

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |                                                               |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------|--|
| <br><b>KJELLER</b><br><small>VINDTEKNIKK AS</small>                                                                                                                                                                                                                                                                                                                                                                                        |  | Boks 122, 2027 Kjeller<br>Gunnar Randers vei 12<br>480 50 480 |  |
| Postadresse<br>Besøksadresse<br>Telefon                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                               |  |
| Notat nummer:<br><b>KVT/ALL/2010/N17</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  | Dato<br><b>23.03.2010</b>                                     |  |
| Notattittel:<br><b>Sted, kommune, fylke/land</b><br><b>Tittel</b><br><b>Engvikfjellet, Sør-Trøndelag</b><br><b>Skyggekast</b>                                                                                                                                                                                                                                                                                                                                                                                               |  |                                                               |  |
| Kunde:<br><b>Rambøll</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |                                                               |  |
| Kundens referanse:<br><b>Svein G. Skogen</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                                               |  |
| Sammendrag:<br>I forbindelse med planlegging av vindkraft på Engvikfjellet er det utført en skyggekast beregning. Dette notatet oppsummerer beregningene. Utskrift fra beregningsprogrammet er vedlagt notatet.                                                                                                                                                                                                                                                                                                             |  |                                                               |  |
| Forbehold:<br>Selv om det i arbeidet i dette notatet, så langt vi kjenner til, er benyttet oppdaterte analysemetoder, og vi i vårt arbeid forsøker å gi et så godt resultat som mulig, kan Kjeller vindteknikk AS ikke holdes ansvarlig for resultatene i notatet eller for framtidig bruk av det, og heller ikke for eventuelle direkte eller indirekte tap som skyldes eventuelle feil i notatet. Et notat er en forenklet rapport. Notatet har ikke vært igjennom en intern review prosess på samme måte som en rapport. |  |                                                               |  |

| Revisjonshistorie |            |           |              |
|-------------------|------------|-----------|--------------|
| Utgave            | Dato       | Kommentar | Distribusjon |
|                   | 23.03.2010 |           | Elektronisk  |

| Navn                               | Dato       | Signatur          |
|------------------------------------|------------|-------------------|
| Utarbeidet av<br>Anne Line Løvholm | 23.03.2010 | Anne Line Løvholm |

## Underlag for beregningene

Hvordan nærliggende bebyggelse til den planlagte vindparken på Engvikfjellet blir påvirket av skyggekastning er basert på beregninger utført i WindPro. Beregningene er basert på kart for området, solsannsynlighet og en layout for vindparken bestående av 49 møller med navhøyde 80m og rotordiameter 93m. For kartet er høydekoter på 20m benyttet og nærliggende bygninger er markert som mulige skyggemottakere. Solsannsynligheten er mulighet for solskinn mellom soloppgang og solnedgang. Sannsynligheten er beregnet ut fra data fra Ørlandet, som er nærmeste meteorologiske observasjonsstasjon, i perioden 1995-2004.

Et vindkraftverk vil forårsake ulike typer for visuelle forstyrrelser. Skygger fra stillestående vindturbiner ansees ikke som problematisk. Refleksblink som skyldes solens refleksjon i turbinbladene kan også i stor grad unngås ved hensiktsmessig overflatebehandling av turbinbladene. Det er skygge fra de roterende turbinene som er mest sjenerende og som kan ha uheldig virkning på de utsatte personene. Det er beregnet to skyggekasttider for vindparken. Det ene scenarioet tar for seg det verste tilfellet, hvor man ikke tar hensyn til at turbinene dreier med vindretningen, at turbinene er stillestående i perioder og skydekke. Det andre scenarioet tar disse hensynene og vil resultere i hva man kan forvente seg av skyggetid. For begge scenarioene er det ikke beregnet skyggekast når bygninger står lenger enn 2km unna vindturbinene, solen står mindre enn 3° over horisonten eller rotorbladene dekker mindre enn 20% av solskiven. Dette er fordi skyggekastningen da ansees å være så diffus at den er neglisjerbar. Før skyggekastberegningen er utført er det beregnet hvilke områder hvor den visuelle sonen er påvirket av vindparken og skyggen fra denne. Det er kun for disse sonene skyggekast er beregnet.

Bygninger nær parken er markert som skyggemottakere. Bebyggelse innenfor den planlagte parkens grenser er ikke definert som skyggemottakere, da det er antatt at disse vil bli kjøpt ut for å få bygget vindparken. I kartgrunlaget er det ikke angitt bruksområdet og dertil brukstid for disse bygningene. Det er imidlertid rimelig å anta at dette i hovedsak er fritidsbebyggelse. Hver bygning er angitt som et stort vindu med utstrekning 5m\*5m som står 1m over bakken og de står normalt på bakken. I tillegg er det antatt at bygningene har vindu på alle sider. Folk som befinner seg innendørs vil bli mindre berørt av skyggekast enn hva beregningene tilsier, da vindusflatene for bygningene er angitt større enn hva som er normalt for bygninger. Dette gjelder begge de beskrevne beregningstilfellene over. For en mer grundig undersøkelse av skyggekastforholdene bør man undersøke nærmere hvordan bygningene ser ut og bruksområdet.

Det er knyttet usikkerhet til beregningene ved kartdata og meteorologiske data. I forhold til kartusikkerhet gjelder dette i hovedsak antall bygninger og plasseringene, kartet benyttet er fra 2008. For de meteorologiske data er det modell data fra WRF (Weather Research Forecast modell) som er benyttet, da det ikke finnes gode nok målinger for området. I tillegg kan det være forskjell på solstatistikken mellom Ørlandet og Engvikfjellet.

Sannsynligheten for sol som er benyttet for beregningen er spesifisert i Tabell 1.

Tabell 1: Sannsynlighet for sol i tidsrommet mellom soloppgang og solnedgang for Engvikfjellet. Sannsynligheten er beregnet fra data fra Ørlandet i perioden 1995-2004.

| Måned | Jan  | Feb  | Mar  | Apr  | Mai  | Jun  | Jul  | Aug  | Sep  | Okt  | Nov  | Des  |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| P     | 0.11 | 0.21 | 0.29 | 0.34 | 0.37 | 0.28 | 0.30 | 0.32 | 0.35 | 0.27 | 0.20 | 0.05 |

Antall timer med vind i hver retning er oppsummert i Tabell 2.

Tabell 2: Forventet antall driftstimer per retning per år for Engvikfjellet

| Retning | N   | NNØ | ØNØ | Ø   | ØSØ | SSØ | S   | SSV | VSV  | V    | VNV | NNV | Sum  |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----|-----|------|
| Timer   | 334 | 193 | 193 | 393 | 972 | 705 | 371 | 564 | 1373 | 1135 | 786 | 401 | 7420 |

## Resultat

I Norge finnes det ingen grenseverdier for hva som er tillatt av skyggekast fra en vindpark. De beregnede tidene er derfor sammenliknet med svenske retningslinjer.

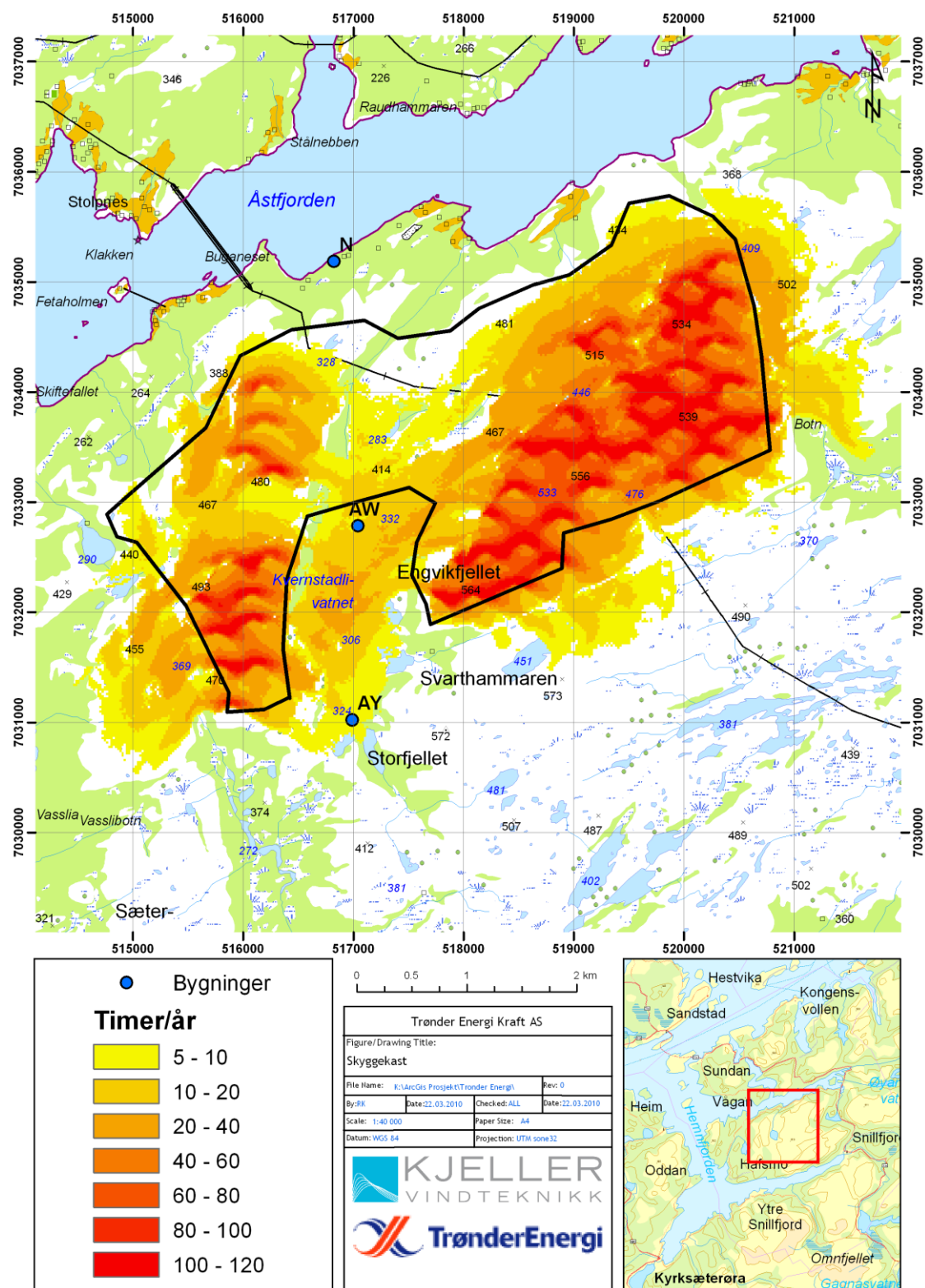
I overkant av 140 bygninger er identifisert som mulige skyggemottakere, men kun tre av disse er får skyggekast. Tid med skyggekast for disse tre er oppsummert i Tabell 3.

Tabell 3: Beregnet skyggekast tid per år for de berørte bygningene nær Engvikfjellet vindpark

|                      | Verste tilfelle scenario |                    |                               | Forventet scenario |
|----------------------|--------------------------|--------------------|-------------------------------|--------------------|
|                      | Skyggetimer per år       | Skyggedager per år | Maksimalt skyggetimer per dag | Skyggetimer per år |
| <b>Grenseverdier</b> | 30:00                    |                    | 0:30                          | 8:00               |
| <b>Lokalitet</b>     |                          |                    |                               |                    |
| N                    | 4:04                     | 19                 | 0:16                          | 0:36               |
| AW                   | 63:14                    | 149                | 0:41                          | 10:29              |
| AY                   | 51:06                    | 133                | 0:40                          | 9:24               |

Som man kan se i Tabell 3 er de svenske grenseverdiene overskredet for de to lokalitetene AW og AY.

De tre plasseringene som blir utsatt for skyggekast er vist i kartet nedenfor. Kartet viser også timer med skyggekast for parkområdet generelt.



Figur 1: Skyggekast kart med berørte bygninger

Project:  
engvikfjPrinted/Page  
23.03.2010 08:50 / 1Licensed user:  
**Kjeller Vindteknikk AS**  
Instituttveien 18  
NO-2025 Kjeller  
+47 63 80 62 11Calculated:  
22.03.2010 15:47/2.6.1.252**SHADOW - Main Result****Calculation:** Skyggekast**Assumptions for shadow calculations**

Maximum distance for influence

Calculate only when more than 20 % of sun is covered by the blade

Please look in WTG table

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

Sun shine probabilities (part of time from sun rise to sun set with sun shine)

| Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
|------|------|------|------|------|------|------|------|------|------|------|------|
| 0.11 | 0.21 | 0.29 | 0.34 | 0.37 | 0.28 | 0.30 | 0.32 | 0.35 | 0.27 | 0.20 | 0.05 |

Operational hours are calculated from WTGs in calculation and wind distribution:

Default Meteo data description

Operational time

| N   | NNE | ENE | E   | ESE | SSE | S   | SSW | WSW  | W    | WNW | NNW | Sum  |
|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----|-----|------|
| 334 | 193 | 193 | 393 | 972 | 705 | 371 | 564 | 1373 | 1135 | 786 | 401 | 7420 |

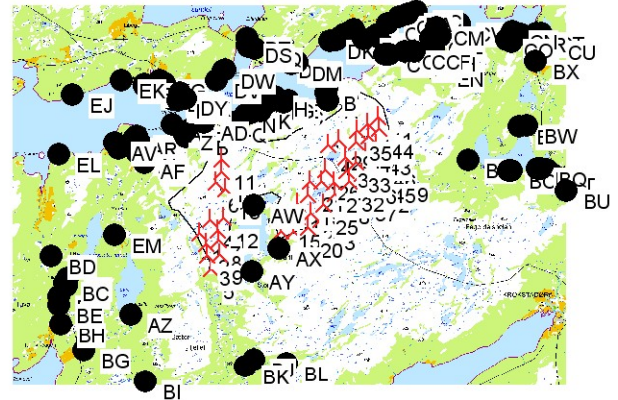
To avoid flicker from WTGs not visible a ZVI calculation is performed before the flicker calculation. The ZVI calculation is based on the following assumptions

Height contours used: Height Contours: Engvikfjellet\_merged\_opt.wpo (2)

Obstacles used in calculation

Eye height: 1.5 m

Grid resolution: 10 m



New WTG

Scale 1:200 000  
Shadow receptor**WTGs**

| UTM WGS84 Zone: 32 |         |           |                             | WTG type |           |                  |                   | Shadow data        |                |                          |       |
|--------------------|---------|-----------|-----------------------------|----------|-----------|------------------|-------------------|--------------------|----------------|--------------------------|-------|
| East               | North   | Z         | Row data/Description        | Valid    | Manufact. | Type-generator   | Power, rated [kW] | Rotor diameter [m] | Hub height [m] | Calculation distance [m] | RPM   |
| UTM WGS84 Zone: 32 |         |           | [m]                         |          |           |                  |                   |                    |                |                          | [RPM] |
| 1                  | 515 576 | 7 032 056 | 480.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 2                  | 515 769 | 7 031 771 | 462.3 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 3                  | 515 786 | 7 031 466 | 460.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 4                  | 515 878 | 7 032 408 | 480.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 5                  | 515 890 | 7 031 104 | 446.6 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 6                  | 516 017 | 7 033 405 | 460.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 7                  | 516 072 | 7 032 119 | 470.7 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 8                  | 516 094 | 7 031 883 | 460.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 9                  | 516 120 | 7 031 479 | 445.7 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 10                 | 516 170 | 7 033 676 | 460.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 11                 | 516 186 | 7 034 015 | 426.6 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 12                 | 516 232 | 7 032 452 | 451.6 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 13                 | 516 276 | 7 033 227 | 460.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 14                 | 517 749 | 7 032 092 | 512.4 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 15                 | 517 887 | 7 032 426 | 554.7 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 16                 | 518 097 | 7 032 110 | 540.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 17                 | 518 192 | 7 032 840 | 540.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 18                 | 518 204 | 7 032 495 | 560.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 19                 | 518 460 | 7 033 082 | 540.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 20                 | 518 463 | 7 032 207 | 540.7 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 21                 | 518 512 | 7 033 434 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 22                 | 518 544 | 7 032 581 | 540.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 23                 | 518 817 | 7 032 420 | 530.2 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 24                 | 518 826 | 7 033 442 | 540.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 25                 | 518 878 | 7 032 817 | 536.8 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 26                 | 518 929 | 7 033 743 | 515.8 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 27                 | 519 154 | 7 033 416 | 540.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 28                 | 519 180 | 7 033 110 | 533.1 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 29                 | 519 302 | 7 034 532 | 500.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 30                 | 519 493 | 7 033 723 | 540.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 31                 | 519 457 | 7 034 057 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |
| 32                 | 519 566 | 7 033 426 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0  |

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**Kjeller Vindteknikk AS**  
Instituttveien 18  
NO-2025 Kjeller  
+47 63 80 62 11Calculated:  
22.03.2010 15:47/2.6.1.252**SHADOW - Main Result**

Calculation: Skyggekast

...continued from previous page

| UTM WGS84 Zone: 32 |         |           |                             | WTG type |           |                  | Shadow data       |                    |                |                          |      |
|--------------------|---------|-----------|-----------------------------|----------|-----------|------------------|-------------------|--------------------|----------------|--------------------------|------|
| East               | North   | Z         | Row data/Description        | Valid    | Manufact. | Type-generator   | Power, rated [kW] | Rotor diameter [m] | Hub height [m] | Calculation distance [m] | RPM  |
| UTM WGS84 Zone: 32 |         | [m]       |                             |          |           |                  |                   |                    |                |                          |      |
| 33                 | 519 753 | 7 033 932 | 533.2 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 34                 | 519 755 | 7 034 476 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 35                 | 519 783 | 7 034 772 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 36                 | 519 906 | 7 033 638 | 527.4 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 37                 | 519 928 | 7 033 167 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 38                 | 520 016 | 7 034 165 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 39                 | 520 087 | 7 034 623 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 40                 | 520 141 | 7 033 824 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 41                 | 520 346 | 7 035 143 | 484.5 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 42                 | 520 237 | 7 033 405 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 43                 | 520 288 | 7 034 410 | 520.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 44                 | 520 361 | 7 034 822 | 500.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 45                 | 520 413 | 7 033 652 | 515.4 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 46                 | 520 421 | 7 034 045 | 500.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 47                 | 520 057 | 7 034 953 | 500.0 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 48                 | 519 006 | 7 034 398 | 487.8 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |
| 49                 | 520 743 | 7 033 680 | 490.4 Siemens SWT-2.3-93... | Yes      | Siemens   | SWT-2.3-93-2 300 | 2 300             | 92.6               | 80.0           | 1 463                    | 16.0 |

**Shadow receptor-Input**

| UTM WGS84 Zone: 32 |         |           |      |       |        |               |                       |                 | Direction mode     |  |
|--------------------|---------|-----------|------|-------|--------|---------------|-----------------------|-----------------|--------------------|--|
| No.                | East    | North     | Z    | Width | Height | Height a.g.l. | Degrees from south cw | Slope of window |                    |  |
|                    |         |           | [m]  | [m]   | [m]    | [m]           | [°]                   | [°]             |                    |  |
| A                  | 519 018 | 7 035 578 | 61.1 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| B                  | 518 970 | 7 035 773 | 20.0 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| C                  | 518 054 | 7 035 390 | 0.9  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| D                  | 517 905 | 7 035 368 | 34.4 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| E                  | 517 968 | 7 035 576 | 6.5  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| F                  | 517 841 | 7 035 520 | 45.2 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| G                  | 517 777 | 7 035 585 | 46.5 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| H                  | 517 653 | 7 035 627 | 30.6 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| I                  | 517 611 | 7 035 683 | 8.7  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| J                  | 517 418 | 7 035 512 | 36.4 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| K                  | 517 233 | 7 035 304 | 67.1 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| L                  | 516 957 | 7 035 238 | 20.1 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| M                  | 516 915 | 7 035 233 | 19.8 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| N                  | 516 820 | 7 035 185 | 20.0 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| O                  | 518 991 | 7 035 900 | 0.0  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| P                  | 516 589 | 7 035 009 | 19.1 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| Q                  | 516 542 | 7 034 936 | 26.6 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| R                  | 515 631 | 7 034 857 | 14.7 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| S                  | 515 468 | 7 034 862 | 5.7  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| T                  | 515 462 | 7 034 826 | 21.0 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| U                  | 515 441 | 7 034 791 | 36.7 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| V                  | 515 406 | 7 034 824 | 18.7 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| W                  | 515 282 | 7 034 721 | 19.1 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| X                  | 515 231 | 7 034 762 | 2.7  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| Y                  | 515 192 | 7 034 743 | 0.4  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| Z                  | 515 172 | 7 034 721 | 0.0  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AB                 | 515 216 | 7 034 608 | 14.2 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AC                 | 514 881 | 7 034 941 | 0.0  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AD                 | 515 712 | 7 034 989 | 0.0  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AE                 | 514 124 | 7 033 915 | 2.1  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AF                 | 514 112 | 7 033 974 | 3.9  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AG                 | 514 109 | 7 034 023 | 2.5  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AH                 | 514 092 | 7 034 061 | 3.1  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AI                 | 514 049 | 7 034 111 | 2.7  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AJ                 | 513 922 | 7 034 184 | 30.4 | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |
| AK                 | 514 093 | 7 034 303 | 2.6  | 5.0   | 5.0    | 1.0           | 0.0                   | 90.0            | "Green house mode" |  |

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**Kjeller Vindteknikk AS**  
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+47 63 80 62 11Calculated:  
22.03.2010 15:47/2.6.1.252**SHADOW - Main Result****Calculation:** Skyggekast

...continued from previous page

**UTM WGS84 Zone: 32**

| No. | East    | North     | Z     | Width | Height | Height<br>a.g.l. | Degrees from<br>south cw | Slope of<br>window | Direction mode     |
|-----|---------|-----------|-------|-------|--------|------------------|--------------------------|--------------------|--------------------|
|     |         |           | [m]   | [m]   | [m]    | [m]              | [°]                      | [°]                |                    |
| AL  | 514 080 | 7 034 384 | 4.7   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AM  | 513 995 | 7 034 431 | 0.0   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AN  | 513 831 | 7 034 333 | 45.1  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AO  | 513 855 | 7 034 472 | 11.3  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AP  | 513 899 | 7 034 494 | 2.0   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AQ  | 513 866 | 7 034 518 | 8.7   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AR  | 513 861 | 7 034 552 | 14.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AS  | 513 938 | 7 034 635 | 7.6   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AT  | 513 428 | 7 034 371 | 14.1  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AU  | 513 438 | 7 034 303 | 14.6  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AV  | 513 350 | 7 034 442 | 2.4   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AW  | 517 042 | 7 032 784 | 337.4 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AX  | 517 716 | 7 031 642 | 330.6 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AY  | 516 987 | 7 031 022 | 340.0 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AZ  | 513 770 | 7 029 871 | 80.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BA  | 512 053 | 7 030 657 | 40.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BB  | 512 093 | 7 030 853 | 40.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BC  | 511 999 | 7 030 731 | 40.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BD  | 511 643 | 7 031 442 | 60.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BE  | 511 863 | 7 030 135 | 20.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BF  | 511 850 | 7 030 369 | 40.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BG  | 512 523 | 7 028 926 | 114.7 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BH  | 511 904 | 7 029 613 | 20.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BI  | 514 149 | 7 028 103 | 137.3 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BJ  | 517 042 | 7 028 668 | 289.7 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BK  | 516 804 | 7 028 489 | 211.2 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BL  | 517 912 | 7 028 587 | 339.6 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BM  | 522 738 | 7 033 983 | 104.6 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BN  | 523 819 | 7 033 712 | 100.0 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BO  | 523 900 | 7 033 715 | 100.0 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BP  | 524 581 | 7 033 769 | 102.3 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BQ  | 524 669 | 7 033 763 | 107.5 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BR  | 524 828 | 7 033 746 | 120.0 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BS  | 524 791 | 7 033 522 | 120.0 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BT  | 524 980 | 7 033 600 | 120.0 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BU  | 525 333 | 7 033 187 | 120.0 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BV  | 524 093 | 7 034 894 | 103.9 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BW  | 524 286 | 7 034 918 | 100.0 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BX  | 524 537 | 7 036 628 | 20.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BY  | 520 523 | 7 036 801 | 2.0   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| BZ  | 520 591 | 7 036 797 | 6.1   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CA  | 520 652 | 7 036 797 | 9.8   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CB  | 521 055 | 7 036 868 | 2.7   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CC  | 521 309 | 7 036 872 | 20.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CD  | 521 326 | 7 036 672 | 41.7  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CE  | 521 465 | 7 036 801 | 12.3  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CF  | 521 627 | 7 036 879 | 4.9   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CG  | 521 702 | 7 036 882 | 5.9   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CH  | 521 739 | 7 036 824 | 16.5  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CI  | 521 824 | 7 036 936 | 15.3  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CJ  | 521 776 | 7 037 089 | 14.9  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CK  | 521 749 | 7 037 244 | 20.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CL  | 521 997 | 7 037 282 | 35.6  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CM  | 521 902 | 7 037 512 | 15.2  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CN  | 523 917 | 7 037 407 | 3.7   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CO  | 523 748 | 7 037 197 | 62.2  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CP  | 523 883 | 7 037 136 | 80.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CQ  | 523 876 | 7 037 217 | 80.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CR  | 524 140 | 7 037 339 | 24.2  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |

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**Kjeller Vindteknikk AS**  
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+47 63 80 62 11Calculated:  
22.03.2010 15:47/2.6.1.252**SHADOW - Main Result**

Calculation: Skyggekast

...continued from previous page

UTM WGS84 Zone: 32

| No. | East    | North     | Z     | Width | Height | Height<br>a.g.l. | Degrees from<br>south cw | Slope of<br>window | Direction mode     |
|-----|---------|-----------|-------|-------|--------|------------------|--------------------------|--------------------|--------------------|
|     |         |           | [m]   | [m]   | [m]    | [m]              | [°]                      | [°]                |                    |
| CS  | 524 554 | 7 037 360 | 20.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CT  | 524 689 | 7 037 356 | 12.6  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CU  | 524 933 | 7 037 136 | 20.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CV  | 522 511 | 7 037 620 | 5.6   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CW  | 520 249 | 7 037 288 | 12.9  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CX  | 520 327 | 7 037 339 | 13.2  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CY  | 520 591 | 7 037 607 | 28.1  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| CZ  | 520 909 | 7 037 797 | 11.8  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DA  | 521 126 | 7 037 868 | 8.2   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DB  | 521 258 | 7 037 759 | 3.7   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DC  | 521 367 | 7 037 939 | 12.4  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DD  | 519 964 | 7 037 217 | 13.6  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DE  | 519 826 | 7 037 119 | 15.7  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DF  | 519 704 | 7 037 475 | 5.6   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DG  | 519 558 | 7 037 400 | 7.4   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DH  | 519 250 | 7 037 194 | 12.6  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DI  | 519 348 | 7 037 265 | 4.2   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DJ  | 519 443 | 7 037 343 | 7.8   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DK  | 519 070 | 7 037 153 | 14.8  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DL  | 518 193 | 7 036 587 | 9.9   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DM  | 518 115 | 7 036 574 | 10.8  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DN  | 518 037 | 7 036 540 | 13.7  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DO  | 517 973 | 7 036 604 | 14.3  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DP  | 517 770 | 7 036 638 | 13.7  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DQ  | 517 055 | 7 036 967 | 22.6  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DR  | 516 886 | 7 037 007 | 2.2   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DS  | 516 859 | 7 037 051 | 6.0   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DT  | 516 876 | 7 037 244 | 3.9   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DU  | 516 283 | 7 036 388 | 27.4  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DV  | 516 049 | 7 036 117 | 16.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DW  | 516 222 | 7 036 360 | 35.8  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DX  | 515 223 | 7 035 632 | 24.9  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DY  | 515 158 | 7 035 656 | 16.6  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| DZ  | 515 098 | 7 035 676 | 12.2  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EA  | 515 074 | 7 035 785 | 20.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EB  | 515 026 | 7 035 581 | 2.7   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EC  | 514 877 | 7 035 595 | 3.6   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| ED  | 514 823 | 7 035 625 | 1.4   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EE  | 514 799 | 7 035 764 | 20.0  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EF  | 514 678 | 7 036 039 | 11.8  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EG  | 514 535 | 7 036 123 | 17.4  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EH  | 514 129 | 7 035 961 | 0.0   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EI  | 514 119 | 7 036 015 | 0.0   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EJ  | 512 225 | 7 035 730 | 46.4  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EK  | 513 509 | 7 036 110 | 7.9   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EL  | 511 860 | 7 034 138 | 9.7   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EM  | 513 343 | 7 032 011 | 78.6  | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| EN  | 521 969 | 7 036 428 | 201.0 | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |
| AA  | 515 206 | 7 034 648 | 8.2   | 5.0   | 5.0    | 1.0              | 0.0                      | 90.0               | "Green house mode" |

**Calculation Results**

Shadow receptor

**Shadow, worst case**

| No. | Shadow hours<br>per year<br>[h/year] | Shadow days<br>per year<br>[days/year] | Max shadow<br>hours per day<br>[h/day] |
|-----|--------------------------------------|----------------------------------------|----------------------------------------|
| A   | 0:00                                 | 0                                      | 0:00                                   |
| B   | 0:00                                 | 0                                      | 0:00                                   |

**Shadow, expected values**

| Shadow hours<br>per year<br>[h/year] |
|--------------------------------------|
| 0:00                                 |
| 0:00                                 |

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Instituttveien 18  
NO-2025 Kjeller  
+47 63 80 62 11  
Calculated:  
22.03.2010 15:47/2.6.1.252

## SHADOW - Main Result

Calculation: Skyggekast

...continued from previous page

| Shadow, worst case |                                      |                                        | Shadow, expected values                |                                      |
|--------------------|--------------------------------------|----------------------------------------|----------------------------------------|--------------------------------------|
| No.                | Shadow hours<br>per year<br>[h/year] | Shadow days<br>per year<br>[days/year] | Max shadow<br>hours per day<br>[h/day] | Shadow hours<br>per year<br>[h/year] |
| C                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| D                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| E                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| F                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| G                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| H                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| I                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| J                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| K                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| L                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| M                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| N                  | 4:04                                 | 19                                     | 0:16                                   | 0:36                                 |
| O                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| P                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| Q                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| R                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| S                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| T                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| U                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| V                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| W                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| X                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| Y                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| Z                  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AB                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AC                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AD                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AE                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AF                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AG                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AH                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AI                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AJ                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AK                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AL                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AM                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AN                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AO                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AP                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AQ                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AR                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AS                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AT                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AU                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AV                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AW                 | 63:14                                | 149                                    | 0:41                                   | 10:29                                |
| AX                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AY                 | 51:06                                | 133                                    | 0:40                                   | 9:24                                 |
| AZ                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BA                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BB                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BC                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BD                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BE                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BF                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BG                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BH                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BI                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BJ                 | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |

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22.03.2010 15:47/2.6.1.252

## SHADOW - Main Result

Calculation: Skyggekast

...continued from previous page

| No. | Shadow, worst case                   |                                        | Shadow, expected values                |                                      |
|-----|--------------------------------------|----------------------------------------|----------------------------------------|--------------------------------------|
|     | Shadow hours<br>per year<br>[h/year] | Shadow days<br>per year<br>[days/year] | Max shadow<br>hours per day<br>[h/day] | Shadow hours<br>per year<br>[h/year] |
| BK  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BL  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BM  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BN  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BO  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BP  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BQ  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BR  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BS  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BT  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BU  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BV  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BW  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BX  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BY  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| BZ  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CA  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CB  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CC  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CD  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CE  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CF  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CG  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CH  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CI  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CJ  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CK  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CL  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CM  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CN  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CO  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CP  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CQ  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CR  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CS  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CT  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CU  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CV  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CW  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CX  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CY  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| CZ  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DA  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DB  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DC  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DD  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DE  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DF  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DG  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DH  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DI  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DJ  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DK  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DL  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DM  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DN  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DO  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DP  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DQ  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |

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 22.03.2010 15:47/2.6.1.252
**SHADOW - Main Result**

Calculation: Skyggekast

...continued from previous page

| No. | Shadow, worst case                   |                                        | Shadow, expected values                |                                      |
|-----|--------------------------------------|----------------------------------------|----------------------------------------|--------------------------------------|
|     | Shadow hours<br>per year<br>[h/year] | Shadow days<br>per year<br>[days/year] | Max shadow<br>hours per day<br>[h/day] | Shadow hours<br>per year<br>[h/year] |
| DR  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DS  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DT  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DU  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DV  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DW  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DX  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DY  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| DZ  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EA  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EB  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EC  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| ED  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EE  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EF  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EG  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EH  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EI  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EJ  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EK  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EL  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EM  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| EN  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |
| AA  | 0:00                                 | 0                                      | 0:00                                   | 0:00                                 |

Total amount of flickering on the shadow receptors caused by each WTG

| No. | Name                                              | Worst case<br>[h/year] |
|-----|---------------------------------------------------|------------------------|
| 1   | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (1)  | 0:00                   |
| 2   | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (2)  | 10:09                  |
| 3   | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (3)  | 7:39                   |
| 4   | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (4)  | 5:30                   |
| 5   | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (5)  | 7:40                   |
| 6   | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (6)  | 19:11                  |
| 7   | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (7)  | 6:01                   |
| 8   | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (8)  | 5:19                   |
| 9   | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (9)  | 25:50                  |
| 10  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (10) | 0:00                   |
| 11  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (11) | 4:04                   |
| 12  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (12) | 10:32                  |
| 13  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (13) | 16:09                  |
| 14  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (14) | 8:05                   |
| 15  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (15) | 0:00                   |
| 16  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (16) | 0:00                   |
| 17  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (17) | 0:00                   |
| 18  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (18) | 0:00                   |
| 19  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (19) | 0:00                   |
| 20  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (20) | 0:00                   |
| 21  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (21) | 0:00                   |
| 22  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (22) | 0:00                   |
| 23  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (23) | 0:00                   |
| 24  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (24) | 0:00                   |
| 25  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (25) | 0:00                   |
| 26  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (26) | 0:00                   |
| 27  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (27) | 0:00                   |
| 28  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (28) | 0:00                   |
| 29  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (29) | 0:00                   |
| 30  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (30) | 0:00                   |
| 31  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (31) | 0:00                   |

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22.03.2010 15:47/2.6.1.252

## SHADOW - Main Result

Calculation: Skyggekast

...continued from previous page

| No. | Name                                              | Worst case<br>[h/year] |
|-----|---------------------------------------------------|------------------------|
| 32  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (32) | 0:00                   |
| 33  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (33) | 0:00                   |
| 34  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (34) | 0:00                   |
| 35  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (35) | 0:00                   |
| 36  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (36) | 0:00                   |
| 37  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (37) | 0:00                   |
| 38  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (38) | 0:00                   |
| 39  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (39) | 0:00                   |
| 40  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (40) | 0:00                   |
| 41  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (41) | 0:00                   |
| 42  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (42) | 0:00                   |
| 43  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (43) | 0:00                   |
| 44  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (44) | 0:00                   |
| 45  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (45) | 0:00                   |
| 46  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (46) | 0:00                   |
| 47  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (47) | 0:00                   |
| 48  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (48) | 0:00                   |
| 49  | Siemens SWT-2.3-93 2300 92.6 !O! hub: 80.0 m (49) | 0:00                   |