov-2006 1800h load and less wind feed-in E.ON expects higher time as more favourable load on cross-boundary E.ON's DACF for 04-nov-2006 E.ON considers earlier E.ON expects lower pre-scheduled shutdown Load flows for the day take earlier shutdown cannot be changed to 04-nov-2006 2200h to bring shutdown forward Meyerwerft requests from E.ON Wehrendorf is close Load at substation to limit (1795A) Load on line Landesbergen-Wehrendorf increases by 100MW E.ON performs an empirical RWE calls E.ON to request assessment of the situation to restore safe operation of the load situation Current on line Landesbergen-Wehrendorf exceeds warning value of 1800A E.ON performs an empirical RWE performs load flow calculations with Conneford-Diele Additional generators connected to the grid. E.ON leaves N-1 calculations to check for N-1 criterion to their dispatchers'. E.ON does not perform load flow calculations E.ON does not perform numerical computations E.ON does not perform end of auction for earlier time (25) (21) (1795A) (52) (58) (57) (59) (60) (78) (42) (41) (40) (71) (70) (72) (73) (74) (75) (76) (77) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100) (101) (102)
Changing of power flows simulation or N-1-calculations are forbidden after E.ON does not perform end of auction (25)

RWE and TenneT of earlier E.ON does not notify shutdown time until 04-nov-2006 1800h E.ON expects higher time as more favourable load on cross-boundary E.ON's DACF for 04-nov-2006 E.ON considers earlier E.ON expects lower line at earlier time pre-scheduled shutdown Load flows for the day take earlier shutdown cannot be changed to does not contain the (20)

E.ON performs an empirical evaluation of grid situation into account (23)

Meyerwerft requests from E.ON (17)

Wehrendorf is close to limit (1795A) E.ON does not find violation of limit values (33) (34) (35)

Load on line Landesbergen-Wehrendorf E.ON does not perform by 3 hours to 4 Nov 2200h to bring shutdown forward Meyerwerft requests from E.ON (17)

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Timeline of Events

Meyerwerft asks E.ON to turn off HV line Conneforde-Diele

E.ON Netz gives provisional approval for shutdown of HV line to Meyerwerft

E.ON performs analysis of load situation for shutdown of HV line

E.ON has no detailed information about load situation on day of shutdown

E.ON informs Dutch network carrier TenneT about planned HV line shutdown

E.ON informs network carrier RWE about planned HV line shutdown

RWE performs N-1 calculations for situation with HV line shut down

TenneT performs N-1 calculations for situation with HV line shut down

RWE anticipates high load but secure operation with HV line shut down

TenneT anticipates high load but secure operation with HV line shut down

E.ON Netz and TenneT agree to reduce cross-boundary flow by 350MW between 0 and 6 a.m. on 05-nov-2006

Meyerwerft requests to bring shutdown forward by 3 hours to 4 Nov 2200h from E.ON

E.ON considers earlier time as more favourable

E.ON expects higher load and less wind feed-in at earlier time

E.ON expects lower load on cross-boundary line at earlier time

E.ON does not perform simulation or N-1-calculations for earlier time

E.ON does not notify RWE and TenneT of earlier shutdown time until 04-nov-2006 1800h

E.ON’s DACF for 04-nov-2006 does not contain the pre-scheduled shutdown

TenneT expects increased infed from wind turbines

04.11.2006

TenneT decides to reduce cross-boundary flow further for 2006-11-04

E.ON, TenneT and RWE agree to change tap position at Meeden phase shifter

TenneT changes tap position at Meeden phase shifter

E.ON does not find violation of limit values

21:29:00

E.ON performs an empirical evaluation of grid situation

E.ON does not perform numerical computations of the load situation

E.ON assumes that N-1 criterion is met

RWE performs load flow calculation and N-1 analysis of situation with Connefard-Diele line turned off

Frequency UCTE area very close to nominal 50 Hz

21:30:00

RWE confirms to E.ON that cross-border-flows would be high

RWE assumes its grid to be secure

RWE gives agreement to shutdown of HV line Conneforde-Diele

TenneT gives agreement to shutdown of HV line Conneforde-Diele

TenneT assumes its grid to be secure

TenneT confirms to E.ON that cross-border-flows would be high

E.ON switches off HV line Conneforde Diele

21:38:00

Load flow redistributes among other lines

E.ON receives warning messages about high power flow on line Elsen-Twistetal

21:39:00

E.ON receives warning messages about high power flow on line Elsen-Bechterdissen

E.ON sees no need for immediate action

E.ON phones RWE to find if it everything is ok

RWE maintains that N-1 criterion is met in their net

RWE points out the security margin for line Landesbergen (E.ON)-Wehrendorf (RWE)

RWE points out the limit of substation Wehrendorf

Load at substation Wehrendorf is close to limit (1795A)
N-1 criterion is met in internal RWE net

E.ON issues passage approval for Norwegian Pearl to Meyerwerft 21:42:00 X
E.ON and Vattenfall still consider situation as tight 21:46:00 X
Load on line Landesbergen-Wehrendorf increases by 100MW to 1900 A 22:05:00
Current on line Landesbergen-Wehrendorf exceeds warning value of 1800A 22:07:00
RWE calls E.ON to request urgent intervention to restore safe operation 22:08:00
E.ON performs an empirical assessment of the situation 22:09:00
E.ON assumes that coupling the busbars at Landesbergen would reduce current by 80A
E.ON decides to couple the busbars at Landesbergen
E.ON does not perform load flow calculations to check for N-1 criterion
E.ON does not co-ordinate busbar-coupling at Landesbergen with RWE 22:10:00
E.ON couples the busbars at Landesbergen 22:10:11
HV line Landesbergen-Wehrendorf trips 22:10:13
Several other lines are automatically shut down in quick succession 22:10:15
European transmission grid is split into three parts
Frequency in the western part rises to 50.4Hz 22:10:30
Frequency in the south-eastern part drops to around 49.8 Hz
Frequency in north-eastern part drops to around 49Hz and slowly rises back to around 49.6Hz
Grid cannot be reconnected due to too high frequency differences
Generators have to be cut off or pumps activated in the western part 22:11:00
Pumps are turned off and consumers have to be cut off in a controlled manner
Too much power generation and too little consumption in western part
Too little power generation and too much consumption in eastern parts
15 Million people in Europe are cut off from electricity supply 22:15:00
Factor List - Details

1. **Meyerwerft asks E.ON to turn off HV line Conneforde-Diele**
   - Type of Factor: Event
   - Date/Time: 18.09.2006 00:00:00
   - Actors involved: Employees of TenneT
   - Employees of E.ON Netz GmbH
   - Annotation:

2. **Distance between ship and HV line too small for safe passage**
   - Type of Factor: State
   - Date/Time:
   - Actors involved:
   - Annotation:

3. **River Ems is dammed up for passage of cruise ship**
   - Type of Factor: State
   - Date/Time:
   - Actors involved:
   - Annotation:

4. **E.ON Netz gives provisional approval for shutdown of HV line to Meyerwerft**
   - Type of Factor: Event
   - Date/Time: 27.10.2006 00:00:00
   - Actors involved: Employees of E.ON Netz GmbH
   - Employees of TenneT
   - Annotation:

5. **E.ON performs analysis of load situation for shutdown of HV line**
   - Type of Factor: Event
   - Date/Time: 27.10.2006 00:00:00
   - Actors involved: Employees of E.ON Netz GmbH
   - Annotation:

6. **E.ON has no detailed information about load situation on day of shutdown**
   - Type of Factor: Process
   - Date/Time: 27.10.2006 00:00:00
   - Actors involved: Employees of E.ON Netz GmbH
   - Annotation:

7. **E.ON informs Dutch network carrier TenneT about planned HV line shutdown**
   - Type of Factor: Event
   - Date/Time: 27.10.2006 00:00:00
   - Actors involved: Employees of E.ON Netz GmbH
   - Employees of RWE Transportnetz Strom
   - Annotation:

8. **E.ON informs network carrier RWE about planned HV line shutdown**
   - Type of Factor: Event
   - Date/Time: 27.10.2006 00:00:00
   - Actors involved: Employees of E.ON Netz GmbH
   - Employees of RWE Transportnetz Strom
   - Annotation:

9. **RWE performs N-1 calculations for situation with HV line shut down**
   - Type of Factor: Event
   - Date/Time: 27.10.2006 00:00:00
   - Actors involved: Employees of RWE Transportnetz Strom
   - Annotation:
11 TenneT performs N-1 calculations for situation with HV line shut down  
Type of Factor: Event  
Date/Time: 27.10.2006 00:00:00  
Actors involved: Employees of RWE Transportnetz Strom  
Annotation:  
12 RWE anticipates high load but secure operation with HV line shut down  
Type of Factor: State  
Date/Time: 27.10.2006 00:00:00  
Actors involved: Employees of RWE Transportnetz Strom  
Annotation:  
13 TenneT anticipates high load but secure operation with HV line shut down  
Type of Factor: State  
Date/Time: 27.10.2006 00:00:00  
Actors involved: Employees of RWE Transportnetz Strom  
Annotation:  
14 E.ON Netz and TenneT agree to reduce cross-boundary flow by 350MW between 0 and 6 a.m. on 05-nov-2006  
Type of Factor: Event  
Date/Time: 27.10.2006 00:00:00  
Actors involved: Employees of E.ON Netz GmbH  
Employees of RWE Transportnetz Strom  
Annotation:  
15 TenneT decides to reduce cross-boundary flow further for 2006-11-04  
Type of Factor: Event  
Date/Time: 04.11.2006 00:00:00  
Actors involved: Employees of E.ON Netz GmbH  
Annotation:  
16 TenneT expects increased infeed from wind turbines  
Type of Factor: State  
Date/Time: 04.11.2006 00:00:00  
Actors involved: Employees of RWE Transportnetz Strom  
Annotation:  
17 Meyerwerft requests to bring shutdown forward by 3 hours to 4 Nov 2200h from E.ON  
Type of Factor: Event  
Date/Time: 03.11.2006 00:00:00  
Actors involved: Employees of E.ON Netz GmbH  
Employees of TenneT  
Annotation:  
18 E.ON considers earlier time as more favourable  
Type of Factor: State  
Date/Time: 03.11.2006 00:00:00  
Actors involved: Employees of E.ON Netz GmbH  
Annotation:  
19 E.ON expects higher load and less wind feed-in at earlier time  
Type of Factor: State  
Date/Time: 03.11.2006 00:00:00  
Actors involved: Employees of E.ON Netz GmbH  
Annotation:  
20 E.ON expects lower load on cross-boundary line at earlier time  
Type of Factor: State  
Date/Time: 03.11.2006 00:00:00  
Actors involved: Employees of E.ON Netz GmbH  
Annotation:
21  E.ON does not perform simulation or N-1-calculations for earlier time
   Type of Factor: UnEvent
   Date/Time: 03.11.2006 00:00:00
   Actors involved: Employees of E.ON Netz GmbH
   Annotation:

22  E.ON does not notify RWE and TenneT of earlier shutdown time until 04-nov-2006 1800h
   Type of Factor: UnEvent
   Date/Time: 03.11.2006 00:00:00
   Actors involved: Employees of E.ON Netz GmbH
   Annotation:

23  E.ON's DACF for 04-nov-2006 does not contain the pre-scheduled shutdown
   Type of Factor: UnEvent
   Date/Time: 03.11.2006 00:00:00
   Actors involved: Employees of E.ON Netz GmbH
   Annotation:

25  Changing of power flows are forbidden after end of auction
   Type of Factor: State
   Date/Time:
   Actors involved:
   Annotation: Rules of energy market in Europe

26  E.ON, TenneT and RWE agree to change tap position at Meeden phase shifter
   Type of Factor: Event
   Date/Time: 04.11.2006 19:00:00
   Actors involved: Employees of E.ON Netz GmbH
   Employees of RWE Transportnetz Strom
   Employees of RWE Transportnetz Strom
   Annotation:

27  TenneT changes tap position at Meeden phase shifter
   Type of Factor: Event
   Date/Time: 04.11.2006 19:33:00
   Actors involved: Employees of RWE Transportnetz Strom
   Annotation:

28  Construction work at 380kV Borken substation
   Type of Factor: State
   Date/Time:
   Actors involved:
   Annotation:

29  Borken substation operates in two-busbar mode
   Type of Factor: State
   Date/Time:
   Actors involved:
   Annotation:

30  No power flows East->West possible at Borken substation
   Type of Factor: State
   Date/Time:
   Actors involved:
   Annotation:

31  Frequency UCTE area very close to nominal 50 Hz
   Type of Factor: Process
   Date/Time: 04.11.2006 21:30:00
   Actors involved:
   Annotation:
33 E.ON does not find violation of limit values
Type of Factor: Event
Date/Time: 04.11.2006 21:29:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

34 E.ON performs an empirical evaluation of grid situation
Type of Factor: Event
Date/Time: 04.11.2006 21:29:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

35 E.ON does not perform numerical computations of the load situation
Type of Factor: UnEvent
Date/Time: 04.11.2006 21:29:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

36 E.ON assumes that N-1 criterion is met
Type of Factor: Event
Date/Time: 04.11.2006 21:29:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

37 RWE confirms to E.ON that cross-border-flows would be high
Type of Factor: Event
Date/Time: 04.11.2006 21:30:00
Actors involved: Employees of RWE Transportnetz Strom
                  Employees of RWE Transportnetz Strom
Annotation:

38 RWE assumes its grid to be secure
Type of Factor: State
Date/Time: 04.11.2006 21:30:00
Actors involved: Employees of RWE Transportnetz Strom
                  Employees of RWE Transportnetz Strom
Annotation:

39 RWE gives agreement to shutdown of HV line Conneforde-Diele
Type of Factor: Event
Date/Time: 04.11.2006 21:30:00
Actors involved: Employees of RWE Transportnetz Strom
                  Employees of RWE Transportnetz Strom
Annotation:

40 RWE performs load flow calculation and N-1 analysis of situation with Conneford-Diele line turned off
Type of Factor: Event
Date/Time: 04.11.2006 21:29:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

41 E.ON switches off HV line Conneforde Diele
Type of Factor: Event
Date/Time: 04.11.2006 21:38:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

42 Load flow redistributes among other lines
Type of Factor: Process
Date/Time: 04.11.2006 21:38:00
Actors involved:
Annotation:
43 E.ON receives warning messages about high power flow on line Elsen-Twistetal
Type of Factor: Event
Date/Time: 04.11.2006 21:39:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

44 E.ON receives warning messages about high power flow on line Elsen-Bechterdissen
Type of Factor: Unspecified
Date/Time: 04.11.2006 21:39:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

45 Internal E.ON regulations
Type of Factor: State
Date/Time:
Actors involved: Employees of E.ON Netz GmbH
Annotation:

46 Temporary overload of up to 25% is permissible
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

47 E.ON sees no need for immediate action
Type of Factor: Unspecified
Date/Time: 04.11.2006 21:39:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

48 E.ON phones RWE to find if it everything is ok
Type of Factor: Event
Date/Time: 04.11.2006 21:41:00
Actors involved: Employees of E.ON Netz GmbH
Employees of RWE Transportnetz Strom
Annotation:

49 RWE maintains that N-1 criterion is met in their net
Type of Factor: Event
Date/Time: 04.11.2006 21:41:00
Actors involved: Employees of RWE Transportnetz Strom
Annotation:

50 RWE points out the security margin for line Landesbergen (E.ON)-Wehrendorf (RWE)
Type of Factor: Event
Date/Time: 04.11.2006 21:41:00
Actors involved: Employees of RWE Transportnetz Strom
Annotation:

51 RWE points out the limit of substation Wehrendorf
Type of Factor: Event
Date/Time: 04.11.2006 21:41:00
Actors involved: Employees of RWE Transportnetz Strom
Annotation:

52 Load at substation Wehrendorf is close to limit (1795A)
Type of Factor: Process
Date/Time: 04.11.2006 21:41:00
Actors involved:
Annotation:
53  N-1 criterion is met in internal RWE net
Type of Factor:  Process
Date/Time:  04.11.2006 21:41:00
Actors involved: Employees of RWE Transportnetz Strom
Annotation:

54  E.ON issues passage approval for Norwegian Pearl to Meyerwerft
Type of Factor:  Event
Date/Time:  04.11.2006 21:42:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

55  E.ON and Vattenfall still consider situation as tight
Type of Factor:  Event
Date/Time:  04.11.2006 21:46:00
Actors involved: Employees of E.ON Netz GmbH
Annotation:

57  Load on line Landesbergen-Wehrendorf increases by 100MW to 1900 A
Type of Factor:  Process
Date/Time:  04.11.2006 22:05:00
Actors involved:  
Annotation:  The reason for this increase is unknown

58  Current on line Landesbergen-Wehrendorf exceeds warning value of 1800A
Type of Factor:  Event
Date/Time:  04.11.2006 22:07:00
Actors involved:  
Annotation:

59  RWE calls E.ON to request urgent intervention to restore safe operation
Type of Factor:  Event
Date/Time:  04.11.2006 22:08:00
Actors involved:  
Annotation:

60  E.ON performs an empirical assessment of the situation
Type of Factor:  Event
Date/Time:  04.11.2006 22:09:00
Actors involved:  
Annotation:

61  E.ON assumes that coupling the busbars at Landesbergen would reduce current by 80A
Type of Factor:  Event
Date/Time:  04.11.2006 22:09:00
Actors involved:  
Annotation:

62  E.ON decides to couple the busbars at Landesbergen
Type of Factor:  Event
Date/Time:  04.11.2006 22:09:00
Actors involved:  
Annotation:

63  E.ON does not perform load flow calculations to check for N-1 criterion
Type of Factor:  UnEvent
Date/Time:  04.11.2006 22:09:00
Actors involved:  
Annotation:
E.ON couples the busbars at Landesbergen
Type of Factor: Event
Date/Time: 04.11.2006 22:10:11
Actors involved:
Annotation:

E.ON does not co-ordinate busbar-coupling at Landesbergen with RWE
Type of Factor: UnEvent
Date/Time: 04.11.2006 22:10:00
Actors involved:
Annotation:

HV line Landesbergen-Wehrendorf trips
Type of Factor: Event
Date/Time: 04.11.2006 22:10:13
Actors involved:
Annotation:

Several other lines are automatically shut down in quick succession
Type of Factor: Process
Date/Time: 04.11.2006 22:10:15
Actors involved:
Annotation:

European transmission grid is split into three parts
Type of Factor: Event
Date/Time: 04.11.2006 22:10:15
Actors involved:
Annotation:

Frequency in the western part rises to 50.4Hz
Type of Factor: Process
Date/Time: 04.11.2006 22:10:30
Actors involved:
Annotation:

Frequency in the south-eastern part drops to around 49.8 Hz
Type of Factor: Process
Date/Time: 04.11.2006 22:10:30
Actors involved:
Annotation:

Frequency in north-eastern part drops to around 49Hz and slowly rises back to around 49.6Hz
Type of Factor: Process
Date/Time: 04.11.2006 22:10:30
Actors involved:
Annotation:

Grid cannot be reconnected due to too high frequency differences
Type of Factor: Process
Date/Time: 04.11.2006 22:10:30
Actors involved:
Annotation:

Generators have to be cut off or pumps activated in the western part
Type of Factor: Process
Date/Time: 04.11.2006 22:11:00
Actors involved:
Annotation:

Pumps are turned off and consumers have to be cut off in a controlled manner
Type of Factor: Process
Date/Time: 04.11.2006 22:11:00
Actors involved:
Annotation:
76 Too much power generation and too little consumption in western part
Type of Factor: Process
Date/Time: 04.11.2006 22:11:00
Actors involved:
Annotation:

77 Too little power generation and too much consumption in eastern parts
Type of Factor: Process
Date/Time: 04.11.2006 22:11:00
Actors involved:
Annotation:

78 15 Million people in Europe are cut off from electricity supply
Type of Factor: Process
Date/Time: 04.11.2006 22:15:00
Actors involved:
Annotation:

79 Uneven distribution of power generation and consumption in European grid
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

80 TenneT gives agreement to shutdown of HV line Conneforde-Diele
Type of Factor: Event
Date/Time: 04.11.2006 21:30:00
Actors involved:
Annotation:

81 TenneT assumes its grid to be secure
Type of Factor: State
Date/Time: 04.11.2006 21:30:00
Actors involved:
Annotation:

82 TenneT confirms to E.ON that cross-border-flows would be high
Type of Factor: Event
Date/Time: 04.11.2006 21:30:00
Actors involved:
Annotation:

83 E.ON and RWE use different limit values at their respective ends of line Wehrendorf - Landesbergen
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

84 E.ON realises very late that line Landesbergen - Wehrendorf is about to trip
Type of Factor: Event
Date/Time:
Actors involved:
Annotation:

85 Insufficient communication and co-ordination between carriers
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

86 Insufficient specification of N-1 criterion in Operations Handbook
Type of Factor: State
Date/Time:
Actors involved:
Annotation:
87 Insufficient technical facilities at E.ON control centre
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

88 No automatic N-1 calculations at E.ON control centre
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

89 E.ON leaves N-1 calculations to their dispatchers’ discretion
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

90 Wind turbines automatically disconnect from the grid
Type of Factor: Event
Date/Time:
Actors involved:
Annotation:

91 Frequency in north-eastern part drops further
Type of Factor: Event
Date/Time:
Actors involved:
Annotation:

92 Decentral Generation units are not controlled from control centres
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

93 Load flows for the day cannot be changed to take earlier shutdown into account
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

94 Current on HV line Landesbergen-Wehrendorf increases by 67A
Type of Factor: Event
Date/Time:
Actors involved:
Annotation:

95 "Norwegian Pearl" cruise ship is too tall to pass safely under the live HV line Conneforde-Diele
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

96 "Norwegian Pearl" cruise ship is scheduled to pass under HV line Conneforde-Diele
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

97 Current on line Landesbergen-Wehrendorf exceeds limit at RWE side
Type of Factor: Event
Date/Time:
Actors involved:
Annotation:
RWE uses a limit of 2100A for line Landesbergen-Wehrendorf
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

TenneT performs load flow calculations
Type of Factor: Assumption
Date/Time:
Actors involved:
Annotation:

Load redistributes among other lines
Type of Factor: Event
Date/Time:
Actors involved:
Annotation:

E.ON uses a limit of 2550A for line Landesbergen-Wehrendorf
Type of Factor: State
Date/Time:
Actors involved:
Annotation:

Additional generators have to be started and connected to the grid.
Type of Factor: Event
Date/Time:
Actors involved:
Annotation: