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YLIVIESKAN URAKKANEVAN TUULIVOIMAPUISTO

Melu- ja varjostusmallinnukset

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Sisällys

1 MELU- JA VARJOSTUSMALLINNUKSEN TAVOITTEET 3
2 LÄHTÖTIEDOT JA MENETELMÄT 3
2.1 Melu 3
2.1.1 Melumallinnus ISO 9613-2 3
2.1.2 Matalataajuisen melun mallinnus 4
2.2 Varjostusmallinnus 9
2.3 Mallinnusten laskentapisteet 10
2.4 Raja- ja ohjearvot 10
2.4.1 Melu 10
2.4.2 Varjostus 11
3 MELU- JA VARJOSTUSMALLINNUSTEN TULOKSET 12
3.1 Melun laskentatulokset ISO 9613-2 12
3.1.1 Yhteisvaikutus Urakkaneva V162 (104,0 dB + 2,0 dB) ja Hirvineva 12
3.1.2 Yhteisvaikutus Urakkaneva N163 (109,2 dB + 2,0 dB) ja Hirvineva 14
3.2 Matalataajuiset melutasot 16
3.3 Varjostusmallinnusten tulokset 18
3.3.1 Yhteisvaikutus Urakkaneva RD 180 ja Hirvineva 18

Henna-Riikka Rintamäki 9.6.2020

Liitteet

Liite 1: V162 - Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2/2014

Liite 2: N163 - Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2/2014

Liite 3: V162 - Matalataajuisen melun skohtaiset arvot

Liite 4: N163 - Matalataajuisen melun rakennuskohtaiset arvot

Liite 5: Varjostusmallinnusten tulokset ”real case, no forest”

Liite 6: Varjostusmallinnusten tulokset ”real case, Luke forest”

YLIVIESKAN URAKKANEVAN TUULIVOIMAPUISTO

1 MELU- JA VARJOSTUSMALLINNUKSEN TAVOITTEET

Ylivieskan kunnassa sijaitsevan Urakkanevan tuulivoimahankkeen hankeomistaja Infinergies suunnittelee 9 voimalan rakentamista. Varjostusmallinnuksissa hankkeen voimaloiden kokonaiskorkeus on 280 metriä, roottorin halkaisija 180 metriä ja napakorkeus 190 metriä. Melumallinnukset on mallinnettu kahdella eri vaihtoehdolla. Voimaloiden kokonaiskorkeudella 280 metriä, roottorin halkaisija 162 metriä ja napakorkeus 199 metriä sekä kokonaiskorkeudella 280 metriä, roottorin halkaisija 163 metriä ja napakorkeus 198,5 metriä.

Mallinnuksissa on otettu huomioon hankealueen läheisyydessä sijaitsevan Hirvinevan tuulivoimahankkeen yhteisvaikutukset.

Tuulivoimaloiden aiheuttamia meluvaikutuksia on arvioitu WindPRO-ohjelman DECIBEL-moduulilla. Tuulivoimaloiden aiheuttamat varjostusvaikutukset on mallinnettu WindPro-ohjelman SHADOW-moduulilla voimalapaikkojen sijoitusten mukaisesti. Melu-ja varjostusmallinnukset on laatinut ins. Henna-Riikka Rintamäki FCG Suunnittelu ja tekniikka Oy:stä. Laaduntarkistuksen on tehnyt FM Liisa Karhu FCG Suunnittelu ja tekniikka Oy:stä.

2 LÄHTÖTIEDOT JA MENETELMÄT

2.1 Melu

2.1.1 Melumallinnus ISO 9613-2

Tuulivoimaloiden aiheuttamat äänenpainetasot on mallinnettu WindPRO-laskentaohjelman Decibel-moduulilla ISO 9613-2 standardin mukaisesti. Ympäristöhallinnon tuulivoimaloiden melun mallintamista koskevan ohjeen 2/2014 mukaisesti tuulen nopeutena käytettiin 10 m korkeudella mitattuna 8 m/s, ilman lämpötilana 15 °C, ilmanpaineena 101,325 kPa, ilman suhteellisena kosteutena 70 % ja maanpinnan kovuutena arvoa 0,4. Laskenta on tehty 4,0 m maan pinnan tasosta.

Urakkanevan tuulivoimaloiden äänenpainetasot on mallinnettu käyttäen kahta eri voimalaitostyyppiä. Koska laitevalmistajat eivät vielä takaa melupäästön kokonaisarvoa voimalamallien uutuuden vuoksi, lisättiin kummankin voimalan melupäästöön varmuusarvona 2,0 dB takuuarvon saamiseksi (YM9/5511/2016). Lähtötietoina eli referenssivoimaloina on käytetty tuulivoimalaitosvalmistaja Vestaksen voimalaitosta V162-5,6MW (napakorkeus 199 m), jonka äänitehotaso (LWA) on 104,0 dB + 2,0 dB sekä Nordexin 163-5,7MW voimalaa (napakorkeus 198,5 m), jonka äänitehotaso on (without serrated trailing edge) 109,2 dB + 2,0 dB.

Urakkanevan tuulivoimaloiden lisäksi on laskelmissa huomioitu suunnitteilla oleva Hirvinevan tuulivoimapuisto hankealueen läheisyydessä. Hirvinevan hanke koostuu neljästä tuulivoimalasta ja mallinnuksissa on käytetty Vestas V150 voimalaa, jonka napakorkeus on 155 metriä. Laskelmissa tuulivoimalan äänitehotaso (LWA) on 104,9 dB.

Melumallinnusten laskentatuloksia on havainnollistettu ns. keskiäänitasokarttojen avulla. Keskiäänitasokartoissa on melun keskiäänitaso- eli ekvivalenttiäänitasokäyrät (LAeq) 5 dB välein.

2.1.2 Matalataajuisen melun mallinnus

Matalataajuinen melu laskettiin Ympäristöministeriön ohjeen 2/2014 mukaisin menetelmin käyttäen voimalavalmistajilta saatuja arvioita niiden äänitehotasoista.

Ohje 2/2014 antaa menetelmän matalataajuisen melun laskentaan rakennusten ulkopuolelle. Sosiaali- ja terveysministeriön Asumisterveysasetus 2015 antaa matalataajuiselle melulle toimenpiderajat asuinhuoneissa. Rakennusten sisälle kantautuva äänitaso arvioitiin Turun AMK:n (Keränen, Hakala ja Hongisto, 2017) julkistamien ääneneristävyysarvoin ja tuloksia verrattiin toimenpiderajoihin.

YM 2/2014 ohjeistaa arvioimaan rakennusten sisälle kantautuvat äänitasot DSO 1284 mukaisesti. Keräsen, Hakalan ja Hongiston (2017) antamat eristysarvot, tersseille 20-200 Hz, ovat 0,6-10,2 dB heikommat kuin vastaavat arvot DSO 1284:ssa. On siten perusteltu arvioida, mikäli melutasot sisällä alittavat asumisterveysasetuksessa annetut toimenpiderajat asuinhuoneissa Keräsen, Hakalan ja Hongiston (2017) arvoilla, ne myös alittuisivat DSO 1284 eristysarviolla.

Matalataajuisen melun laskelmassa huomioitiin maanpinnan muodon vaikutus ohjeen 4/2014 mukaisesti. Tulokset on esitetty taajuuskohtaisena taulukkona hankealueen ympäröidyille asuin- ja lomarakennuksille.

Taulukko 1. Urakkanevan tuulivoimahankkeen kokotiedot varjostusmallinnuksissa

TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)					
Tuulivoimalan valmistaja: Generic				Tyyppi: RD180	Sarjanumero/t:-
Nimellisteho: -		Napakorkeus:190 m		Roottorin halkaisija:180	Tornin tyyppi: teräs/hybridi
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun					
Lapakulman säätö		Pyörimisnopeus		Muu, mikä	
Kyllä	- dB	Kyllä	- dB	Noise mode säätö:	-
~~Ei~~		~~Ei~~		Noise mode, lähtömelutaso	-

Taulukko 2. Urakkanevan tuulivoimahankkeen mallinnusohjelma ja tuulivoimaloiden äänitehotasot sekä melun erityispiirteet.

MALLINNUSOHJELMAN TIEDOT							
Mallinnusohjelma ja versio: WindPRO version 3.3.247				Mallinnusmenetelmä: ISO 9613-2			
TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)							
Tuulivoimalan valmistaja: Vestas				Tyyppi: V162-5,6MW		Sarjanumero/t:-	
Nimellisteho:5.6 MW		Napakorkeus:199 m		Roottorin halkaisija:162 m		Tornin tyyppi: teräs/hybridi	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä			
Kyllä	- dB	Kyllä	- dB	Noise mode säätö: Mode 0		Kyllä	
~~Ei~~		~~Ei~~		Noise mode, lähtömelutaso		104,0 dB	

AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT
Melupäästötiedot perustuvat dokumenttiin: " Vestas; V162-5.6 MW Third octave noise emission, DMS 0079-5298_01, 2014-11-11, 2019-01-23. Valmistajan ilmoittama tuulivoimalan tuottaman äänitehotaso vastaa "declared value" (Michael Rasmussen, Vestas: e-mail 9.4.2019 09:08:26)." Mallinnuksissa voimaloiden äänitehotasoon on lisätty 2 dB.

Oktaaveittain [Hz],dB(A)		1/3-oktaaveittain [Hz] LWA dB					
		20	59.8	200	91.0	1600	91.1
63	84,9	25	64.3	250	92.3	2000	89.6
125	92,4	31,5	68.6	315	93.3	2500	87.7
250	97,1	40	72.6	400	94.0	3150	85.4
500	99	50	76.1	500	94.3	4000	82.7
1000	98,1	63	79.4	630	94.4	5000	79.9
2000	94,5	80	82.5	800	94.0	6300	76.7
4000	88	100	85.0	1000	93.4	8000	72.9
8000	78,7	125	87.3	1250	92.5	10000	69.2
104,0 dB(A)		160	89.4				

Melun erityispiirteiden mittaus ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudimodulaatio)		Muu, Mikä:	
~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei

Taulukko 3. Urakkanevan tuulivoimahankkeen mallinnusohjelma ja tuulivoimaloiden äänitehotasot sekä melun erityispiirteet.

MALLINNUSOHJELMAN TIEDOT							
Mallinnusohjelma ja versio: WindPRO version 3.3.247				Mallinnusmenetelmä: ISO 9613-2			
TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)							
Tuulivoimalan valmistaja: Nordex				Tyyppi: N163		Sarjanumero/t:-	
Nimellisteho:5.7 MW		Napakorkeus:198,5 m		Roottorin halkaisija:163 m		Tornin tyyppi: teräs/hybridi	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä: no STE			
Kyllä	- dB	Kyllä	- dB	Noise mode säätö: Mode 0		Kyllä	
~~Ei~~		~~Ei~~		Noise mode, lähtömelutaso		109,2 dB	

AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT
Melupäästötiedot perustuvat dokumenttiin ” F008_276_A17_EN Revision 01, 2019-08-30” NO STE Valmistajan ilmoittama tuulivoimalan tuottama äänitehotaso vastaa keskiäänitasoa. Mallinnuksissa voimaloiden äänitehotasoon on lisätty 2 dB.

Oktaaveittain [Hz],dB(A)		1/3-oktaaveittain [Hz] LWA dB					
		20	64,5	200	92,8	1600	99,0
63	89,5	25	68,5	250	93,9	2000	97,4
125	95,7	31,5	74,0	315	97,4	2500	95,2
250	99,9	40	77,5	400	97,1	3150	91,8
500	103,2	50	82,6	500	97,6	4000	87,2
1000	104,6	63	83,9	630	100	5000	82,1
2000	102,2	80	86,7	800	99,3	6300	81,8
4000	93,4	100	91,4	1000	100,3	8000	79,9
8000	84,6	125	89,9	1250	99,7	10000	75,7
109,2 dB(A)		160	91,2				

Melun erityispiirteiden mittaus ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudimodulaatio)		Muu, Mikä:	
~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei

Taulukko 4. Suunnitteilla olevien Hirvinevan tuulivoimaloiden äänitehotasot sekä melun erityispiirteet.

MALLINNUSOHJELMAN TIEDOT	
Mallinnusohjelma ja versio: WindPRO version 3.1.617	Mallinnusmenetelmä: ISO 9613-2

TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)					
Tuulivoimalan valmistaja: Vestas				Tyyppi: V150	Sarjanumero/t:-
Nimellisteho:4,2 MW		Napakorkeus:155 m		Roottorin halkaisija:150	Tornin tyyppi: teräs
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun					
Lapakulman säätö		Pyörimisnopeus		Muu, mikä: STE blades	
Kyllä	- dB	Kyllä	- dB	Noise mode säätö:	Mode 0
~~Ei~~		~~Ei~~		Noise mode, lähtömelutaso	

AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT
Melupäästötiedot perustuvat dokumenttiin ” V150-4.0/4.2 MW Third Octave noise emission, DMS 0067-4767 V03

Oktaaveittain [Hz],dB(A)		1/3-oktaaveittain [Hz], dB(A)					
31,5	-	10	47,0	100	86,5	1000	94,2
63	86,5	12,5	52,2	125	88,7	1250	93,2
125	93,7	16	57,6	160	90,7	1600	91,8
250	98,2	20	62,2	200	92,2	2000	90,2
500	99,9	25	66,5	250	93,4	2500	88,3
1000	98,9	31,5	70,7	315	94,3	3150	86,1
2000	95,1	40	74,6	400	94,9	4000	83,4
4000	88,7	50	78,0	500	95,2	5000	80,6
8000	79,4	63	81,1	630	95,2	6300	77,3
104,9 dB(A)		80	84,1	800	94,8	8000	73,7
						10 000	69,9

Melun erityispiirteiden mittaus ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudimodulaatio)		Muu, Mikä:	
~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei

Taulukko 5. Käytetyt mallinnusparametrit ISO 9613-2 laskelmissa sekä melulle altistuvat kohteet.

AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT			
Laskenta korkeus		Laskentaruudun koko [m·m]	
ISO 9613-2: 4,0 m		25x25 m	
Suhteellinen kosteus		Lämpötila	
70 %	Muu, mikä ja miksi:	ISO 9613-2: 15 C°	
Maastomallin lähde ja tarkkuus			
Maastomallin lähde: MML maastotietokanta		Vaakaresoluutio:1,0	Pystyresoluutio:0,5
Maan- ja vedenpinnan absorption ja heijastuksen huomioiminen, käytetyt kertoimet			
ISO 9613-2	0,4		HUOM
Ilmakehän stabiilius laskennassa/meteorologinen korjaus			
Neutraali, (0): Neutraali		Muu, mikä ja miksi:	
Sääolosuhteiden huomiointi; laskennassa käytetty tuulen suunnat ja nopeus			
Tuulen suunta: 0-360°		Tuulen nopeus: 10 metrin korkeudella mitattuna 8 m/s	
Voimalan äänen suuntaavuus ja vaimentuminen			
Vapaa avaruus: kyllä		Muu, mikä, miksi:	

2.2 Varjostusmallinnus

Tuulivoimaloiden varjostusvaikutuksia mallinnettiin WindPRO-ohjelman Shadow-moduulilla. Laskennassa varjot huomioidaan, kun aurinko on yli 3 astetta horisontin yläpuolella. Varjoksi lasketaan tilanne, jossa siipi peittää vähintään 20 % auringosta.

Varjostusmallin laskennassa on huomioitu hankealueen korkeustiedot, tuulivoimaloiden sijainnit, tuulivoimalan napakorkeudet ja roottorin halkaisija sekä hankealueen aikavyöhyke. Mallinnuksessa otettiin huomioon auringon asema horisontissa eri kellon- ja vuodenaikoina, pilvisyys kuukausittain eli kuinka paljon aurinko paistaa ollessaan horisontin yläpuolella sekä tuulivoimalaitosten arvioitu vuotuinen käyntiaika.

Varjostuksen tarkastelukorkeutena lähialueen asuin- tai lomarakennusten pihapiirissä käytettiin 1,0 metriä ja laskenta-alueen kokoa 5,0 x 5,0 metriä. Laskentaikkunoiden suunnat asennettiin voimaloita kohti ns. ”greenhouse mode”.

Auringon keskimääräiset paistetunnit perustuvat Oulunsalon Oulun lentoaseman pitkäaikaisiin mitattuihin säätietoihin 1981-2010. Laskentojen tuulen suunta ja nopeusjakaumana käytettiin NASA:n MERRA-dataa (Modern Era Retrospective-analysis for Research and Applications) hankealueen läheisyydeltä.

Varjostusmallinnuksissa (Luke forest) on huomioitu puuston peittävyys käyttämällä Luonnonvarakeskuksen vuoden 2017 puuston keskipituus aineistoa.

Varjostusmallinnuksen tuloksia on havainnollistettu kartan avulla. Kartalla esitetään varjostusvaikutuksen (1, 8 ja 20 tuntia vuodessa) laajuus. Sen lisäksi mallinnuksessa on erikseen laskettu vaikutus tuulivoimapuistoalueen ympäristössä oleviin herkkiin kohteisiin.

2.3 Mallinnusten laskentapisteet

Melumallinnuksen, varjostusmallinnuksen ja matalataajuisen melun mallinnuksen laskentapisteet perustuvat Maanmittauslaitoksen Maastotietokannan rakennuskantaa koskeviin tietoihin sekä Ylivieskan kaupungin rakennusvalvonnan tietoihin Maanmittauslaitoksen Maastotietokannassa asuin- ja lomarakennuksiksi merkittyjen rakennusten käyttötarkoituksesta. Kahden kilometrin säteellä suunnitelluista voimaloista MML:n Maastotietokannan rakennuskanta-aineisto on tarkistettu Ylivieskan kaupungin rakennusvalvonnasta. Alueella sijaitsevat rakennuskanta-aineistossa asuin- tai lomarakennuksiksi merkityt rakennukset ovat joko vailla rakennuslupaa olevia rakennuksia tai statuksella muu rakennus olevia metsätalouteen liittyviä taukotupia tai eräkämppiä. Näitä rakennuksia ei huomioida mallinnuksen laskentapisteinä, koska niihin ei sovelleta tuulivoimaloiden aiheuttaman melun tai varjostuksen raja- ja ohjearvoja tai matalataajuisen melun toimenpiderajoja (kts. 2.4).

2.4 Raja- ja ohjearvot

2.4.1 Melu

Valtioneuvoston asetuksessa (1107/2015) tuulivoimaloille on määritelty suunnitteluarvot päivä- ja yöajan keskiäänitasojen maksimiarvolle. Jos tuulivoimalan melu sisältää tonaalisia, kapeakaistaisia tai impulssimaisia komponentteja, tai se on selvästi amplitudimoduloitunutta, mallinnustuloksiin tulee ohjeen mukaan lisätä viisi desibeliä ennen ohjearvoon vertaamista. Koska ohjearvo sisältää jo tyypillisen tuulivoimamelun piirteet, edellä mainitut äänenpiirteiden tulee olla tuulivoimalalle epätyypillisen voimakkaita, jotta mallinnustuloksissa täytyy huomioida viiden desibelin lisä äänenvoimakkuuteen.

Taulukko 5. Valtioneuvoston asetuksen mukaiset tuulivoimaloiden melutason toimenpiderajat (Valtioneuvoston asetus 27.8.2015).

Vaikutuskohde	Päivä (7-22)	Yö (22-7)
Pysyvä asutus	45 dB	40 dB
Loma-asutus	45 dB	40 dB
Hoitolaitokset	45 dB	40 dB
Oppilaitokset	45 dB	—
Virkistysalueet	45 dB	—
Leirintäalueet	45 dB	40 dB
Kansallispuistot	40 dB	40 dB

Sosiaali- ja terveysministeriön asetuksessa (545/2015) on annettu matalataajuiselle melulle toimenpiderajoja. Toimenpiderajat koskevat asuinhuoneita ja ne on annettu taajuuspainottamattomina yhden tunnin keskiäänitasoina tersseittäin. Toimenpiderajat koskevat yöaikaa ja päivällä sallitaan 5 dB suuremmat arvot.

Taulukko 6. Matalataajuisen sisämelun tunnin keskiäänitason toimenpiderajat nukkumiseen tarkoitetuissa tiloissa.

Terssikaista Hz	20	25	31,5	40	50	63	80	100	125	160	200
Keskiäänitaso LZeq,1h, dB	74	64	56	49	44	42	40	38	36	34	32
Edellisestä laskettu keski-äänitaso A-painotettuna LAeq,1h, dB	24	19	17	14	14	16	18	19	20	21	21

Lisäksi yöaikainen mahdollisesti unihäiriötä aiheuttava melu, joka erottuu selvästi taustamelusta, ei saa ylittää 25 dB yhden tunnin keskiäänitasona LAeq,1h mitattuna niissä tiloissa, jotka on tarkoitettu nukkumiseen.

2.4.2 Varjostus

Suomessa ei ole viranomaisten antamia yleisiä määräyksiä tuulivoimaloiden muodostaman varjostuksen enimmäiskestoista eikä varjonmuodostuksen arviointiperusteista. Ympäristöministeriön tuulivoimarakentamisen suunnitteluohjeistuksessa esitetään käytettäväksi muiden maiden suosituksia välkkeen rajoittamisesta (Ympäristöministeriö 2012).

Useissa maissa on annettu raja-arvoja tai suosituksia hyväksyttävän välkevaikutuksen määrästä. Esimerkiksi Ruotsissa suositus on kahdeksan tuntia vuodessa ja 30 minuuttia päivässä.

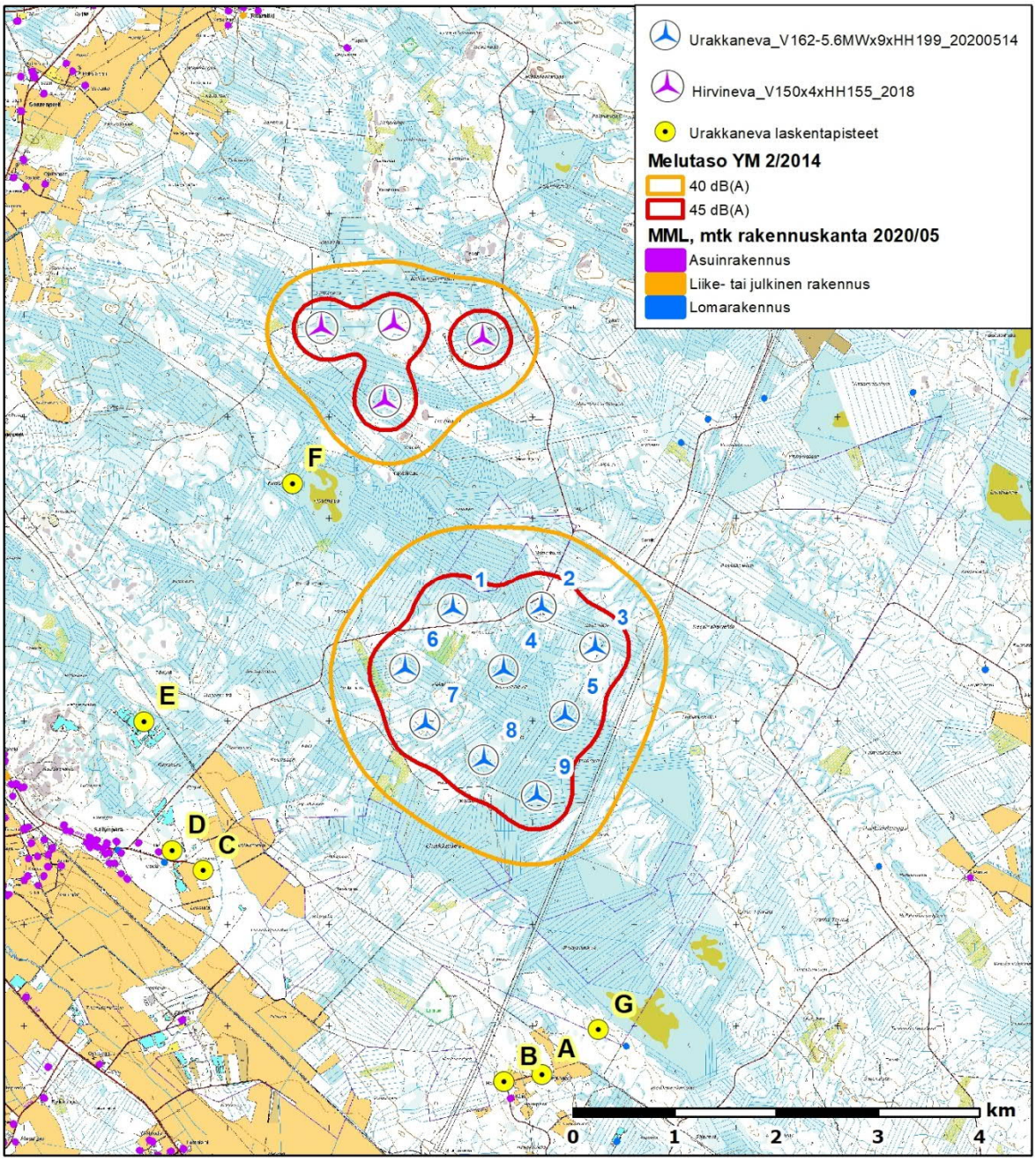
Arvioinnissa on tarkasteltu vaikutuksia alueella, jossa varjoja tai välkettä mallinnuksen mukaisessa todellisessa tilanteessa (”real case”) esiintyy vähintään kahdeksan tuntia vuodessa.

3 MELU- JA VARJOSTUSMALLINNUSTEN TULOKSET

3.1 Melun laskentatulokset ISO 9613-2

3.1.1 Yhteisvaikutus Urakkaneva V162 (104,0 dB + 2,0 dB) ja Hirvineva

Melumallinnuksen mukaan melutaso 40 dB(A) ei ylity lähimmillä asuin- ja lomarakennuksilla. Katso tarkemmat laskentatulokset liitteestä 1.



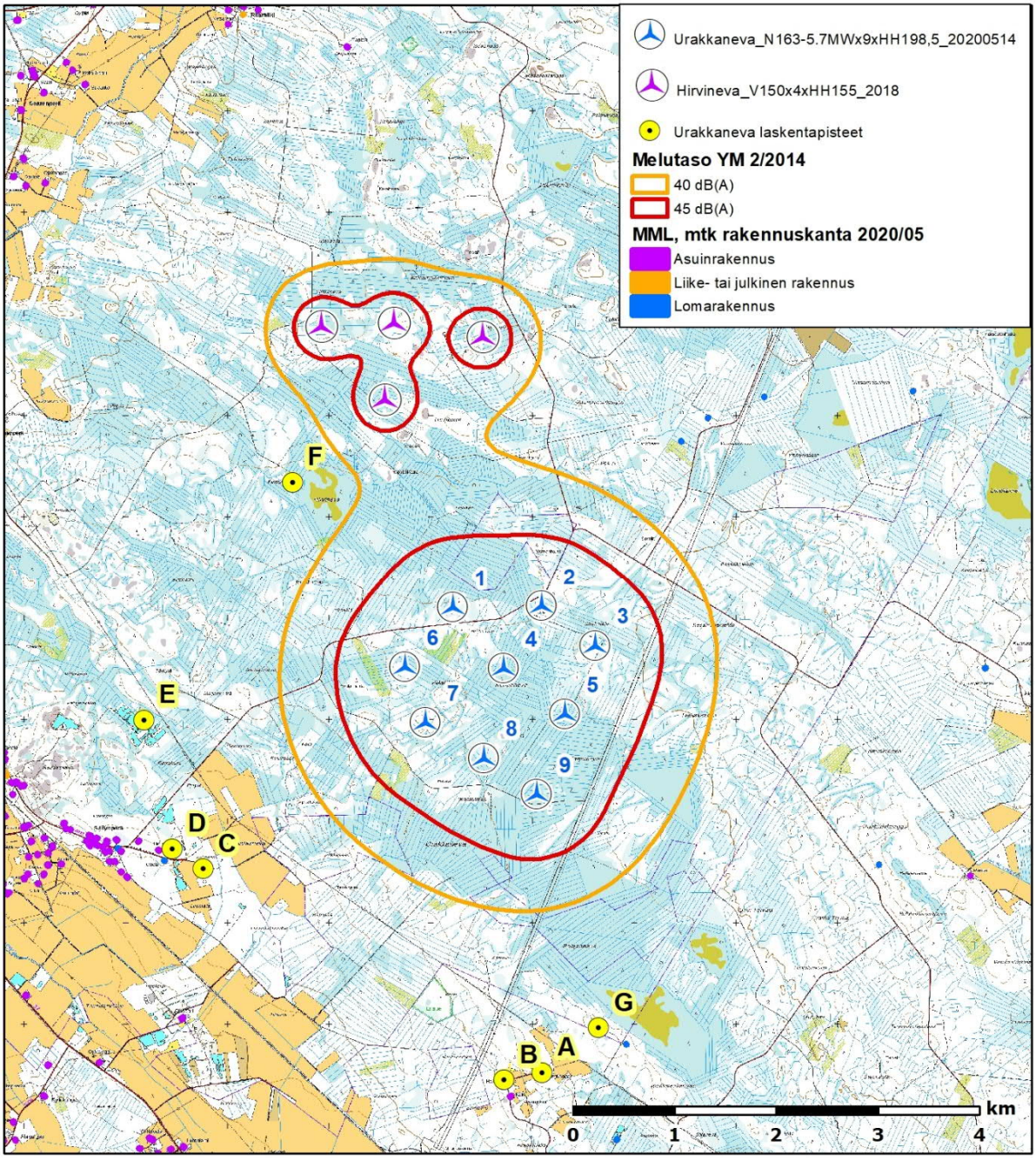
Kuva 1. Laskennalliset melutasot käytettäessä Urakkanevan tuulivoimahankkeen osalta V162 voimalaitosta sekä huomioiden suunnitteilla olevat Hirvinevan tuulivoimalat. Yhteensä 13 tuulivoimalaa.

Taulukko 7. Laskennalliset melutasot (käytettäessä Urakkanevan voimalaitostyyppinä Vestas V162-voimalaitosta) standardin ISO 9613-2 ja YM 2/2014 ohjeen mukaisesti.

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-korkeus (m)	Melutaso dB(A)
A Asuinrakennus (Hakuperäntie 202)	397 098	7 096 526	95,0	4,0	27,6
B Asuinrakennus (Hakuperäntie 169)	396 724	7 096 452	92,5	4,0	27,3
C Asuinrakennus (Säilyntie 285)	393 762	7 098 532	81,7	4,0	29
D Asuinrakennus (Säilyntie 264)	393 460	7 098 729	84,1	4,0	28,4
E Lomarakennus (977-405-85-7)	393 183	7 099 996	87,5	4,0	29,1
F Lomarakennus (Hirvinevanhaara 147)	394 644	7 102 345	90,4	4,0	35,5
G Lomarakennus (Pohjanneva - 977-405-36-0)	397 651	7 096 966	97,5	4,0	28,9

3.1.2 Yhteisvaikutus Urakkaneva N163 (109,2 dB + 2,0 dB) ja Hirvineva

Melumallinnuksen mukaan melutaso 40 dB(A) ei ylity lähimmillä asuin- ja lomarakennuksilla. Katso tarkemmat laskentatulokset liitteestä 2.



Kuva 2. Laskennalliset melutasot käytettäessä Urakkanevan tuulivoimahankkeen osalta N163 voimalaitosta sekä huomioiden suunnitteilla olevat Hirvinevan tuulivoimalat. Yhteensä 13 tuulivoimalaa.

Taulukko 8. Laskennalliset melutasot (käytettäessä Urakkanevan voimalaitostyyppinä Nordex N163-voimalaitosta) standardin ISO 9613-2 ja YM 2/2014 ohjeen mukaisesti.

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-korkeus (m)	Melutaso dB(A)
A Asuinrakennus (Hakuperäntie 202)	397 098	7 096 526	95,0	4,0	31,2
B Asuinrakennus (Hakuperäntie 169)	396 724	7 096 452	92,5	4,0	31
C Asuinrakennus (Säilyntie 285)	393 762	7 098 532	81,7	4,0	32,7
D Asuinrakennus (Säilyntie 264)	393 460	7 098 729	84,1	4,0	32
E Lomarakennus (977-405-85-7)	393 183	7 099 996	87,5	4,0	32,5
F Lomarakennus (Hirvinevanhaara 147)	394 644	7 102 345	90,4	4,0	37,5
G Lomarakennus (Pohjanneva - 977-405-36-0)	397 651	7 096 966	97,5	4,0	32,6

3.2 Matalataajuiset melutasot

Sisätilojen laskennallisia tuloksia on verrattu Sosiaali- ja terveysministeriön (STM) Asumisterveysasetuksessa (545/2015) annettuihin toimenpiderajoihin. Nämä ovat enimmäisarvoja, jotka on laadittu yöaikaiselle melulle nukkumiseen tarkoitettuihin tiloihin. Toimenpiderajaa on verrattu myös äänitasoon tarkasteltujen rakennusten ulkopuolella.

Mallinnettaessa voimalaitostyypillä Vestas V162 5.6MW, on matalataajuinen melu ei ylitä Sosiaali- ja terveysministeriön asumisterveysohjearvoa. Taulukoissa näkyy toimenpiderajan alitus (negatiivinen arvo) tai ylitys (positiivinen arvo).

Taulukko 9. Matalataajuisen melun mallinnustulokset käytettäessä Urakkanevan voimalaitostyyppinä Vestas V162 voimalaitosta sekä vertailu Sosiaali- ja terveysministeriön toimenpiderajaan kohteissa ”A-L”. Myös suunnitteilla olevat Hirvinevan tuulivoimalat on huomioitu.

Rakennus	Äänitaso ulkona		Äänitaso sisällä	
	L eq,1h – Asumis-terveys ohje sisällä	Hz	L eq,1h – Asumis-terveys ohje sisällä	Hz
A Asuinrakennus (Hakuperäntie 202)	-2,3	100	-11,6	50
B Asuinrakennus (Hakuperäntie 169)	-2,4	100	-11,8	50
C Asuinrakennus (Säilyntie 285)	-1,1	100	-10,5	50
D Asuinrakennus (Säilyntie 264)	-1,5	100	-10,9	50
E Lomarakennus (977-405-85-7)	-1,0	100	-10,4	50
F Lomarakennus (Hirvinevanhaara 147)	3,7	100	-5,8	50
G Lomarakennus (Pohjanneva - 977-405-36-0)	-1,4	100	-10,8	50

Mallinnettaessa voimalaitostyypillä Nordex N163 5.7MW, on matalataajuinen melu voimakkainta kohteen G Lomarakennus (Hellalan metsätien haara), jossa se ulkona enimmillään ylittää asuinhuoneiden ohjearvon kummankin osalta noin 11,9 dB taajuudella 100 Hz. Sisällä se ylittää asuinhuoneiden ohjearvon enimmillään noin 2,2 dB taajuudella 50 Hz. Myös kohteessa H Lomarakennus (Hellalan metsätie - Sonnila) ohjearvo ylittyy sisätiloissa 1,1 dB taajuudella 50 Hz.

Muissa tuulivoimahankkeen läheisyydessä sijaitsevissa herkissä kohteissa matalataajuinen tuulivoimamelu ei ylitä Sosiaali- ja terveysministeriön asumisterveysohjearvoa. Taulukoissa näkyy toimenpiderajan alitus (negatiivinen arvo) tai ylitys (positiivinen arvo).

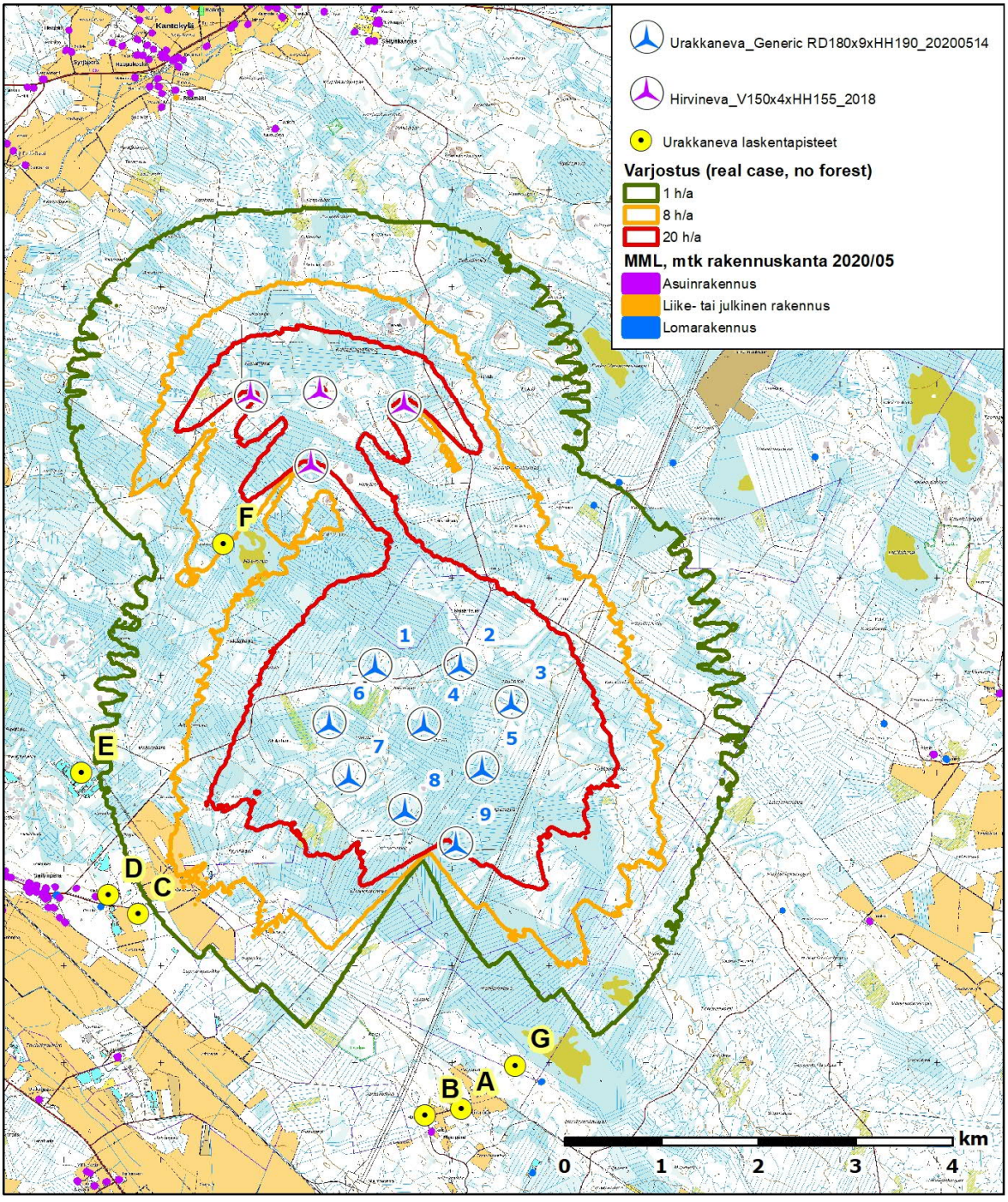
Taulukko 10. Matalataajuisen melun mallinnustulokset käytettäessä Urakkanevan voimalaitostyyppinä Nordex N163 voimalaitosta sekä vertailu Sosiaali- ja terveysministeriön toimenpiderajaan kohteissa ”A-L”. Myös suunnitteilla olevat Hirvinevan tuulivoimalat on huomioitu.

Rakennus	Äänitaso ulkona		Äänitaso sisällä	
	L eq,1h – Asumis-terveys ohje sisällä	Hz	L eq,1h – Asumis-terveys ohje sisällä	Hz
A Asuinrakennus (Hakuperäntie 202)	3,9	100	-5,5	50
B Asuinrakennus (Hakuperäntie 169)	3,7	100	-5,6	50
C Asuinrakennus (Säilyntie 285)	4,9	100	-4,5	50
D Asuinrakennus (Säilyntie 264)	4,4	100	-4,9	50
E Lomarakennus (977-405-85-7)	4,8	100	-4,6	50
F Lomarakennus (Hirvinevanhaara 147)	7,7	100	-1,8	50
G Lomarakennus (Pohjanneva - 977-405-36-0)	4,8	100	-4,6	50

3.3 Varjostusmallinnusten tulokset

3.3.1 Yhteisvaikutus Urakkaneva RD 180 ja Hirvineva

Tuulivoimapuistoa lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on mallinnuksessa yli 8 h/a laskentapisteessä F, kun puustoa ei huomioitu.



Kuva 3. Laskennalliset varjostusvaikutukset voimalaitostyypillä RD 180 m ja HH 190 m. Myös suunnitteilla olevat Hirvinevan tuulivoimalat on huomioitu. Yhteensä 13 tuulivoimalaa. Laskelmissa suojaavaa puustoa EI ole huomioitu.

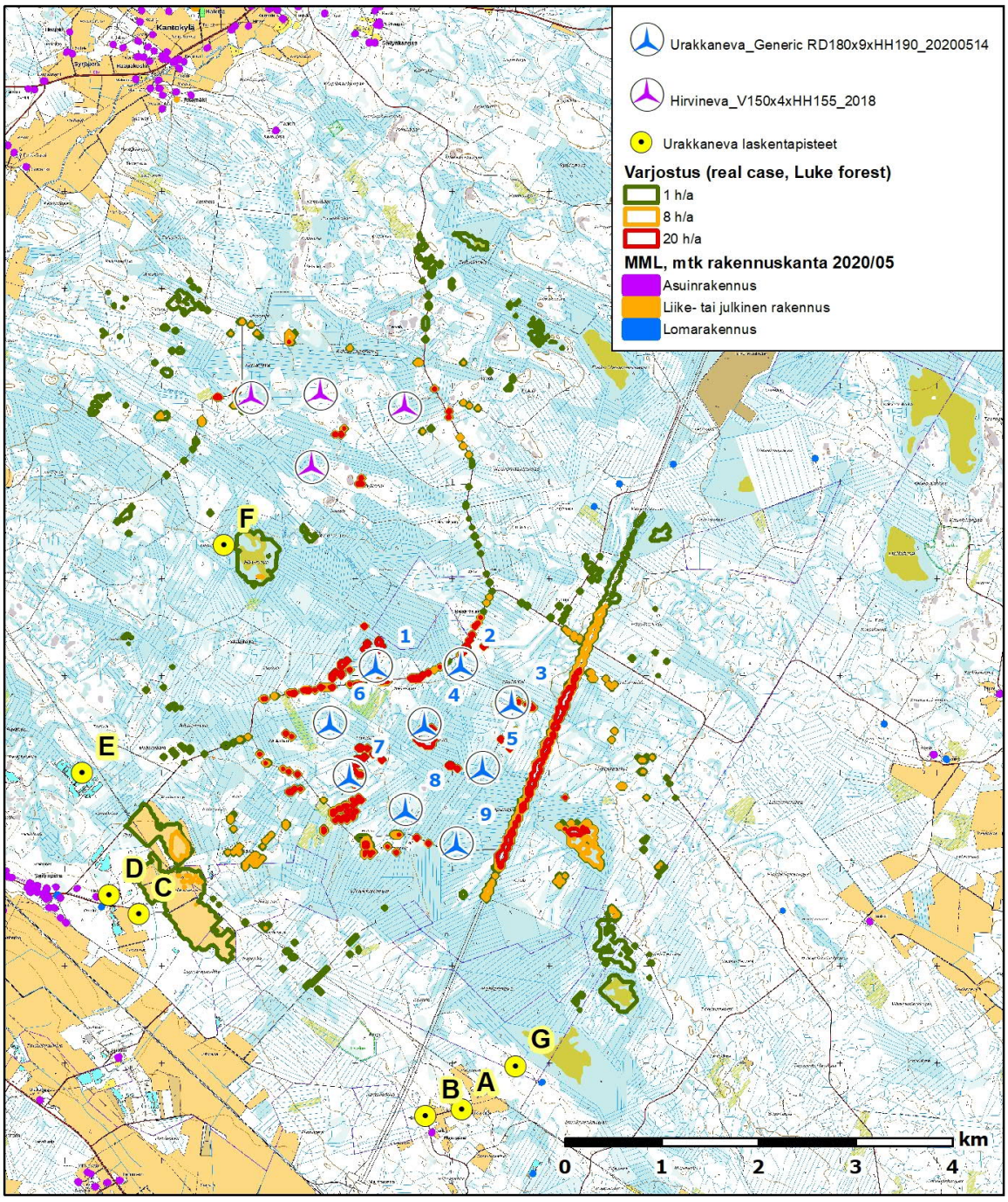
Taulukko 11. Urakkanevan ja Hirvinevan tuulivoimalat (yhteensä 13 tuulivoimalaa) laskennalliset varjostustunnit lähialueen laskentapisteissä ”A-L” kun puuston suojaavaa vaikutusta ei ole huomioitu ”real case, no forest”.

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-ikkuna (m)	Varjostus (h/a)
A Asuinrakennus (Hakuperäntie 202)	397 098	7 096 526	95,0	5 x 5	0:00
B Asuinrakennus (Hakuperäntie 169)	396 724	7 096 452	92,5	5 x 5	0:00
C Asuinrakennus (Säilyntie 285)	393 762	7 098 532	81,7	5 x 5	0:00
D Asuinrakennus (Säilyntie 264)	393 460	7 098 729	84,1	5 x 5	0:00
E Lomarakennus (977-405-85-7)	393 183	7 099 996	87,5	5 x 5	0:00
F Lomarakennus (Hirvinevanhaara 147)	394 644	7 102 345	90,4	5 x 5	10:19
G Lomarakennus (Pohjanneva - 977-405-36-0)	397 651	7 096 966	97,5	5 x 5	0:00

Tuulivoimapuistoa lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus ei ylitä puuston huomioivassa mallinnuksessa yli 8 h/a minkään laskentapisteen kohdalla.

Taulukko 12. Urakkanevan ja Hirvinevan tuulivoimalat (yhteensä 13 tuulivoimalaa) laskennalliset varjostustunnit lähialueen laskentapisteissä ”A-L” kun puuston suojaava vaikutus on huomioitu ”real case, forest luke”.

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-ikkuna (m)	Varjostus (h/a)
A Asuinrakennus (Hakuperäntie 202)	397 098	7 096 526	95,0	5 x 5	0:00
B Asuinrakennus (Hakuperäntie 169)	396 724	7 096 452	92,5	5 x 5	0:00
C Asuinrakennus (Säilyntie 285)	393 762	7 098 532	81,7	5 x 5	0:00
D Asuinrakennus (Säilyntie 264)	393 460	7 098 729	84,1	5 x 5	0:00
E Lomarakennus (977-405-85-7)	393 183	7 099 996	87,5	5 x 5	0:00
F Lomarakennus (Hirvinevanhaara 147)	394 644	7 102 345	90,4	5 x 5	0:00
G Lomarakennus (Pohjanneva - 977-405-36-0)	397 651	7 096 966	97,5	5 x 5	0:00



Kuva 4. Laskennalliset varjostustulokset voimalaitostyypillä RD 180 m ja HH 190 m. Myös suunnitteilla olevat Hirvinevan tuulivoimalat on huomioitu. Yhteensä 13 tuulivoimalaa. Laskelmissa suojaava puusto on huomioitu.

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Tarkastaja

Liite 1: V162 - Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2/2014

Project:
Urakkaneva_20200521

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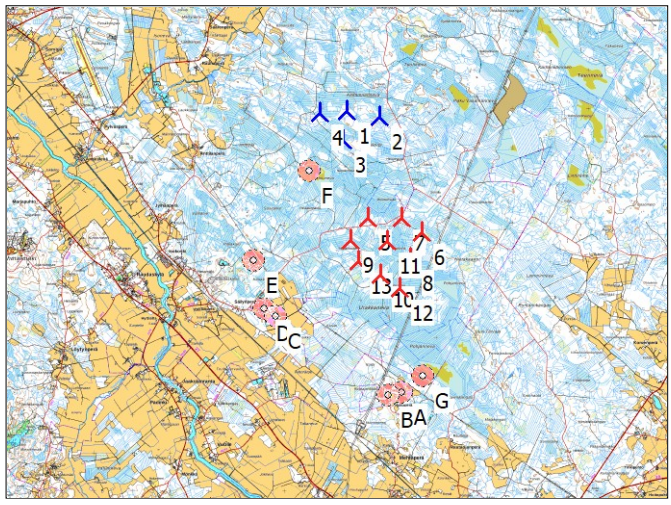
Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
9.6.2020 20.38/3.3.247

DECIBEL - Main Result

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609

Noise calculation model:
ISO 9613-2 General
Wind speed (in 10 m height):
8,0 m/s
Ground attenuation:
General, Ground factor: 0,4
Meteorological coefficient, C0:
0,0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Fixed penalty added to source noise of WTGs with pure tones
WTG catalogue
Height above ground level, when no value in NSA object:
4,0 m; Don't allow override of model height with height from NSA object
Uncertainty margin:
0,0 dB; Uncertainty margin in NSA has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)



Scale 1:200 000
New WTG
Noise sensitive area

WTGs

	East	North	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Noise data Rotor diameter [m]	Hub height [m]	Creator	Name	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones
1	395638	7103907	90,4	VESTAS V150-4.2 4200 150....	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	USER	Level 0 - - Mode 0/PO1 - 10-2017	8,0	104,9	No
2	396514	7103767	95,0	VESTAS V150-4.2 4200 150....	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	USER	Level 0 - - Mode 0/PO1 - 10-2017	8,0	104,9	No
3	395550	7103150	89,6	VESTAS V150-4.2 4200 150....	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	USER	Level 0 - - Mode 0/PO1 - 10-2017	8,0	104,9	No
4	394929	7103873	86,8	VESTAS V150-4.2 4200 150....	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	USER	Level 0 - - Mode 0/PO1 - 10-2017	8,0	104,9	No
5	396213	7101101	93,0	VESTAS V162-5.6 HH180 56...	Yes	VESTAS	V162-5.6 HH180-5600	5600	162,0	199,0	USER	V162 - 5.6 MW Mode 0 STE + 2 dB(A)	8,0	104,0	Yes
6	397616	7100723	97,6	VESTAS V162-5.6 HH180 56...	Yes	VESTAS	V162-5.6 HH180-5600	5600	162,0	199,0	USER	V162 - 5.6 MW Mode 0 STE + 2 dB(A)	8,0	104,0	Yes
7	397086	7101114	95,0	VESTAS V162-5.6 HH180 56...	Yes	VESTAS	V162-5.6 HH180-5600	5600	162,0	199,0	USER	V162 - 5.6 MW Mode 0 STE + 2 dB(A)	8,0	104,0	Yes
8	397318	7100046	97,1	VESTAS V162-5.6 HH180 56...	Yes	VESTAS	V162-5.6 HH180-5600	5600	162,0	199,0	USER	V162 - 5.6 MW Mode 0 STE + 2 dB(A)	8,0	104,0	Yes
9	395742	7100512	93,3	VESTAS V162-5.6 HH180 56...	Yes	VESTAS	V162-5.6 HH180-5600	5600	162,0	199,0	USER	V162 - 5.6 MW Mode 0 STE + 2 dB(A)	8,0	104,0	Yes
10	396517	7099615	95,2	VESTAS V162-5.6 HH180 56...	Yes	VESTAS	V162-5.6 HH180-5600	5600	162,0	199,0	USER	V162 - 5.6 MW Mode 0 STE + 2 dB(A)	8,0	104,0	Yes
11	396717	7100499	95,4	VESTAS V162-5.6 HH180 56...	Yes	VESTAS	V162-5.6 HH180-5600	5600	162,0	199,0	USER	V162 - 5.6 MW Mode 0 STE + 2 dB(A)	8,0	104,0	Yes
12	397043	7099259	96,0	VESTAS V162-5.6 HH180 56...	Yes	VESTAS	V162-5.6 HH180-5600	5600	162,0	199,0	USER	V162 - 5.6 MW Mode 0 STE + 2 dB(A)	8,0	104,0	Yes
13	395944	7099965	95,0	VESTAS V162-5.6 HH180 56...	Yes	VESTAS	V162-5.6 HH180-5600	5600	162,0	199,0	USER	V162 - 5.6 MW Mode 0 STE + 2 dB(A)	8,0	104,0	Yes

Calculation Results

Sound level

Noise sensitive area No.	Name	East	North	Z [m]	Demands Imission height [m]	Noise [dB(A)]	Sound level From WTGs [dB(A)]	Distance to noise demand [m]
A	Asuinrakennus A (Hakuperäntie 202)	397098	7096526	95,0	4,0	40,0	27,6	2066
B	Asuinrakennus B (Hakuperäntie 169)	396724	7096452	92,5	4,0	40,0	27,3	2148
C	Asuinrakennus C (Säilyntie 285)	393762	7098532	81,7	4,0	40,0	29,0	1850
D	Asuinrakennus D (Säilyntie 264)	393460	7098729	84,2	4,0	40,0	28,4	2006
E	Lomarakennus E (Raudaskallion metsatie)	393183	7099996	87,5	4,0	40,0	29,1	1865
F	Lomarakennus F (Hirvinevanhaara 147)	394644	7102345	90,5	4,0	40,0	35,5	612
G	Lomarakennus G (Pohjanneva)	397651	7096966	97,5	4,0	40,0	28,9	1715

Distances (m)

WTG	A	B	C	D	E	F	G
1	7524	7533	5693	5618	4617	1851	7227
2	7264	7318	5915	5892	5031	2349	6896
3	6802	6800	4953	4890	3943	1212	6531
4	7660	7635	5467	5350	4252	1554	7424
5	4659	4676	3551	3634	3225	2003	4378
6	4228	4363	4434	4610	4493	3386	3757
7	4587	4675	4210	4340	4060	2735	4186
8	3527	3643	3866	4077	4136	3526	3099
9	4210	4177	2800	2896	2610	2137	4028
10	3142	3169	2961	3183	3356	3311	2881
11	3991	4047	3550	3707	3569	2776	3655
12	2733	2824	3361	3621	3930	3909	2372
13	3627	3598	2611	2775	2762	2712	3451

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Calculated:
9.6.2020 20.38/3.3.247

DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

Assumptions

Calculated L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet
(when calculated with ground attenuation, then Dc = Domega)

LWA,ref:	Sound pressure level at WTG
K:	Pure tone
Dc:	Directivity correction
Adiv:	the attenuation due to geometrical divergence
Aatm:	the attenuation due to atmospheric absorption
Agr:	the attenuation due to ground effect
Abar:	the attenuation due to a barrier
Amisc:	the attenuation due to miscellaneous other effects
Cmet:	Meteorological correction

Calculation Results

Noise sensitive area: A Asuinrakennus A (Hakuperäntie 202)

Wind speed: 8,0 m/s
WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	7524	7525		7,63	104,9		0,00	88,53	-	-	0,00	0,00	-
1			63	1,30	86,5				0,79	-4,10			85,22
1			125	3,23	93,7				2,83	-0,85			90,51
1			250	2,84	98,2				8,43	-1,64			95,31
1			500	-3,96	99,9				17,76	-2,46			103,83
1			1000	-17,89	98,9				30,70	-2,46			116,77
1			2000	-57,04	95,1				66,07	-2,46			152,14
1			4000	-197,54	88,7				200,17	-2,46			286,24
1			8000	-721,56	79,4				714,88	-2,46			800,96
10	3142	3148		19,77	104,0	2	0,00	80,96	-	-	0,00	0,00	-
10			63	8,56	84,9				0,33	-3,00			78,29
10			125	12,42	92,4				1,18	-0,20			81,95
10			250	15,57	97,1				3,53	-0,98			83,50
10			500	14,41	99,0				7,43	-1,80			86,60
10			1000	8,11	98,1				12,85	-1,80			92,01
10			2000	-10,35	94,5				27,64	-1,80			106,81
10			4000	-72,91	88,0				83,75	-1,80			162,91
10			8000	-297,54	78,7				299,11	-1,80			378,27
11	3991	3996		16,54	104,0	2	0,00	83,03	-	-	0,00	0,00	-
11			63	6,40	84,9				0,42	-3,00			80,45
11			125	10,03	92,4				1,50	-0,20			84,34
11			250	12,55	97,1				4,48	-0,98			86,52
11			500	10,34	99,0				9,43	-1,80			90,67
11			1000	2,58	98,1				16,30	-1,80			97,53
11			2000	-19,86	94,5				35,08	-1,80			116,31
11			4000	-97,52	88,0				106,28	-1,80			187,52
11			8000	-380,09	78,7				379,59	-1,80			460,82
12	2733	2740		21,60	104,0	2	0,00	79,75	-	-	0,00	0,00	-
12			63	9,81	84,9				0,29	-3,00			77,04
12			125	13,78	92,4				1,03	-0,20			80,59
12			250	17,23	97,1				3,07	-0,98			81,84
12			500	16,58	99,0				6,47	-1,80			84,42
12			1000	10,98	98,1				11,18	-1,80			89,13
12			2000	-5,55	94,5				24,05	-1,80			102,01
12			4000	-60,83	88,0				72,88	-1,80			150,83
12			8000	-257,50	78,7				260,27	-1,80			338,23
13	3627	3632		17,84	104,0	2	0,00	82,20	-	-	0,00	0,00	-
13			63	7,27	84,9				0,38	-3,00			79,58
13			125	10,99	92,4				1,37	-0,20			83,37
13			250	13,79	97,1				4,07	-0,98			85,29
13			500	12,03	99,0				8,57	-1,80			88,98
13			1000	4,89	98,1				14,82	-1,80			95,22
13			2000	-15,84	94,5				31,89	-1,80			112,29

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
13			4000	-87,02	88,0				96,61	-1,80			177,02
13			8000	-344,73	78,7				345,05	-1,80			425,45
2	7264	7266		8,07	104,9		0,00	88,23	-	-	0,00	0,00	-
2			63	1,56	86,5				0,76	-4,03			84,96
2			125	3,59	93,7				2,73	-0,81			90,14
2			250	3,39	98,2				8,14	-1,60			94,76
2			500	-3,08	99,9				17,15	-2,41			102,96
2			1000	-16,56	98,9				29,64	-2,42			115,45
2			2000	-54,50	95,1				63,79	-2,42			149,60
2			4000	-190,38	88,7				193,27	-2,42			279,08
2			8000	-696,66	79,4				690,24	-2,42			776,05
3	6802	6804		8,90	104,9		0,00	87,65	-	-	0,00	0,00	-
3			63	2,05	86,5				0,71	-3,90			84,47
3			125	4,25	93,7				2,56	-0,73			89,48
3			250	4,40	98,2				7,62	-1,52			93,75
3			500	-1,50	99,9				16,06	-2,33			101,38
3			1000	-14,19	98,9				27,76	-2,34			113,08
3			2000	-49,95	95,1				59,74	-2,34			145,05
3			4000	-177,60	88,7				180,98	-2,34			266,30
3			8000	-652,28	79,4				646,35	-2,34			731,67
4	7660	7661		7,40	104,9		0,00	88,69	-	-	0,00	0,00	-
4			63	1,16	86,5				0,80	-4,13			85,36
4			125	3,04	93,7				2,88	-0,87			90,69
4			250	2,55	98,2				8,58	-1,66			95,60
4			500	-4,42	99,9				18,08	-2,48			104,29
4			1000	-18,58	98,9				31,26	-2,48			117,47
4			2000	-58,37	95,1				67,27	-2,48			153,48
4			4000	-201,30	88,7				203,80	-2,48			290,00
4			8000	-734,66	79,4				727,84	-2,48			814,05
5	4659	4663		14,39	104,0	2	0,00	84,37	-	-	0,00	0,00	-
5			63	4,99	84,9				0,49	-3,00			81,86
5			125	8,43	92,4				1,75	-0,20			85,93
5			250	10,46	97,1				5,22	-0,98			88,61
5			500	7,43	99,0				11,01	-1,80			93,58
5			1000	-1,48	98,1				19,03	-1,80			101,60
5			2000	-27,06	94,5				40,94	-1,80			123,52
5			4000	-116,62	88,0				124,04	-1,80			206,61
5			8000	-444,85	78,7				443,00	-1,80			525,57
6	4228	4233		15,74	104,0	2	0,00	83,53	-	-	0,00	0,00	-
6			63	5,87	84,9				0,44	-3,00			80,98
6			125	9,44	92,4				1,59	-0,20			84,93
6			250	11,78	97,1				4,74	-0,98			87,29
6			500	9,28	99,0				9,99	-1,80			91,73
6			1000	1,11	98,1				17,27	-1,80			99,00
6			2000	-22,44	94,5				37,17	-1,80			118,90
6			4000	-104,33	88,0				112,60	-1,80			194,33
6			8000	-403,15	78,7				402,14	-1,80			483,87
7	4587	4592		14,61	104,0	2	0,00	84,24	-	-	0,00	0,00	-
7			63	5,13	84,9				0,48	-3,00			81,72
7			125	8,60	92,4				1,73	-0,20			85,77
7			250	10,67	97,1				5,14	-0,98			88,40
7			500	7,73	99,0				10,84	-1,80			93,28
7			1000	-1,06	98,1				18,73	-1,80			101,17
7			2000	-26,30	94,5				40,31	-1,80			122,75
7			4000	-114,58	88,0				122,14	-1,80			204,58
7			8000	-437,92	78,7				436,20	-1,80			518,64
8	3527	3532		18,22	104,0	2	0,00	81,96	-	-	0,00	0,00	-
8			63	7,52	84,9				0,37	-3,00			79,33
8			125	11,27	92,4				1,33	-0,20			83,09
8			250	14,14	97,1				3,96	-0,98			84,93
8			500	12,51	99,0				8,34	-1,80			88,50
8			1000	5,54	98,1				14,41	-1,80			94,57
8			2000	-14,72	94,5				31,01	-1,80			111,18
8			4000	-84,13	88,0				93,96	-1,80			174,12

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
8			8000	-335,02	78,7				335,58	-1,80			415,74
9	4210	4215		15,80	104,0	2	0,00	83,50	-	-	0,00	0,00	-
9			63	5,91	84,9				0,44	-3,00			80,94
9			125	9,48	92,4				1,58	-0,20			84,88
9			250	11,84	97,1				4,72	-0,98			87,23
9			500	9,36	99,0				9,95	-1,80			91,65
9			1000	1,22	98,1				17,20	-1,80			98,89
9			2000	-22,24	94,5				37,00	-1,80			118,70
9			4000	-103,81	88,0				112,11	-1,80			193,80
9			8000	-401,36	78,7				400,39	-1,80			482,08
Sum				27,55									
Sum			63	43,36									
Sum			125	36,83									
Sum			250	32,00									
Sum			500	24,91									
Sum			1000	15,01									
Sum			2000	-4,60									
Sum			4000	-61,54									
Sum			8000	-256,40									

- Data undefined due to calculation with octave data

Noise sensitive area: B Asuinrakennus B (Hakuperäntie 169)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	7533	7535		7,61	104,9		0,00	88,54	-	-	0,00	0,00	-
1			63	1,29	86,5				0,79	-4,10			85,23
1			125	3,22	93,7				2,83	-0,86			90,52
1			250	2,82	98,2				8,44	-1,65			95,34
1			500	-3,99	99,9				17,78	-2,46			103,87
1			1000	-17,94	98,9				30,74	-2,46			116,82
1			2000	-57,14	95,1				66,16	-2,46			152,24
1			4000	-197,81	88,7				200,43	-2,46			286,51
1			8000	-722,50	79,4				715,81	-2,46			801,89
10	3169	3175		19,66	104,0	2	0,00	81,04	-	-	0,00	0,00	-
10			63	8,48	84,9				0,33	-3,00			78,37
10			125	12,33	92,4				1,19	-0,20			82,03
10			250	15,47	97,1				3,56	-0,98			83,61
10			500	14,28	99,0				7,49	-1,80			86,73
10			1000	7,92	98,1				12,95	-1,80			92,19
10			2000	-10,66	94,5				27,88	-1,80			107,11
10			4000	-73,70	88,0				84,46	-1,80			163,69
10			8000	-300,15	78,7				301,64	-1,80			380,87
11	4047	4051		16,35	104,0	2	0,00	83,15	-	-	0,00	0,00	-
11			63	6,27	84,9				0,43	-3,00			80,58
11			125	9,89	92,4				1,52	-0,20			84,48
11			250	12,37	97,1				4,54	-0,98			86,70
11			500	10,09	99,0				9,56	-1,80			90,92
11			1000	2,23	98,1				16,53	-1,80			97,88
11			2000	-20,47	94,5				35,57	-1,80			116,92
11			4000	-99,12	88,0				107,77	-1,80			189,12
11			8000	-385,51	78,7				384,88	-1,80			466,23
12	2824	2831		21,18	104,0	2	0,00	80,04	-	-	0,00	0,00	-
12			63	9,52	84,9				0,30	-3,00			77,34
12			125	13,46	92,4				1,06	-0,20			80,91
12			250	16,85	97,1				3,17	-0,98			82,22
12			500	16,08	99,0				6,68	-1,80			84,92
12			1000	10,32	98,1				11,55	-1,80			89,79
12			2000	-6,64	94,5				24,86	-1,80			103,10
12			4000	-63,55	88,0				75,31	-1,80			153,54
12			8000	-266,46	78,7				268,95	-1,80			347,19
13	3598	3603		17,95	104,0	2	0,00	82,13	-	-	0,00	0,00	-
13			63	7,34	84,9				0,38	-3,00			79,51

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Calculated:
9.6.2020 20.38/3.3.247

DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
13			125	11,07	92,4				1,35	-0,20			83,29
13			250	13,89	97,1				4,04	-0,98			85,18
13			500	12,17	99,0				8,50	-1,80			88,84
13			1000	5,08	98,1				14,70	-1,80			95,04
13			2000	-15,52	94,5				31,64	-1,80			111,97
13			4000	-86,19	88,0				95,85	-1,80			176,18
13			8000	-341,93	78,7				342,32	-1,80			422,65
2	7318	7319		7,98	104,9		0,00	88,29	-	-	0,00	0,00	-
2			63	1,51	86,5				0,77	-4,04			85,01
2			125	3,52	93,7				2,75	-0,82			90,22
2			250	3,28	98,2				8,20	-1,61			94,88
2			500	-3,27	99,9				17,27	-2,42			103,14
2			1000	-16,84	98,9				29,86	-2,43			115,72
2			2000	-55,02	95,1				64,26	-2,43			150,13
2			4000	-191,86	88,7				194,69	-2,43			280,55
2			8000	-701,80	79,4				695,32	-2,43			781,19
3	6800	6801		8,91	104,9		0,00	87,65	-	-	0,00	0,00	-
3			63	2,05	86,5				0,71	-3,90			84,47
3			125	4,26	93,7				2,56	-0,73			89,48
3			250	4,41	98,2				7,62	-1,52			93,75
3			500	-1,50	99,9				16,05	-2,33			101,37
3			1000	-14,18	98,9				27,75	-2,34			113,06
3			2000	-49,93	95,1				59,72	-2,34			145,03
3			4000	-177,53	88,7				180,92	-2,34			266,23
3			8000	-652,05	79,4				646,13	-2,34			731,44
4	7635	7636		7,44	104,9		0,00	88,66	-	-	0,00	0,00	-
4			63	1,19	86,5				0,80	-4,13			85,33
4			125	3,08	93,7				2,87	-0,87			90,66
4			250	2,61	98,2				8,55	-1,66			95,55
4			500	-4,33	99,9				18,02	-2,47			104,21
4			1000	-18,45	98,9				31,16	-2,48			117,34
4			2000	-58,13	95,1				67,04	-2,48			153,23
4			4000	-200,60	88,7				203,12	-2,48			289,30
4			8000	-732,22	79,4				725,43	-2,48			811,61
5	4676	4680		14,34	104,0	2	0,00	84,41	-	-	0,00	0,00	-
5			63	4,96	84,9				0,49	-3,00			81,90
5			125	8,40	92,4				1,76	-0,20			85,97
5			250	10,41	97,1				5,24	-0,98			88,66
5			500	7,35	99,0				11,05	-1,80			93,65
5			1000	-1,59	98,1				19,10	-1,80			101,70
5			2000	-27,24	94,5				41,09	-1,80			123,70
5			4000	-117,11	88,0				124,50	-1,80			207,10
5			8000	-446,51	78,7				444,64	-1,80			527,24
6	4363	4367		15,31	104,0	2	0,00	83,80	-	-	0,00	0,00	-
6			63	5,59	84,9				0,46	-3,00			81,26
6			125	9,12	92,4				1,64	-0,20			85,25
6			250	11,36	97,1				4,89	-0,98			87,71
6			500	8,69	99,0				10,31	-1,80			92,31
6			1000	0,29	98,1				17,82	-1,80			99,82
6			2000	-23,89	94,5				38,34	-1,80			120,35
6			4000	-108,17	88,0				116,17	-1,80			198,17
6			8000	-416,17	78,7				414,89	-1,80			496,89
7	4675	4680		14,34	104,0	2	0,00	84,40	-	-	0,00	0,00	-
7			63	4,96	84,9				0,49	-3,00			81,90
7			125	8,40	92,4				1,76	-0,20			85,97
7			250	10,41	97,1				5,24	-0,98			88,66
7			500	7,36	99,0				11,04	-1,80			93,65
7			1000	-1,58	98,1				19,09	-1,80			101,70
7			2000	-27,24	94,5				41,09	-1,80			123,69
7			4000	-117,08	88,0				124,48	-1,80			207,08
7			8000	-446,44	78,7				444,56	-1,80			527,17
8	3643	3648		17,78	104,0	2	0,00	82,24	-	-	0,00	0,00	-
8			63	7,23	84,9				0,38	-3,00			79,62
8			125	10,95	92,4				1,37	-0,20			83,42

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
8			250	13,73	97,1				4,09	-0,98			85,34
8			500	11,95	99,0				8,61	-1,80			89,05
8			1000	4,79	98,1				14,88	-1,80			95,33
8			2000	-16,02	94,5				32,03	-1,80			112,47
8			4000	-87,49	88,0				97,04	-1,80			177,48
8			8000	-346,29	78,7				346,58	-1,80			427,02
9	4177	4181		15,91	104,0	2	0,00	83,43	-	-	0,00	0,00	-
9			63	5,99	84,9				0,44	-3,00			80,87
9			125	9,56	92,4				1,57	-0,20			84,80
9			250	11,95	97,1				4,68	-0,98			87,12
9			500	9,51	99,0				9,87	-1,80			91,50
9			1000	1,43	98,1				17,06	-1,80			98,69
9			2000	-21,88	94,5				36,71	-1,80			118,34
9			4000	-102,85	88,0				111,23	-1,80			192,85
9			8000	-398,14	78,7				397,24	-1,80			478,86
Sum				27,34									
Sum			63	43,23									
Sum			125	36,68									
Sum			250	31,80									
Sum			500	24,63									
Sum			1000	14,60									
Sum			2000	-5,41									
Sum			4000	-64,11									
Sum			8000	-265,36									

- Data undefined due to calculation with octave data

Noise sensitive area: C Asuinrakennus C (Säilyntie 285)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5693	5696		11,11	104,9		0,00	86,11	-	-	0,00	0,00	-
1			63	3,30	86,5				0,60	-3,49			83,22
1			125	5,97	93,7				2,14	-0,49			87,77
1			250	6,94	98,2				6,38	-1,28			91,21
1			500	2,41	99,9				13,44	-2,09			97,46
1			1000	-8,37	98,9				23,24	-2,09			107,26
1			2000	-38,93	95,1				50,01	-2,09			134,03
1			4000	-146,83	88,7				151,51	-2,09			235,52
1			8000	-545,72	79,4				541,09	-2,09			625,11
10	2961	2968		20,55	104,0	2	0,00	80,45	-	-	0,00	0,00	-
10			63	9,09	84,9				0,31	-3,00			77,76
10			125	13,00	92,4				1,12	-0,20			81,37
10			250	16,28	97,1				3,32	-0,98			82,79
10			500	15,35	99,0				7,00	-1,80			85,66
10			1000	9,35	98,1				12,11	-1,80			90,76
10			2000	-8,26	94,5				26,06	-1,80			104,71
10			4000	-67,61	88,0				78,95	-1,80			157,60
10			8000	-279,90	78,7				281,98	-1,80			360,63
11	3550	3556		18,13	104,0	2	0,00	82,02	-	-	0,00	0,00	-
11			63	7,46	84,9				0,37	-3,00			79,39
11			125	11,20	92,4				1,34	-0,20			83,16
11			250	14,05	97,1				3,98	-0,98			85,02
11			500	12,39	99,0				8,39	-1,80			88,62
11			1000	5,39	98,1				14,51	-1,80			94,73
11			2000	-14,99	94,5				31,22	-1,80			111,44
11			4000	-84,82	88,0				94,59	-1,80			174,81
11			8000	-337,33	78,7				337,83	-1,80			418,05
12	3361	3367		18,87	104,0	2	0,00	81,55	-	-	0,00	0,00	-
12			63	7,95	84,9				0,35	-3,00			78,90
12			125	11,75	92,4				1,27	-0,20			82,62
12			250	14,74	97,1				3,77	-0,98			84,33
12			500	13,31	99,0				7,95	-1,80			87,70
12			1000	6,63	98,1				13,74	-1,80			93,48

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
12			2000	-12,85	94,5				29,56	-1,80			109,31
12			4000	-79,31	88,0				89,57	-1,80			169,31
12			8000	-318,89	78,7				319,88	-1,80			399,62
13	2611	2619		22,19	104,0	2	0,00	79,36	-	-	0,00	0,00	-
13			63	10,21	84,9				0,28	-3,00			76,64
13			125	14,21	92,4				0,98	-0,20			80,15
13			250	17,76	97,1				2,93	-0,98			81,31
13			500	17,26	99,0				6,18	-1,80			83,75
13			1000	11,86	98,1				10,69	-1,80			88,25
13			2000	-4,11	94,5				23,00	-1,80			100,56
13			4000	-57,24	88,0				69,67	-1,80			147,24
13			8000	-245,67	78,7				248,84	-1,80			326,40
2	5915	5917		10,64	104,9		0,00	86,44	-	-	0,00	0,00	-
2			63	3,04	86,5				0,62	-3,58			83,48
2			125	5,61	93,7				2,22	-0,54			88,12
2			250	6,42	98,2				6,63	-1,33			91,74
2			500	1,61	99,9				13,96	-2,14			98,26
2			1000	-9,55	98,9				24,14	-2,15			108,44
2			2000	-41,14	95,1				51,95	-2,15			136,25
2			4000	-152,99	88,7				157,39	-2,15			241,69
2			8000	-567,02	79,4				562,12	-2,15			646,42
3	4953	4955		12,80	104,9		0,00	84,90	-	-	0,00	0,00	-
3			63	4,21	86,5				0,52	-3,11			82,31
3			125	7,23	93,7				1,86	-0,26			86,50
3			250	8,76	98,2				5,55	-1,05			89,40
3			500	5,14	99,9				11,69	-1,86			94,73
3			1000	-4,36	98,9				20,22	-1,87			103,25
3			2000	-31,44	95,1				43,51	-1,87			126,54
3			4000	-126,14	88,7				131,81	-1,87			214,84
3			8000	-474,38	79,4				470,73	-1,87			553,77
4	5467	5470		11,61	104,9		0,00	85,76	-	-	0,00	0,00	-
4			63	3,57	86,5				0,57	-3,38			82,95
4			125	6,34	93,7				2,06	-0,43			87,39
4			250	7,48	98,2				6,13	-1,21			90,67
4			500	3,23	99,9				12,91	-2,03			96,64
4			1000	-7,16	98,9				22,32	-2,03			106,05
4			2000	-36,65	95,1				48,02	-2,03			131,75
4			4000	-140,53	88,7				145,49	-2,03			229,22
4			8000	-523,96	79,4				519,62	-2,03			603,35
5	3551	3557		18,13	104,0	2	0,00	82,02	-	-	0,00	0,00	-
5			63	7,46	84,9				0,37	-3,00			79,40
5			125	11,20	92,4				1,34	-0,20			83,16
5			250	14,05	97,1				3,98	-0,98			85,02
5			500	12,39	99,0				8,39	-1,80			88,62
5			1000	5,38	98,1				14,51	-1,80			94,73
5			2000	-15,00	94,5				31,23	-1,80			111,45
5			4000	-84,84	88,0				94,62	-1,80			174,84
5			8000	-337,41	78,7				337,91	-1,80			418,14
6	4434	4439		15,08	104,0	2	0,00	83,95	-	-	0,00	0,00	-
6			63	5,44	84,9				0,47	-3,00			81,41
6			125	8,95	92,4				1,67	-0,20			85,42
6			250	11,14	97,1				4,97	-0,98			87,93
6			500	8,38	99,0				10,48	-1,80			92,63
6			1000	-0,14	98,1				18,11	-1,80			100,26
6			2000	-24,67	94,5				38,98	-1,80			121,12
6			4000	-110,23	88,0				118,08	-1,80			200,23
6			8000	-423,14	78,7				421,72	-1,80			503,86
7	4210	4215		15,80	104,0	2	0,00	83,50	-	-	0,00	0,00	-
7			63	5,91	84,9				0,44	-3,00			80,94
7			125	9,48	92,4				1,58	-0,20			84,89
7			250	11,84	97,1				4,72	-0,98			87,23
7			500	9,36	99,0				9,95	-1,80			91,65
7			1000	1,22	98,1				17,20	-1,80			98,89
7			2000	-22,25	94,5				37,01	-1,80			118,70

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
7			4000	-103,81	88,0				112,12	-1,80			193,81
7			8000	-401,38	78,7				400,41	-1,80			482,11
8	3866	3872		16,97	104,0	2	0,00	82,76	-	-	0,00	0,00	-
8			63	6,69	84,9				0,41	-3,00			80,16
8			125	10,35	92,4				1,46	-0,20			84,02
8			250	12,96	97,1				4,34	-0,98			86,11
8			500	10,91	99,0				9,14	-1,80			90,10
8			1000	3,36	98,1				15,80	-1,80			96,75
8			2000	-18,50	94,5				33,99	-1,80			114,95
8			4000	-93,94	88,0				102,98	-1,80			183,94
8			8000	-368,03	78,7				367,80	-1,80			448,76
9	2800	2808		21,28	104,0	2	0,00	79,97	-	-	0,00	0,00	-
9			63	9,59	84,9				0,29	-3,00			77,26
9			125	13,54	92,4				1,06	-0,20			80,83
9			250	16,94	97,1				3,14	-0,98			82,13
9			500	16,21	99,0				6,63	-1,80			84,80
9			1000	10,49	98,1				11,46	-1,80			89,62
9			2000	-6,37	94,5				24,65	-1,80			102,82
9			4000	-62,86	88,0				74,69	-1,80			152,86
9			8000	-264,19	78,7				266,75	-1,80			344,92
Sum				29,02									
Sum			63	44,41									
Sum			125	38,00									
Sum			250	33,41									
Sum			500	26,66									
Sum			1000	17,16									
Sum			2000	-1,62									
Sum			4000	-56,85									
Sum			8000	-244,51									

- Data undefined due to calculation with octave data

Noise sensitive area: D Asuinrakennus D (Säilyntie 264)

Wind speed: 8,0 m/s

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5618	5620		11,28	104,9		0,00	85,99	-	-	0,00	0,00	-
1			63	3,39	86,5				0,59	-3,45			83,13
1			125	6,09	93,7				2,11	-0,47			87,64
1			250	7,12	98,2				6,29	-1,26			91,03
1			500	2,68	99,9				13,26	-2,07			97,19
1			1000	-7,97	98,9				22,93	-2,07			106,85
1			2000	-38,17	95,1				49,34	-2,07			133,27
1			4000	-144,72	88,7				149,49	-2,07			233,41
1			8000	-538,43	79,4				533,90	-2,07			617,82
10	3183	3190		19,60	104,0	2	0,00	81,07	-	-	0,00	0,00	-
10			63	8,44	84,9				0,33	-3,00			78,41
10			125	12,29	92,4				1,20	-0,20			82,08
10			250	15,41	97,1				3,57	-0,98			83,66
10			500	14,20	99,0				7,53	-1,80			86,81
10			1000	7,83	98,1				13,01	-1,80			92,29
10			2000	-10,82	94,5				28,00	-1,80			107,28
10			4000	-74,12	88,0				84,84	-1,80			164,12
10			8000	-301,56	78,7				303,01	-1,80			382,28
11	3707	3712		17,55	104,0	2	0,00	82,39	-	-	0,00	0,00	-
11			63	7,07	84,9				0,39	-3,00			79,78
11			125	10,77	92,4				1,40	-0,20			83,59
11			250	13,51	97,1				4,16	-0,98			85,57
11			500	11,65	99,0				8,76	-1,80			89,36
11			1000	4,38	98,1				15,15	-1,80			95,74
11			2000	-16,73	94,5				32,59	-1,80			113,19
11			4000	-89,34	88,0				98,75	-1,80			179,34
11			8000	-352,54	78,7				352,67	-1,80			433,26
12	3621	3627		17,86	104,0	2	0,00	82,19	-	-	0,00	0,00	-

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
12			63	7,28	84,9				0,38	-3,00			79,57
12			125	11,01	92,4				1,36	-0,20			83,36
12			250	13,80	97,1				4,06	-0,98			85,27
12			500	12,05	99,0				8,56	-1,80			88,96
12			1000	4,92	98,1				14,80	-1,80			95,19
12			2000	-15,79	94,5				31,85	-1,80			112,24
12			4000	-86,88	88,0				96,49	-1,80			176,88
12			8000	-344,26	78,7				344,60	-1,80			424,99
13	2775	2782		21,40	104,0	2	0,00	79,89	-	-	0,00	0,00	-
13			63	9,67	84,9				0,29	-3,00			77,18
13			125	13,63	92,4				1,05	-0,20			80,74
13			250	17,05	97,1				3,12	-0,98			82,02
13			500	16,35	99,0				6,57	-1,80			84,66
13			1000	10,68	98,1				11,35	-1,80			89,44
13			2000	-6,06	94,5				24,43	-1,80			102,52
13			4000	-62,10	88,0				74,01	-1,80			152,10
13			8000	-261,67	78,7				264,31	-1,80			342,40
2	5892	5894		10,69	104,9		0,00	86,41	-	-	0,00	0,00	-
2			63	3,07	86,5				0,62	-3,57			83,46
2			125	5,65	93,7				2,22	-0,54			88,09
2			250	6,47	98,2				6,60	-1,33			91,68
2			500	1,70	99,9				13,91	-2,14			98,18
2			1000	-9,43	98,9				24,05	-2,14			108,31
2			2000	-40,91	95,1				51,75	-2,14			136,01
2			4000	-152,34	88,7				156,78	-2,14			241,04
2			8000	-564,79	79,4				559,92	-2,14			644,18
3	4890	4893		12,95	104,9		0,00	84,79	-	-	0,00	0,00	-
3			63	4,29	86,5				0,51	-3,07			82,23
3			125	7,34	93,7				1,84	-0,24			86,39
3			250	8,91	98,2				5,48	-1,03			89,24
3			500	5,38	99,9				11,55	-1,84			94,50
3			1000	-4,02	98,9				19,96	-1,84			102,91
3			2000	-30,81	95,1				42,96	-1,84			125,91
3			4000	-124,40	88,7				130,15	-1,84			213,10
3			8000	-468,39	79,4				464,83	-1,84			547,78
4	5350	5352		11,87	104,9		0,00	85,57	-	-	0,00	0,00	-
4			63	3,71	86,5				0,56	-3,33			82,81
4			125	6,54	93,7				2,01	-0,39			87,19
4			250	7,77	98,2				5,99	-1,18			90,39
4			500	3,66	99,9				12,63	-1,99			96,21
4			1000	-6,53	98,9				21,84	-2,00			105,41
4			2000	-35,47	95,1				46,99	-2,00			130,57
4			4000	-137,25	88,7				142,37	-2,00			225,95
4			8000	-512,65	79,4				508,46	-2,00			592,04
5	3634	3640		17,82	104,0	2	0,00	82,22	-	-	0,00	0,00	-
5			63	7,25	84,9				0,38	-3,00			79,60
5			125	10,97	92,4				1,37	-0,20			83,39
5			250	13,76	97,1				4,08	-0,98			85,31
5			500	11,99	99,0				8,59	-1,80			89,01
5			1000	4,84	98,1				14,85	-1,80			95,27
5			2000	-15,92	94,5				31,96	-1,80			112,38
5			4000	-87,24	88,0				96,81	-1,80			177,23
5			8000	-345,46	78,7				345,76	-1,80			426,18
6	4610	4615		14,54	104,0	2	0,00	84,28	-	-	0,00	0,00	-
6			63	5,09	84,9				0,48	-3,00			81,77
6			125	8,54	92,4				1,74	-0,20			85,82
6			250	10,61	97,1				5,17	-0,98			88,47
6			500	7,63	99,0				10,89	-1,80			93,38
6			1000	-1,20	98,1				18,83	-1,80			101,31
6			2000	-26,55	94,5				40,52	-1,80			123,00
6			4000	-115,24	88,0				122,75	-1,80			205,23
6			8000	-440,15	78,7				438,39	-1,80			520,88
7	4340	4345		15,38	104,0	2	0,00	83,76	-	-	0,00	0,00	-
7			63	5,64	84,9				0,46	-3,00			81,22

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
7			125	9,17	92,4				1,63	-0,20			85,20
7			250	11,43	97,1				4,87	-0,98			87,64
7			500	8,79	99,0				10,25	-1,80			92,22
7			1000	0,43	98,1				17,73	-1,80			99,69
7			2000	-23,66	94,5				38,15	-1,80			120,11
7			4000	-107,55	88,0				115,58	-1,80			197,54
7			8000	-414,03	78,7				412,80	-1,80			494,76
8	4077	4082		16,24	104,0	2	0,00	83,22	-	-	0,00	0,00	-
8			63	6,21	84,9				0,43	-3,00			80,65
8			125	9,81	92,4				1,53	-0,20			84,56
8			250	12,27	97,1				4,57	-0,98			86,81
8			500	9,95	99,0				9,63	-1,80			91,06
8			1000	2,04	98,1				16,66	-1,80			98,07
8			2000	-20,81	94,5				35,84	-1,80			117,26
8			4000	-100,01	88,0				108,59	-1,80			190,01
8			8000	-388,51	78,7				387,82	-1,80			469,24
9	2896	2903		20,85	104,0	2	0,00	80,26	-	-	0,00	0,00	-
9			63	9,29	84,9				0,30	-3,00			77,56
9			125	13,21	92,4				1,09	-0,20			81,15
9			250	16,55	97,1				3,25	-0,98			82,52
9			500	15,70	99,0				6,85	-1,80			85,31
9			1000	9,81	98,1				11,84	-1,80			90,30
9			2000	-7,49	94,5				25,49	-1,80			103,94
9			4000	-65,67	88,0				77,22	-1,80			155,67
9			8000	-273,50	78,7				275,77	-1,80			354,23
Sum				28,42									
Sum			63	44,04									
Sum			125	37,58									
Sum			250	32,86									
Sum			500	25,88									
Sum			1000	16,08									
Sum			2000	-3,43									
Sum			4000	-61,31									
Sum			8000	-260,30									

- Data undefined due to calculation with octave data

Noise sensitive area: E Lomarakennus E (Raudaskallion metsatie)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	4617	4620		13,70	104,9		0,00	84,29	-	-	0,00	0,00	-
1			63	4,74	86,5				0,49	-3,00			81,78
1			125	7,90	93,7				1,74	-0,20			85,83
1			250	9,67	98,2				5,17	-0,98			88,48
1			500	6,47	99,9				10,90	-1,80			93,40
1			1000	-2,46	98,9				18,85	-1,80			101,34
1			2000	-27,96	95,1				40,56	-1,80			123,06
1			4000	-116,69	88,7				122,89	-1,80			205,38
1			8000	-442,00	79,4				438,90	-1,80			521,39
10	3356	3362		18,89	104,0	2	0,00	81,53	-	-	0,00	0,00	-
10			63	7,97	84,9				0,35	-3,00			78,89
10			125	11,76	92,4				1,26	-0,20			82,60
10			250	14,76	97,1				3,77	-0,98			84,31
10			500	13,34	99,0				7,94	-1,80			87,67
10			1000	6,66	98,1				13,72	-1,80			93,45
10			2000	-12,80	94,5				29,52	-1,80			109,26
10			4000	-79,18	88,0				89,44	-1,80			169,17
10			8000	-318,44	78,7				319,43	-1,80			399,16
11	3569	3575		18,06	104,0	2	0,00	82,07	-	-	0,00	0,00	-
11			63	7,41	84,9				0,38	-3,00			79,44
11			125	11,15	92,4				1,34	-0,20			83,21
11			250	13,99	97,1				4,00	-0,98			85,09
11			500	12,30	99,0				8,44	-1,80			88,71

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
11			1000	5,26	98,1				14,59	-1,80			94,85
11			2000	-15,20	94,5				31,39	-1,80			111,66
11			4000	-85,37	88,0				95,10	-1,80			175,37
11			8000	-339,18	78,7				339,64	-1,80			419,91
12	3930	3935		16,75	104,0	2	0,00	82,90	-	-	0,00	0,00	-
12			63	6,54	84,9				0,41	-3,00			80,31
12			125	10,18	92,4				1,48	-0,20			84,18
12			250	12,75	97,1				4,41	-0,98			86,32
12			500	10,62	99,0				9,29	-1,80			90,39
12			1000	2,96	98,1				16,06	-1,80			97,15
12			2000	-19,19	94,5				34,55	-1,80			115,65
12			4000	-95,77	88,0				104,67	-1,80			185,77
12			8000	-374,20	78,7				373,83	-1,80			454,93
13	2762	2769		21,47	104,0	2	0,00	79,85	-	-	0,00	0,00	-
13			63	9,72	84,9				0,29	-3,00			77,14
13			125	13,67	92,4				1,04	-0,20			80,69
13			250	17,11	97,1				3,10	-0,98			81,96
13			500	16,42	99,0				6,53	-1,80			84,58
13			1000	10,77	98,1				11,30	-1,80			89,34
13			2000	-5,90	94,5				24,31	-1,80			102,36
13			4000	-61,70	88,0				73,66	-1,80			151,70
13			8000	-260,38	78,7				263,06	-1,80			341,10
2	5031	5034		12,61	104,9		0,00	85,04	-	-	0,00	0,00	-
2			63	4,11	86,5				0,53	-3,16			82,41
2			125	7,09	93,7				1,89	-0,29			86,64
2			250	8,56	98,2				5,64	-1,08			89,60
2			500	4,85	99,9				11,88	-1,89			95,03
2			1000	-4,80	98,9				20,54	-1,89			103,68
2			2000	-32,24	95,1				44,20	-1,89			127,34
2			4000	-128,35	88,7				133,90	-1,89			217,04
2			8000	-481,97	79,4				478,21	-1,89			561,36
3	3943	3946		15,85	104,9		0,00	82,92	-	-	0,00	0,00	-
3			63	6,18	86,5				0,41	-3,00			80,34
3			125	9,52	93,7				1,48	-0,20			84,21
3			250	11,80	98,2				4,42	-0,98			86,36
3			500	9,43	99,9				9,31	-1,80			90,44
3			1000	1,66	98,9				16,10	-1,80			97,22
3			2000	-20,67	95,1				34,65	-1,80			115,77
3			4000	-97,39	88,7				104,97	-1,80			186,09
3			8000	-376,62	79,4				374,88	-1,80			456,01
4	4252	4254		14,83	104,9		0,00	83,58	-	-	0,00	0,00	-
4			63	5,50	86,5				0,45	-3,00			81,02
4			125	8,75	93,7				1,60	-0,20			84,98
4			250	10,80	98,2				4,76	-0,98			87,36
4			500	8,05	99,9				10,04	-1,80			91,82
4			1000	-0,25	98,9				17,36	-1,80			99,13
4			2000	-24,03	95,1				37,35	-1,80			119,13
4			4000	-106,25	88,7				113,17	-1,80			194,94
4			8000	-406,55	79,4				404,17	-1,80			485,94
5	3225	3231		19,42	104,0	2	0,00	81,19	-	-	0,00	0,00	-
5			63	8,33	84,9				0,34	-3,00			78,53
5			125	12,16	92,4				1,22	-0,20			82,21
5			250	15,25	97,1				3,62	-0,98			83,82
5			500	13,99	99,0				7,63	-1,80			87,02
5			1000	7,54	98,1				13,18	-1,80			92,57
5			2000	-11,31	94,5				28,37	-1,80			107,76
5			4000	-75,35	88,0				85,96	-1,80			165,34
5			8000	-305,65	78,7				306,99	-1,80			386,37
6	4493	4497		14,90	104,0	2	0,00	84,06	-	-	0,00	0,00	-
6			63	5,32	84,9				0,47	-3,00			81,53
6			125	8,81	92,4				1,69	-0,20			85,55
6			250	10,96	97,1				5,04	-0,98			88,11
6			500	8,13	99,0				10,61	-1,80			92,88
6			1000	-0,49	98,1				18,35	-1,80			100,61

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
6			2000	-25,29	94,5				39,49	-1,80			121,75
6			4000	-111,89	88,0				119,63	-1,80			201,89
6			8000	-428,79	78,7				427,26	-1,80			509,52
7	4060	4065		16,30	104,0	2	0,00	83,18	-	-	0,00	0,00	-
7			63	6,24	84,9				0,43	-3,00			80,61
7			125	9,85	92,4				1,53	-0,20			84,52
7			250	12,32	97,1				4,55	-0,98			86,75
7			500	10,03	99,0				9,59	-1,80			90,98
7			1000	2,15	98,1				16,59	-1,80			97,97
7			2000	-20,62	94,5				35,69	-1,80			117,08
7			4000	-99,52	88,0				108,14	-1,80			189,52
7			8000	-386,87	78,7				386,22	-1,80			467,60
8	4136	4141		16,04	104,0	2	0,00	83,34	-	-	0,00	0,00	-
8			63	6,08	84,9				0,43	-3,00			80,78
8			125	9,66	92,4				1,56	-0,20			84,70
8			250	12,08	97,1				4,64	-0,98			86,99
8			500	9,69	99,0				9,77	-1,80			91,32
8			1000	1,68	98,1				16,89	-1,80			98,44
8			2000	-21,44	94,5				36,36	-1,80			117,90
8			4000	-101,69	88,0				110,15	-1,80			191,69
8			8000	-394,20	78,7				393,39	-1,80			474,93
9	2610	2618		22,20	104,0	2	0,00	79,36	-	-	0,00	0,00	-
9			63	10,22	84,9				0,27	-3,00			76,63
9			125	14,22	92,4				0,98	-0,20			80,15
9			250	17,77	97,1				2,93	-0,98			81,31
9			500	17,27	99,0				6,18	-1,80			83,74
9			1000	11,87	98,1				10,68	-1,80			88,24
9			2000	-4,09	94,5				22,98	-1,80			100,54
9			4000	-57,20	88,0				69,63	-1,80			147,19
9			8000	-245,53	78,7				248,69	-1,80			326,25
Sum				29,07									
Sum			63	44,52									
Sum			125	38,11									
Sum			250	33,48									
Sum			500	26,64									
Sum			1000	17,02									
Sum			2000	-1,91									
Sum			4000	-56,80									
Sum			8000	-244,29									

- Data undefined due to calculation with octave data

Noise sensitive area: F Lomarakennus F (Hirvinevanhaara 147)

Wind speed: 8,0 m/s

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	1851	1857		25,54	104,9		0,00	76,38	-	-	0,00	0,00	-
1			63	12,95	86,5				0,20	-3,00			73,57
1			125	16,85	93,7				0,70	-0,20			76,88
1			250	20,68	98,2				2,08	-0,98			77,47
1			500	20,91	99,9				4,38	-1,80			78,97
1			1000	16,73	98,9				7,58	-1,80			82,16
1			2000	4,21	95,1				16,31	-1,80			90,89
1			4000	-35,29	88,7				49,41	-1,80			123,99
1			8000	-171,65	79,4				176,46	-1,80			251,04
10	3311	3317		19,07	104,0	2	0,00	81,42	-	-	0,00	0,00	-
10			63	8,09	84,9				0,35	-3,00			78,76
10			125	11,90	92,4				1,25	-0,20			82,47
10			250	14,93	97,1				3,72	-0,98			84,15
10			500	13,56	99,0				7,83	-1,80			87,45
10			1000	6,96	98,1				13,53	-1,80			93,15
10			2000	-12,29	94,5				29,13	-1,80			108,74
10			4000	-77,86	88,0				88,24	-1,80			167,86
10			8000	-314,03	78,7				315,14	-1,80			394,76

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

...continued from previous page

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
11	2776	2783		21,40	104,0	2	0,00	79,89	-	-	0,00	0,00	-
11			63	9,67	84,9				0,29	-3,00			77,18
11			125	13,63	92,4				1,05	-0,20			80,74
11			250	17,05	97,1				3,12	-0,98			82,02
11			500	16,35	99,0				6,57	-1,80			84,66
11			1000	10,67	98,1				11,35	-1,80			89,44
11			2000	-6,07	94,5				24,43	-1,80			102,52
11			4000	-62,11	88,0				74,02	-1,80			152,11
11			8000	-261,73	78,7				264,37	-1,80			342,46
12	3909	3914		16,82	104,0	2	0,00	82,85	-	-	0,00	0,00	-
12			63	6,59	84,9				0,41	-3,00			80,26
12			125	10,24	92,4				1,47	-0,20			84,13
12			250	12,82	97,1				4,38	-0,98			86,25
12			500	10,71	99,0				9,24	-1,80			90,29
12			1000	3,09	98,1				15,97	-1,80			97,02
12			2000	-18,96	94,5				34,37	-1,80			115,42
12			4000	-95,17	88,0				104,12	-1,80			185,17
12			8000	-372,18	78,7				371,85	-1,80			452,90
13	2712	2720		21,70	104,0	2	0,00	79,69	-	-	0,00	0,00	-
13			63	9,88	84,9				0,29	-3,00			76,98
13			125	13,85	92,4				1,02	-0,20			80,52
13			250	17,32	97,1				3,05	-0,98			81,75
13			500	16,70	99,0				6,42	-1,80			84,31
13			1000	11,13	98,1				11,10	-1,80			88,99
13			2000	-5,31	94,5				23,88	-1,80			101,77
13			4000	-60,23	88,0				72,34	-1,80			150,23
13			8000	-255,53	78,7				258,36	-1,80			336,25
2	2349	2354		22,62	104,9		0,00	78,44	-	-	0,00	0,00	-
2			63	10,84	86,5				0,25	-3,00			75,68
2			125	14,61	93,7				0,89	-0,20			79,13
2			250	18,07	98,2				2,64	-0,98			80,09
2			500	17,68	99,9				5,56	-1,80			82,20
2			1000	12,64	98,9				9,61	-1,80			86,24
2			2000	-2,21	95,1				20,67	-1,80			97,31
2			4000	-50,56	88,7				62,62	-1,80			139,26
2			8000	-220,90	79,4				223,66	-1,80			300,29
3	1212	1221		30,44	104,9		0,00	72,74	-	-	0,00	0,00	-
3			63	16,66	86,5				0,13	-3,00			69,86
3			125	20,74	93,7				0,46	-0,20			72,99
3			250	25,04	98,2				1,37	-0,98			73,12
3			500	26,05	99,9				2,88	-1,80			73,82
3			1000	22,97	98,9				4,98	-1,80			75,92
3			2000	13,44	95,1				10,72	-1,80			81,66
3			4000	-14,72	88,7				32,48	-1,80			103,42
3			8000	-107,55	79,4				116,01	-1,80			186,94
4	1554	1561		27,61	104,9		0,00	74,87	-	-	0,00	0,00	-
4			63	14,49	86,5				0,16	-3,00			72,03
4			125	18,47	93,7				0,59	-0,20			75,26
4			250	22,52	98,2				1,75	-0,98			75,63
4			500	23,12	99,9				3,68	-1,80			76,76
4			1000	19,45	98,9				6,37	-1,80			79,44
4			2000	8,32	95,1				13,71	-1,80			86,78
4			4000	-25,90	88,7				41,53	-1,80			114,60
4			8000	-141,99	79,4				148,31	-1,80			221,38
5	2003	2012		25,53	104,0	2	0,00	77,07	-	-	0,00	0,00	-
5			63	12,57	84,9				0,21	-3,00			74,29
5			125	16,73	92,4				0,76	-0,20			77,64
5			250	20,73	97,1				2,25	-0,98			78,34
5			500	20,98	99,0				4,75	-1,80			80,03
5			1000	16,63	98,1				8,21	-1,80			83,48
5			2000	3,51	94,5				17,67	-1,80			92,94
5			4000	-38,80	88,0				53,53	-1,80			128,80
5			8000	-185,72	78,7				191,17	-1,80			266,45
6	3386	3392		18,77	104,0	2	0,00	81,61	-	-	0,00	0,00	-

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
6			63	7,89	84,9				0,36	-3,00			78,97
6			125	11,68	92,4				1,28	-0,20			82,69
6			250	14,65	97,1				3,80	-0,98			84,42
6			500	13,19	99,0				8,01	-1,80			87,82
6			1000	6,46	98,1				13,84	-1,80			93,65
6			2000	-13,14	94,5				29,78	-1,80			109,59
6			4000	-80,05	88,0				90,24	-1,80			170,05
6			8000	-321,35	78,7				322,27	-1,80			402,08
7	2735	2742		21,59	104,0	2	0,00	79,76	-	-	0,00	0,00	-
7			63	9,80	84,9				0,29	-3,00			77,05
7			125	13,77	92,4				1,03	-0,20			80,60
7			250	17,22	97,1				3,07	-0,98			81,85
7			500	16,57	99,0				6,47	-1,80			84,44
7			1000	10,96	98,1				11,19	-1,80			89,15
7			2000	-5,59	94,5				24,08	-1,80			102,04
7			4000	-60,91	88,0				72,95	-1,80			150,91
7			8000	-257,77	78,7				260,54	-1,80			338,50
8	3526	3532		18,22	104,0	2	0,00	81,96	-	-	0,00	0,00	-
8			63	7,52	84,9				0,37	-3,00			79,33
8			125	11,27	92,4				1,33	-0,20			83,09
8			250	14,14	97,1				3,96	-0,98			84,93
8			500	12,51	99,0				8,34	-1,80			88,50
8			1000	5,54	98,1				14,41	-1,80			94,57
8			2000	-14,72	94,5				31,01	-1,80			111,17
8			4000	-84,12	88,0				93,96	-1,80			174,12
8			8000	-335,00	78,7				335,56	-1,80			415,72
9	2137	2146		24,73	104,0	2	0,00	77,63	-	-	0,00	0,00	-
9			63	12,00	84,9				0,23	-3,00			74,86
9			125	16,12	92,4				0,81	-0,20			78,24
9			250	20,02	97,1				2,40	-0,98			79,05
9			500	20,11	99,0				5,06	-1,80			80,90
9			1000	15,53	98,1				8,75	-1,80			84,59
9			2000	1,78	94,5				18,84	-1,80			94,67
9			4000	-42,91	88,0				57,08	-1,80			132,91
9			8000	-198,94	78,7				203,84	-1,80			279,67
Sum				35,54									
Sum			63	49,02									
Sum			125	42,91									
Sum			250	39,25									
Sum			500	34,09									
Sum			1000	26,86									
Sum			2000	14,47									
Sum			4000	-15,34									
Sum			8000	-106,45									

- Data undefined due to calculation with octave data

Noise sensitive area: G Lomarakennus G (Pohjanneva)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	7227	7229		8,14	104,9		0,00	88,18	-	-	0,00	0,00	-
1			63	1,60	86,5				0,76	-4,02			84,92
1			125	3,64	93,7				2,72	-0,81			90,09
1			250	3,47	98,2				8,10	-1,60			94,68
1			500	-2,96	99,9				17,06	-2,41			102,83
1			1000	-16,37	98,9				29,49	-2,41			115,26
1			2000	-54,14	95,1				63,47	-2,41			149,24
1			4000	-189,35	88,7				192,28	-2,41			278,05
1			8000	-693,10	79,4				686,72	-2,41			772,49
10	2881	2888		20,92	104,0	2	0,00	80,21	-	-	0,00	0,00	-
10			63	9,34	84,9				0,30	-3,00			77,51
10			125	13,26	92,4				1,09	-0,20			81,10
10			250	16,61	97,1				3,23	-0,98			82,46

To be continued on next page...

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DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

...continued from previous page

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
10			500	15,78	99,0				6,81	-1,80			85,23
10			1000	9,92	98,1				11,78	-1,80			90,19
10			2000	-7,31	94,5				25,35	-1,80			103,76
10			4000	-65,23	88,0				76,81	-1,80			155,22
10			8000	-272,01	78,7				274,33	-1,80			352,74
11	3655	3660		17,74	104,0	2	0,00	82,27	-	-	0,00	0,00	-
11			63	7,20	84,9				0,38	-3,00			79,65
11			125	10,92	92,4				1,38	-0,20			83,45
11			250	13,69	97,1				4,10	-0,98			85,38
11			500	11,90	99,0				8,64	-1,80			89,11
11			1000	4,71	98,1				14,93	-1,80			95,40
11			2000	-16,15	94,5				32,13	-1,80			112,60
11			4000	-87,82	88,0				97,35	-1,80			177,82
11			8000	-347,42	78,7				347,68	-1,80			428,14
12	2372	2380		23,42	104,0	2	0,00	78,53	-	-	0,00	0,00	-
12			63	11,07	84,9				0,25	-3,00			75,78
12			125	15,14	92,4				0,89	-0,20			79,23
12			250	18,86	97,1				2,67	-0,98			80,21
12			500	18,66	99,0				5,62	-1,80			82,35
12			1000	13,67	98,1				9,71	-1,80			86,44
12			2000	-1,17	94,5				20,90	-1,80			97,63
12			4000	-50,04	88,0				63,31	-1,80			140,04
12			8000	-222,10	78,7				226,09	-1,80			302,82
13	3451	3456		18,52	104,0	2	0,00	81,77	-	-	0,00	0,00	-
13			63	7,72	84,9				0,36	-3,00			79,13
13			125	11,49	92,4				1,30	-0,20			82,88
13			250	14,41	97,1				3,87	-0,98			84,66
13			500	12,88	99,0				8,16	-1,80			88,13
13			1000	6,04	98,1				14,10	-1,80			94,07
13			2000	-13,86	94,5				30,34	-1,80			110,31
13			4000	-81,90	88,0				91,93	-1,80			171,90
13			8000	-327,56	78,7				328,32	-1,80			408,29
2	6896	6897		8,73	104,9		0,00	87,77	-	-	0,00	0,00	-
2			63	1,95	86,5				0,72	-3,92			84,57
2			125	4,12	93,7				2,59	-0,75			89,62
2			250	4,20	98,2				7,72	-1,54			93,96
2			500	-1,83	99,9				16,28	-2,35			101,70
2			1000	-14,67	98,9				28,14	-2,35			113,56
2			2000	-50,88	95,1				60,56	-2,35			145,98
2			4000	-180,19	88,7				183,47	-2,35			268,88
2			8000	-661,26	79,4				655,24	-2,35			740,66
3	6531	6533		9,41	104,9		0,00	87,30	-	-	0,00	0,00	-
3			63	2,34	86,5				0,69	-3,81			84,18
3			125	4,66	93,7				2,46	-0,68			89,08
3			250	5,01	98,2				7,32	-1,47			93,15
3			500	-0,56	99,9				15,42	-2,28			100,44
3			1000	-12,78	98,9				26,65	-2,29			111,67
3			2000	-47,27	95,1				57,36	-2,29			142,38
3			4000	-170,09	88,7				173,78	-2,29			258,79
3			8000	-626,25	79,4				620,63	-2,29			705,65
4	7424	7426		7,80	104,9		0,00	88,41	-	-	0,00	0,00	-
4			63	1,40	86,5				0,78	-4,07			85,12
4			125	3,37	93,7				2,79	-0,84			90,37
4			250	3,05	98,2				8,32	-1,63			95,10
4			500	-3,63	99,9				17,52	-2,44			103,50
4			1000	-17,38	98,9				30,30	-2,44			116,27
4			2000	-56,07	95,1				65,20	-2,44			151,17
4			4000	-194,79	88,7				197,52	-2,44			283,49
4			8000	-712,01	79,4				705,43	-2,44			791,40
5	4378	4382		15,26	104,0	2	0,00	83,83	-	-	0,00	0,00	-
5			63	5,56	84,9				0,46	-3,00			81,29
5			125	9,08	92,4				1,65	-0,20			85,29
5			250	11,32	97,1				4,91	-0,98			87,76
5			500	8,63	99,0				10,34	-1,80			92,38

To be continued on next page...

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9.6.2020 20.38/3.3.247

DECIBEL - Detailed results

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

...continued from previous page

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
5			1000	0,20	98,1				17,88	-1,80			99,91
5			2000	-24,05	94,5				38,47	-1,80			120,51
5			4000	-108,59	88,0				116,56	-1,80			198,59
5			8000	-417,59	78,7				416,28	-1,80			498,32
6	3757	3762		17,36	104,0	2	0,00	82,51	-	-	0,00	0,00	-
6			63	6,95	84,9				0,40	-3,00			79,90
6			125	10,64	92,4				1,41	-0,20			83,73
6			250	13,33	97,1				4,21	-0,98			85,74
6			500	11,42	99,0				8,88	-1,80			89,59
6			1000	4,05	98,1				15,35	-1,80			96,06
6			2000	-17,29	94,5				33,03	-1,80			113,74
6			4000	-90,79	88,0				100,08	-1,80			180,79
6			8000	-357,41	78,7				357,43	-1,80			438,14
7	4186	4191		15,88	104,0	2	0,00	83,45	-	-	0,00	0,00	-
7			63	5,97	84,9				0,44	-3,00			80,89
7			125	9,54	92,4				1,58	-0,20			84,83
7			250	11,92	97,1				4,69	-0,98			87,15
7			500	9,47	99,0				9,89	-1,80			91,54
7			1000	1,37	98,1				17,10	-1,80			98,74
7			2000	-21,99	94,5				36,79	-1,80			118,44
7			4000	-103,12	88,0				111,47	-1,80			193,12
7			8000	-399,04	78,7				398,12	-1,80			479,77
8	3099	3105		19,96	104,0	2	0,00	80,84	-	-	0,00	0,00	-
8			63	8,69	84,9				0,33	-3,00			78,17
8			125	12,55	92,4				1,17	-0,20			81,81
8			250	15,74	97,1				3,48	-0,98			83,33
8			500	14,64	99,0				7,33	-1,80			86,37
8			1000	8,41	98,1				12,67	-1,80			91,71
8			2000	-9,84	94,5				27,26	-1,80			106,30
8			4000	-71,63	88,0				82,58	-1,80			161,62
8			8000	-293,26	78,7				294,94	-1,80			373,99
9	4028	4032		16,41	104,0	2	0,00	83,11	-	-	0,00	0,00	-
9			63	6,32	84,9				0,42	-3,00			80,53
9			125	9,93	92,4				1,52	-0,20			84,43
9			250	12,43	97,1				4,52	-0,98			86,64
9			500	10,18	99,0				9,52	-1,80			90,83
9			1000	2,35	98,1				16,45	-1,80			97,76
9			2000	-20,26	94,5				35,40	-1,80			116,71
9			4000	-98,57	88,0				107,25	-1,80			188,56
9			8000	-383,63	78,7				383,05	-1,80			464,36
Sum				28,88									
Sum			63	44,18									
Sum			125	37,77									
Sum			250	33,22									
Sum			500	26,59									
Sum			1000	17,31									
Sum			2000	-0,57									
Sum			4000	-50,88									
Sum			8000	-221,00									

- Data undefined due to calculation with octave data

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DECIBEL - Assumptions for noise calculation

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609

Noise calculation model:
ISO 9613-2 General
Wind speed (in 10 m height):
8,0 m/s
Ground attenuation:
General, Ground factor: 0,4
Meteorological coefficient, C0:
0,0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Fixed penalty added to source noise of WTGs with pure tones
WTG catalogue
Height above ground level, when no value in NSA object:
4,0 m; Don't allow override of model height with height from NSA object
Uncertainty margin:
0,0 dB; Uncertainty margin in NSA has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)
Octave data required
Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

WTG: VESTAS V150-4.2 4200 150.0 !O!
Noise: Level 0 - - Mode 0/PO1 - 10-2017

Source	Source/Date	Creator	Edited
Manufacturer	18.10.2017	USER	9.6.2020 17.59

Performance Specification 0067-7067 V05

					Octave data							
Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	155,0	8,0	104,9	No	86,5	93,7	98,2	99,9	98,9	95,1	88,7	79,4

WTG: VESTAS V162-5.6 HH180 5600 162.0 !O!
Noise: V162 - 5.6 MW Mode 0 STE + 2 dB(A)

Source	Source/Date	Creator	Edited
Vestas	11.4.2019	USER	9.6.2020 17.35

DMS no.: 0079-5298_01

						Octave data							
Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Penalty [dB]	63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	199,0	8,0	104,0	Yes	2,0	84,9	92,4	97,1	99,0	98,1	94,5	88,0	78,7

Noise sensitive area: A Asuinrakennus A (Hakuperäntie 202)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: B Asuinrakennus B (Hakuperäntie 169)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

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DECIBEL - Assumptions for noise calculation

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609

Noise sensitive area: C Asuinrakennus C (Säilyntie 285)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: D Asuinrakennus D (Säilyntie 264)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: E Lomarakennus E (Raudaskallion metsatie)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: F Lomarakennus F (Hirvinevanhaara 147)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: G Lomarakennus G (Pohjanneva)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

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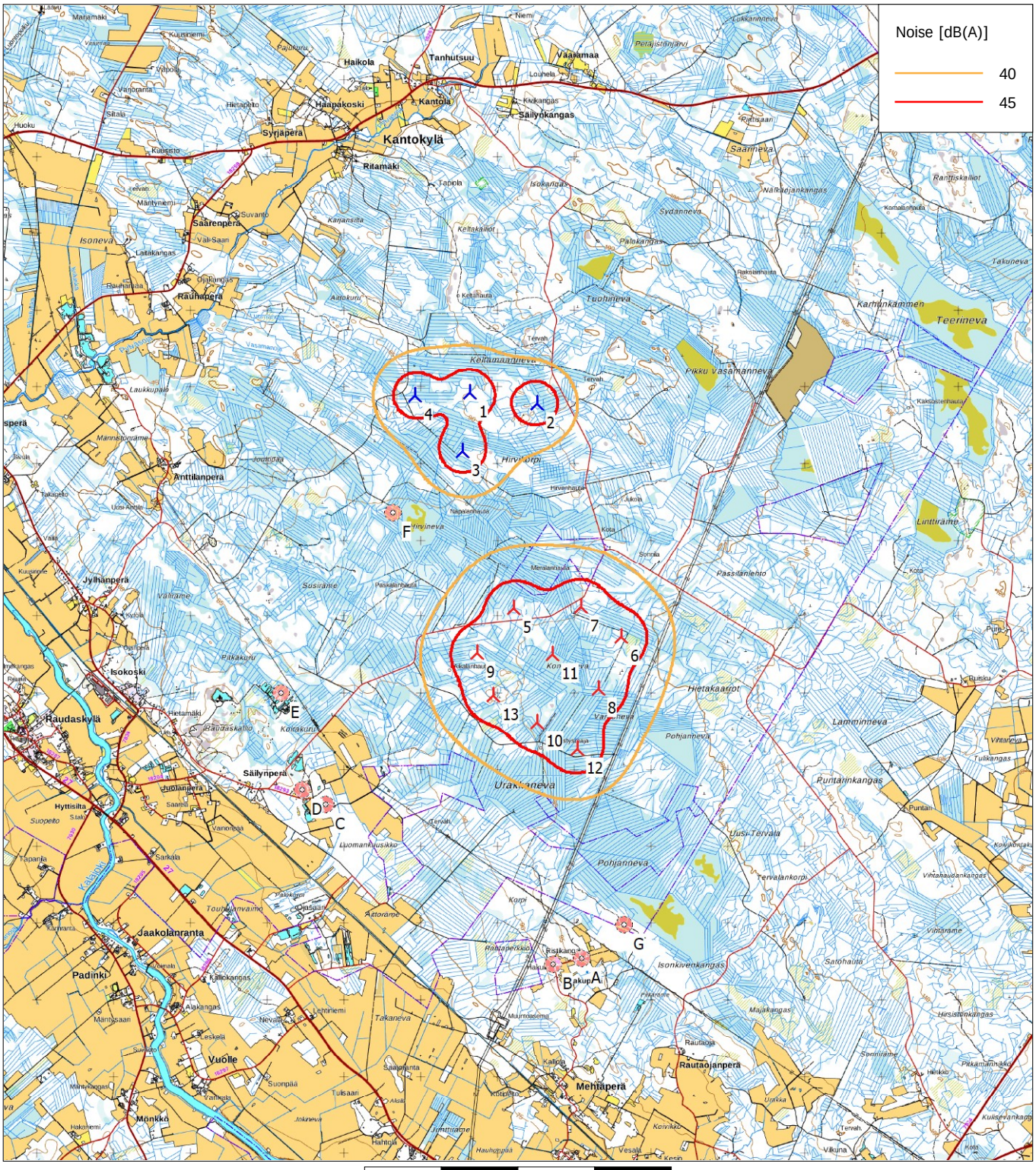
DECIBEL - Map 8,0 m/s

Calculation: Urakkaneva_V162-5.6MWx9xHH199_104.0dB+2.0dB_20200609



Map: Bitmap map: Q414.png , Print scale 1:75 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 396 273 North: 7 101 430

New WTG Noise sensitive area

Noise calculation model: ISO 9613-2 General. Wind speed: 8,0 m/s
Height above sea level from active line object

Urakkaneva_V162-5.6MWx9xHH199_20200514

Hirvineva_V150x4xHH155_2018

Urakkaneva laskentapisteet

Melutaso YM 2/2014

40 dB(A)

45 dB(A)

MML, mtk rakennuskanta 2020/05

Asuinrakennus

Liike- tai julkinen rakennus

Lomarakennus

1 2 3 4 5 6 7 8 9

A B C D E F G

0 1 2 3 4 km

Liite 2: N163 - Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2/2014

Project:
Urakkaneva_20200521

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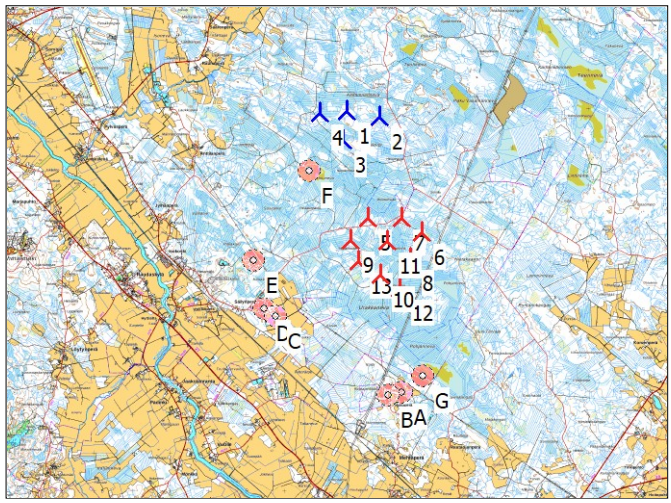
DECIBEL - Main Result

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609

Noise calculation model:
ISO 9613-2 General
Wind speed (in 10 m height):
8,0 m/s
Ground attenuation:
General, Ground factor: 0,4
Meteorological coefficient, C0:
0,0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Fixed penalty added to source noise of WTGs with pure tones
WTG catalogue
Height above ground level, when no value in NSA object:
4,0 m; Don't allow override of model height with height from NSA object
Uncertainty margin:
0,0 dB; Uncertainty margin in NSA has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)



Scale 1:200 000
New WTG
Noise sensitive area

WTGs

	East	North	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Creator	Name	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones
1	395638	7103907	90,4	VESTAS V150-4.2 4200 150.0 ...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	USER	Level 0 - - Mode 0/PO1 - 10-2017	8,0	104,9	No
2	396514	7103767	95,0	VESTAS V150-4.2 4200 150.0 ...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	USER	Level 0 - - Mode 0/PO1 - 10-2017	8,0	104,9	No
3	395550	7103150	89,6	VESTAS V150-4.2 4200 150.0 ...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	USER	Level 0 - - Mode 0/PO1 - 10-2017	8,0	104,9	No
4	394929	7103873	86,8	VESTAS V150-4.2 4200 150.0 ...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	USER	Level 0 - - Mode 0/PO1 - 10-2017	8,0	104,9	No
5	396213	7101101	93,0	NORDEX N163/5,7MW 5700 1...	Yes	NORDEX	N163/5,7MW-5700	5700	163,0	198,5	USER	N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB	8,0	109,2	Yes
6	397616	7100723	97,6	NORDEX N163/5,7MW 5700 1...	Yes	NORDEX	N163/5,7MW-5700	5700	163,0	198,5	USER	N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB	8,0	109,2	Yes
7	397086	7101114	95,0	NORDEX N163/5,7MW 5700 1...	Yes	NORDEX	N163/5,7MW-5700	5700	163,0	198,5	USER	N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB	8,0	109,2	Yes
8	397318	7100046	97,1	NORDEX N163/5,7MW 5700 1...	Yes	NORDEX	N163/5,7MW-5700	5700	163,0	198,5	USER	N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB	8,0	109,2	Yes
9	395742	7100512	93,3	NORDEX N163/5,7MW 5700 1...	Yes	NORDEX	N163/5,7MW-5700	5700	163,0	198,5	USER	N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB	8,0	109,2	Yes
10	396517	7099615	95,2	NORDEX N163/5,7MW 5700 1...	Yes	NORDEX	N163/5,7MW-5700	5700	163,0	198,5	USER	N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB	8,0	109,2	Yes
11	396717	7100499	95,4	NORDEX N163/5,7MW 5700 1...	Yes	NORDEX	N163/5,7MW-5700	5700	163,0	198,5	USER	N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB	8,0	109,2	Yes
12	397043	7099259	96,0	NORDEX N163/5,7MW 5700 1...	Yes	NORDEX	N163/5,7MW-5700	5700	163,0	198,5	USER	N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB	8,0	109,2	Yes
13	395944	7099965	95,0	NORDEX N163/5,7MW 5700 1...	Yes	NORDEX	N163/5,7MW-5700	5700	163,0	198,5	USER	N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB	8,0	109,2	Yes

Calculation Results

Sound level

Noise sensitive area No.	Name	East	North	Z [m]	Imission height [m]	Demands Noise [dB(A)]	Sound level From WTGs [dB(A)]	Distance to noise demand [m]
A	Asuinrakennus A (Hakuperäntie 202)	397098	7096526	95,0	4,0	40,0	31,2	1593
B	Asuinrakennus B (Hakuperäntie 169)	396724	7096452	92,5	4,0	40,0	31,0	1665
C	Asuinrakennus C (Säilyntie 285)	393762	7098532	81,7	4,0	40,0	32,7	1328
D	Asuinrakennus D (Säilyntie 264)	393460	7098729	84,2	4,0	40,0	32,0	1485
E	Lomarakennus E (Raudaskallion metsatie)	393183	7099996	87,5	4,0	40,0	32,5	1357
F	Lomarakennus F (Hirvinevanhaara 147)	394644	7102345	90,5	4,0	40,0	37,5	519
G	Lomarakennus G (Pohjanneva)	397651	7096966	97,5	4,0	40,0	32,6	1250

Distances (m)

WTG	A	B	C	D	E	F	G
1	7524	7533	5693	5618	4617	1851	7227
2	7264	7318	5915	5892	5031	2349	6896
3	6802	6800	4953	4890	3943	1212	6531
4	7660	7635	5467	5350	4252	1554	7424
5	4659	4676	3551	3634	3225	2003	4378
6	4228	4363	4434	4610	4493	3386	3757
7	4587	4675	4210	4340	4060	2735	4186
8	3527	3643	3866	4077	4136	3526	3099
9	4210	4177	2800	2896	2610	2137	4028
10	3142	3169	2961	3183	3356	3311	2881
11	3991	4047	3550	3707	3569	2776	3655
12	2733	2824	3361	3621	3930	3909	2372
13	3627	3598	2611	2775	2762	2712	3451

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9.6.2020 21.23/3.3.247

DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

Assumptions

Calculated L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet
(when calculated with ground attenuation, then Dc = Domega)

LWA,ref:	Sound pressure level at WTG
K:	Pure tone
Dc:	Directivity correction
Adiv:	the attenuation due to geometrical divergence
Aatm:	the attenuation due to atmospheric absorption
Agr:	the attenuation due to ground effect
Abar:	the attenuation due to a barrier
Amisc:	the attenuation due to miscellaneous other effects
Cmet:	Meteorological correction

Calculation Results

Noise sensitive area: A Asuinrakennus A (Hakuperäntie 202)

Wind speed: 8,0 m/s
WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	7524	7525		7,63	104,9		0,00	88,53	-	-	0,00	0,00	-
1			63	1,30	86,5				0,79	-4,10			85,22
1			125	3,23	93,7				2,83	-0,85			90,51
1			250	2,84	98,2				8,43	-1,64			95,31
1			500	-3,96	99,9				17,76	-2,46			103,83
1			1000	-17,89	98,9				30,70	-2,46			116,77
1			2000	-57,04	95,1				66,07	-2,46			152,14
1			4000	-197,54	88,7				200,17	-2,46			286,24
1			8000	-721,56	79,4				714,88	-2,46			800,96
10	3142	3148		23,61	109,2	2	0,00	80,96	-	-	0,00	0,00	-
10			63	13,23	89,5				0,33	-3,00			78,29
10			125	15,70	95,7				1,18	-0,20			81,95
10			250	18,43	99,9				3,53	-0,98			83,50
10			500	18,60	103,2				7,43	-1,80			86,60
10			1000	14,55	104,6				12,85	-1,80			92,01
10			2000	-2,57	102,2				27,64	-1,80			106,81
10			4000	-67,49	93,4				83,75	-1,80			162,91
10			8000	-291,70	84,6				299,10	-1,80			378,26
11	3991	3996		20,23	109,2	2	0,00	83,03	-	-	0,00	0,00	-
11			63	11,07	89,5				0,42	-3,00			80,45
11			125	13,32	95,7				1,50	-0,20			84,34
11			250	15,41	99,9				4,48	-0,98			86,52
11			500	14,53	103,2				9,43	-1,80			90,66
11			1000	9,02	104,6				16,30	-1,80			97,53
11			2000	-12,07	102,2				35,08	-1,80			116,31
11			4000	-92,09	93,4				106,28	-1,80			187,52
11			8000	-374,25	84,6				379,59	-1,80			460,82
12	2733	2740		25,54	109,2	2	0,00	79,75	-	-	0,00	0,00	-
12			63	14,48	89,5				0,29	-3,00			77,04
12			125	17,06	95,7				1,03	-0,20			80,59
12			250	20,10	99,9				3,07	-0,98			81,84
12			500	20,77	103,2				6,47	-1,80			84,42
12			1000	17,43	104,6				11,18	-1,80			89,13
12			2000	2,23	102,2				24,05	-1,80			102,01
12			4000	-55,40	93,4				72,88	-1,80			150,83
12			8000	-251,66	84,6				260,27	-1,80			338,22
13	3627	3632		21,59	109,2	2	0,00	82,20	-	-	0,00	0,00	-
13			63	11,93	89,5				0,38	-3,00			79,58
13			125	14,28	95,7				1,37	-0,20			83,37
13			250	16,65	99,9				4,07	-0,98			85,29
13			500	16,22	103,2				8,57	-1,80			88,98
13			1000	11,34	104,6				14,82	-1,80			95,22
13			2000	-8,05	102,2				31,89	-1,80			112,29

To be continued on next page...

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

...continued from previous page

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
13			4000	-81,59	93,4				96,61	-1,80			177,02
13			8000	-338,88	84,6				345,05	-1,80			425,45
2	7264	7266		8,07	104,9		0,00	88,23	-	-	0,00	0,00	-
2			63	1,56	86,5				0,76	-4,03			84,96
2			125	3,59	93,7				2,73	-0,81			90,14
2			250	3,39	98,2				8,14	-1,60			94,76
2			500	-3,08	99,9				17,15	-2,41			102,96
2			1000	-16,56	98,9				29,64	-2,42			115,45
2			2000	-54,50	95,1				63,79	-2,42			149,60
2			4000	-190,38	88,7				193,27	-2,42			279,08
2			8000	-696,66	79,4				690,24	-2,42			776,05
3	6802	6804		8,90	104,9		0,00	87,65	-	-	0,00	0,00	-
3			63	2,05	86,5				0,71	-3,90			84,47
3			125	4,25	93,7				2,56	-0,73			89,48
3			250	4,40	98,2				7,62	-1,52			93,75
3			500	-1,50	99,9				16,06	-2,33			101,38
3			1000	-14,19	98,9				27,76	-2,34			113,08
3			2000	-49,95	95,1				59,74	-2,34			145,05
3			4000	-177,60	88,7				180,98	-2,34			266,30
3			8000	-652,28	79,4				646,35	-2,34			731,67
4	7660	7661		7,40	104,9		0,00	88,69	-	-	0,00	0,00	-
4			63	1,16	86,5				0,80	-4,13			85,36
4			125	3,04	93,7				2,88	-0,87			90,69
4			250	2,55	98,2				8,58	-1,66			95,60
4			500	-4,42	99,9				18,08	-2,48			104,29
4			1000	-18,58	98,9				31,26	-2,48			117,47
4			2000	-58,37	95,1				67,27	-2,48			153,48
4			4000	-201,30	88,7				203,80	-2,48			290,00
4			8000	-734,66	79,4				727,84	-2,48			814,05
5	4659	4663		18,01	109,2	2	0,00	84,37	-	-	0,00	0,00	-
5			63	9,66	89,5				0,49	-3,00			81,86
5			125	11,72	95,7				1,75	-0,20			85,93
5			250	13,33	99,9				5,22	-0,98			88,61
5			500	11,62	103,2				11,00	-1,80			93,58
5			1000	4,96	104,6				19,03	-1,80			101,60
5			2000	-19,28	102,2				40,94	-1,80			123,52
5			4000	-111,19	93,4				124,04	-1,80			206,61
5			8000	-439,00	84,6				443,00	-1,80			525,57
6	4228	4233		19,40	109,2	2	0,00	83,53	-	-	0,00	0,00	-
6			63	10,54	89,5				0,44	-3,00			80,98
6			125	12,72	95,7				1,59	-0,20			84,93
6			250	14,65	99,9				4,74	-0,98			87,29
6			500	13,47	103,2				9,99	-1,80			91,73
6			1000	7,55	104,6				17,27	-1,80			99,00
6			2000	-14,66	102,2				37,17	-1,80			118,90
6			4000	-98,91	93,4				112,60	-1,80			194,33
6			8000	-397,30	84,6				402,14	-1,80			483,87
7	4587	4592		18,23	109,2	2	0,00	84,24	-	-	0,00	0,00	-
7			63	9,80	89,5				0,48	-3,00			81,72
7			125	11,88	95,7				1,73	-0,20			85,77
7			250	13,54	99,9				5,14	-0,98			88,40
7			500	11,92	103,2				10,84	-1,80			93,28
7			1000	5,38	104,6				18,73	-1,80			101,17
7			2000	-18,51	102,2				40,31	-1,80			122,75
7			4000	-109,15	93,4				122,14	-1,80			204,58
7			8000	-432,07	84,6				436,20	-1,80			518,64
8	3527	3532		21,99	109,2	2	0,00	81,96	-	-	0,00	0,00	-
8			63	12,19	89,5				0,37	-3,00			79,33
8			125	14,56	95,7				1,33	-0,20			83,09
8			250	17,00	99,9				3,96	-0,98			84,93
8			500	16,70	103,2				8,34	-1,80			88,50
8			1000	11,98	104,6				14,41	-1,80			94,57
8			2000	-6,94	102,2				31,01	-1,80			111,18
8			4000	-78,70	93,4				93,96	-1,80			174,12

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
8			8000	-329,17	84,6				335,58	-1,80			415,74
9	4210	4215		19,47	109,2	2	0,00	83,50	-	-	0,00	0,00	-
9			63	10,58	89,5				0,44	-3,00			80,94
9			125	12,77	95,7				1,58	-0,20			84,88
9			250	14,71	99,9				4,72	-0,98			87,23
9			500	13,55	103,2				9,95	-1,80			91,65
9			1000	7,67	104,6				17,20	-1,80			98,89
9			2000	-14,46	102,2				37,00	-1,80			118,70
9			4000	-98,38	93,4				112,11	-1,80			193,80
9			8000	-395,51	84,6				400,39	-1,80			482,08
Sum				31,23									
Sum			63	47,70									
Sum			125	39,94									
Sum			250	34,78									
Sum			500	29,07									
Sum			1000	21,44									
Sum			2000	3,18									
Sum			4000	-56,11									
Sum			8000	-250,56									

- Data undefined due to calculation with octave data

Noise sensitive area: B Asuinrakennus B (Hakuperäntie 169)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	7533	7535		7,61	104,9		0,00	88,54	-	-	0,00	0,00	-
1			63	1,29	86,5				0,79	-4,10			85,23
1			125	3,22	93,7				2,83	-0,86			90,52
1			250	2,82	98,2				8,44	-1,65			95,34
1			500	-3,99	99,9				17,78	-2,46			103,87
1			1000	-17,94	98,9				30,74	-2,46			116,82
1			2000	-57,14	95,1				66,16	-2,46			152,24
1			4000	-197,81	88,7				200,43	-2,46			286,51
1			8000	-722,50	79,4				715,81	-2,46			801,89
10	3169	3175		23,49	109,2	2	0,00	81,04	-	-	0,00	0,00	-
10			63	13,15	89,5				0,33	-3,00			78,37
10			125	15,62	95,7				1,19	-0,20			82,03
10			250	18,33	99,9				3,56	-0,98			83,61
10			500	18,47	103,2				7,49	-1,80			86,73
10			1000	14,37	104,6				12,95	-1,80			92,19
10			2000	-2,87	102,2				27,88	-1,80			107,11
10			4000	-68,27	93,4				84,46	-1,80			163,69
10			8000	-294,30	84,6				301,64	-1,80			380,87
11	4047	4051		20,03	109,2	2	0,00	83,15	-	-	0,00	0,00	-
11			63	10,94	89,5				0,43	-3,00			80,58
11			125	13,17	95,7				1,52	-0,20			84,48
11			250	15,23	99,9				4,54	-0,98			86,70
11			500	14,28	103,2				9,56	-1,80			90,92
11			1000	8,68	104,6				16,53	-1,80			97,88
11			2000	-12,68	102,2				35,57	-1,80			116,92
11			4000	-93,69	93,4				107,77	-1,80			189,12
11			8000	-379,66	84,6				384,88	-1,80			466,23
12	2824	2831		25,08	109,2	2	0,00	80,04	-	-	0,00	0,00	-
12			63	14,18	89,5				0,30	-3,00			77,34
12			125	16,75	95,7				1,06	-0,20			80,91
12			250	19,71	99,9				3,17	-0,98			82,22
12			500	20,27	103,2				6,68	-1,80			84,92
12			1000	16,77	104,6				11,55	-1,80			89,79
12			2000	1,15	102,2				24,86	-1,80			103,09
12			4000	-58,12	93,4				75,30	-1,80			153,54
12			8000	-260,62	84,6				268,94	-1,80			347,18
13	3598	3603		21,70	109,2	2	0,00	82,13	-	-	0,00	0,00	-
13			63	12,01	89,5				0,38	-3,00			79,51

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9.6.2020 21.23/3.3.247

DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
13			125	14,36	95,7				1,35	-0,20			83,29
13			250	16,75	99,9				4,04	-0,98			85,18
13			500	16,36	103,2				8,50	-1,80			88,84
13			1000	11,52	104,6				14,70	-1,80			95,04
13			2000	-7,73	102,2				31,64	-1,80			111,97
13			4000	-80,76	93,4				95,85	-1,80			176,18
13			8000	-336,08	84,6				342,32	-1,80			422,65
2	7318	7319		7,98	104,9		0,00	88,29	-	-	0,00	0,00	-
2			63	1,51	86,5				0,77	-4,04			85,01
2			125	3,52	93,7				2,75	-0,82			90,22
2			250	3,28	98,2				8,20	-1,61			94,88
2			500	-3,27	99,9				17,27	-2,42			103,14
2			1000	-16,84	98,9				29,86	-2,43			115,72
2			2000	-55,02	95,1				64,26	-2,43			150,13
2			4000	-191,86	88,7				194,69	-2,43			280,55
2			8000	-701,80	79,4				695,32	-2,43			781,19
3	6800	6801		8,91	104,9		0,00	87,65	-	-	0,00	0,00	-
3			63	2,05	86,5				0,71	-3,90			84,47
3			125	4,26	93,7				2,56	-0,73			89,48
3			250	4,41	98,2				7,62	-1,52			93,75
3			500	-1,50	99,9				16,05	-2,33			101,37
3			1000	-14,18	98,9				27,75	-2,34			113,06
3			2000	-49,93	95,1				59,72	-2,34			145,03
3			4000	-177,53	88,7				180,92	-2,34			266,23
3			8000	-652,05	79,4				646,13	-2,34			731,44
4	7635	7636		7,44	104,9		0,00	88,66	-	-	0,00	0,00	-
4			63	1,19	86,5				0,80	-4,13			85,33
4			125	3,08	93,7				2,87	-0,87			90,66
4			250	2,61	98,2				8,55	-1,66			95,55
4			500	-4,33	99,9				18,02	-2,47			104,21
4			1000	-18,45	98,9				31,16	-2,48			117,34
4			2000	-58,13	95,1				67,04	-2,48			153,23
4			4000	-200,60	88,7				203,12	-2,48			289,30
4			8000	-732,22	79,4				725,43	-2,48			811,61
5	4676	4680		17,96	109,2	2	0,00	84,41	-	-	0,00	0,00	-
5			63	9,62	89,5				0,49	-3,00			81,90
5			125	11,68	95,7				1,76	-0,20			85,97
5			250	13,27	99,9				5,24	-0,98			88,66
5			500	11,54	103,2				11,05	-1,80			93,65
5			1000	4,86	104,6				19,10	-1,80			101,70
5			2000	-19,46	102,2				41,09	-1,80			123,70
5			4000	-111,68	93,4				124,50	-1,80			207,10
5			8000	-440,67	84,6				444,63	-1,80			527,24
6	4363	4367		18,96	109,2	2	0,00	83,80	-	-	0,00	0,00	-
6			63	10,26	89,5				0,46	-3,00			81,26
6			125	12,40	95,7				1,64	-0,20			85,25
6			250	14,23	99,9				4,89	-0,98			87,71
6			500	12,88	103,2				10,31	-1,80			92,31
6			1000	6,74	104,6				17,82	-1,80			99,82
6			2000	-16,11	102,2				38,34	-1,80			120,35
6			4000	-102,75	93,4				116,17	-1,80			198,17
6			8000	-410,32	84,6				414,89	-1,80			496,89
7	4675	4680		17,96	109,2	2	0,00	84,40	-	-	0,00	0,00	-
7			63	9,62	89,5				0,49	-3,00			81,90
7			125	11,69	95,7				1,76	-0,20			85,97
7			250	13,28	99,9				5,24	-0,98			88,66
7			500	11,55	103,2				11,04	-1,80			93,65
7			1000	4,86	104,6				19,09	-1,80			101,70
7			2000	-19,45	102,2				41,09	-1,80			123,69
7			4000	-111,66	93,4				124,48	-1,80			207,08
7			8000	-440,60	84,6				444,56	-1,80			527,16
8	3643	3648		21,53	109,2	2	0,00	82,24	-	-	0,00	0,00	-
8			63	11,89	89,5				0,38	-3,00			79,62
8			125	14,24	95,7				1,37	-0,20			83,42

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
8			250	16,59	99,9				4,09	-0,98			85,34
8			500	16,14	103,2				8,61	-1,80			89,05
8			1000	11,23	104,6				14,88	-1,80			95,33
8			2000	-8,23	102,2				32,03	-1,80			112,47
8			4000	-82,06	93,4				97,04	-1,80			177,48
8			8000	-340,45	84,6				346,58	-1,80			427,02
9	4177	4181		19,58	109,2	2	0,00	83,43	-	-	0,00	0,00	-
9			63	10,65	89,5				0,44	-3,00			80,87
9			125	12,85	95,7				1,57	-0,20			84,80
9			250	14,81	99,9				4,68	-0,98			87,12
9			500	13,70	103,2				9,87	-1,80			91,50
9			1000	7,87	104,6				17,06	-1,80			98,69
9			2000	-14,10	102,2				36,71	-1,80			118,34
9			4000	-97,43	93,4				111,23	-1,80			192,85
9			8000	-392,29	84,6				397,24	-1,80			478,86
Sum				30,99									
Sum			63	47,56									
Sum			125	39,78									
Sum			250	34,58									
Sum			500	28,78									
Sum			1000	21,03									
Sum			2000	2,37									
Sum			4000	-58,68									
Sum			8000	-259,51									

- Data undefined due to calculation with octave data

Noise sensitive area: C Asuinrakennus C (Säilyntie 285)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5693	5696		11,11	104,9		0,00	86,11	-	-	0,00	0,00	-
1			63	3,30	86,5				0,60	-3,49			83,22
1			125	5,97	93,7				2,14	-0,49			87,77
1			250	6,94	98,2				6,38	-1,28			91,21
1			500	2,41	99,9				13,44	-2,09			97,46
1			1000	-8,37	98,9				23,24	-2,09			107,26
1			2000	-38,93	95,1				50,01	-2,09			134,03
1			4000	-146,83	88,7				151,51	-2,09			235,52
1			8000	-545,72	79,4				541,09	-2,09			625,11
10	2961	2968		24,43	109,2	2	0,00	80,45	-	-	0,00	0,00	-
10			63	13,76	89,5				0,31	-3,00			77,76
10			125	16,28	95,7				1,12	-0,20			81,37
10			250	19,15	99,9				3,32	-0,98			82,79
10			500	19,54	103,2				7,00	-1,80			85,66
10			1000	15,80	104,6				12,11	-1,80			90,76
10			2000	-0,47	102,2				26,06	-1,80			104,71
10			4000	-62,18	93,4				78,95	-1,80			157,60
10			8000	-274,06	84,6				281,98	-1,80			360,63
11	3550	3556		21,89	109,2	2	0,00	82,02	-	-	0,00	0,00	-
11			63	12,13	89,5				0,37	-3,00			79,39
11			125	14,49	95,7				1,34	-0,20			83,16
11			250	16,92	99,9				3,98	-0,98			85,02
11			500	16,58	103,2				8,39	-1,80			88,62
11			1000	11,83	104,6				14,51	-1,80			94,73
11			2000	-7,20	102,2				31,22	-1,80			111,44
11			4000	-79,39	93,4				94,59	-1,80			174,81
11			8000	-331,48	84,6				337,83	-1,80			418,05
12	3361	3367		22,66	109,2	2	0,00	81,55	-	-	0,00	0,00	-
12			63	12,62	89,5				0,35	-3,00			78,90
12			125	15,04	95,7				1,27	-0,20			82,62
12			250	17,61	99,9				3,77	-0,98			84,33
12			500	17,50	103,2				7,95	-1,80			87,69
12			1000	13,07	104,6				13,74	-1,80			93,48

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

...continued from previous page

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
12			2000	-5,07	102,2				29,56	-1,80			109,31
12			4000	-73,88	93,4				89,56	-1,80			169,31
12			8000	-313,05	84,6				319,87	-1,80			399,62
13	2611	2619		26,15	109,2	2	0,00	79,36	-	-	0,00	0,00	-
13			63	14,88	89,5				0,28	-3,00			76,64
13			125	17,50	95,7				0,98	-0,20			80,15
13			250	20,62	99,9				2,93	-0,98			81,31
13			500	21,45	103,2				6,18	-1,80			83,75
13			1000	18,31	104,6				10,69	-1,80			88,25
13			2000	3,68	102,2				23,00	-1,80			100,56
13			4000	-51,81	93,4				69,67	-1,80			147,24
13			8000	-239,83	84,6				248,83	-1,80			326,40
2	5915	5917		10,64	104,9		0,00	86,44	-	-	0,00	0,00	-
2			63	3,04	86,5				0,62	-3,58			83,48
2			125	5,61	93,7				2,22	-0,54			88,12
2			250	6,42	98,2				6,63	-1,33			91,74
2			500	1,61	99,9				13,96	-2,14			98,26
2			1000	-9,55	98,9				24,14	-2,15			108,44
2			2000	-41,14	95,1				51,95	-2,15			136,25
2			4000	-152,99	88,7				157,39	-2,15			241,69
2			8000	-567,02	79,4				562,12	-2,15			646,42
3	4953	4955		12,80	104,9		0,00	84,90	-	-	0,00	0,00	-
3			63	4,21	86,5				0,52	-3,11			82,31
3			125	7,23	93,7				1,86	-0,26			86,50
3			250	8,76	98,2				5,55	-1,05			89,40
3			500	5,14	99,9				11,69	-1,86			94,73
3			1000	-4,36	98,9				20,22	-1,87			103,25
3			2000	-31,44	95,1				43,51	-1,87			126,54
3			4000	-126,14	88,7				131,81	-1,87			214,84
3			8000	-474,38	79,4				470,73	-1,87			553,77
4	5467	5470		11,61	104,9		0,00	85,76	-	-	0,00	0,00	-
4			63	3,57	86,5				0,57	-3,38			82,95
4			125	6,34	93,7				2,06	-0,43			87,39
4			250	7,48	98,2				6,13	-1,21			90,67
4			500	3,23	99,9				12,91	-2,03			96,64
4			1000	-7,16	98,9				22,32	-2,03			106,05
4			2000	-36,65	95,1				48,02	-2,03			131,75
4			4000	-140,53	88,7				145,49	-2,03			229,22
4			8000	-523,96	79,4				519,62	-2,03			603,35
5	3551	3557		21,89	109,2	2	0,00	82,02	-	-	0,00	0,00	-
5			63	12,12	89,5				0,37	-3,00			79,40
5			125	14,49	95,7				1,34	-0,20			83,16
5			250	16,92	99,9				3,98	-0,98			85,02
5			500	16,58	103,2				8,39	-1,80			88,62
5			1000	11,82	104,6				14,51	-1,80			94,73
5			2000	-7,21	102,2				31,23	-1,80			111,45
5			4000	-79,41	93,4				94,62	-1,80			174,84
5			8000	-331,57	84,6				337,91	-1,80			418,13
6	4434	4439		18,72	109,2	2	0,00	83,95	-	-	0,00	0,00	-
6			63	10,11	89,5				0,47	-3,00			81,41
6			125	12,23	95,7				1,67	-0,20			85,42
6			250	14,00	99,9				4,97	-0,98			87,93
6			500	12,57	103,2				10,48	-1,80			92,63
6			1000	6,30	104,6				18,11	-1,80			100,26
6			2000	-16,88	102,2				38,98	-1,80			121,12
6			4000	-104,80	93,4				118,08	-1,80			200,23
6			8000	-417,29	84,6				421,72	-1,80			503,86
7	4210	4215		19,47	109,2	2	0,00	83,50	-	-	0,00	0,00	-
7			63	10,58	89,5				0,44	-3,00			80,94
7			125	12,77	95,7				1,58	-0,20			84,88
7			250	14,71	99,9				4,72	-0,98			87,23
7			500	13,55	103,2				9,95	-1,80			91,65
7			1000	7,67	104,6				17,20	-1,80			98,89
7			2000	-14,46	102,2				37,01	-1,80			118,70

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
7			4000	-98,39	93,4				112,12	-1,80			193,81
7			8000	-395,54	84,6				400,41	-1,80			482,11
8	3866	3872		20,68	109,2	2	0,00	82,76	-	-	0,00	0,00	-
8			63	11,35	89,5				0,41	-3,00			80,16
8			125	13,64	95,7				1,46	-0,20			84,02
8			250	15,83	99,9				4,34	-0,98			86,11
8			500	15,10	103,2				9,14	-1,80			90,10
8			1000	9,80	104,6				15,80	-1,80			96,75
8			2000	-10,71	102,2				33,99	-1,80			114,95
8			4000	-88,52	93,4				102,98	-1,80			183,94
8			8000	-362,19	84,6				367,80	-1,80			448,75
9	2800	2808		25,20	109,2	2	0,00	79,97	-	-	0,00	0,00	-
9			63	14,26	89,5				0,29	-3,00			77,26
9			125	16,83	95,7				1,06	-0,20			80,83
9			250	19,81	99,9				3,14	-0,98			82,13
9			500	20,40	103,2				6,63	-1,80			84,80
9			1000	16,93	104,6				11,46	-1,80			89,62
9			2000	1,42	102,2				24,65	-1,80			102,82
9			4000	-57,43	93,4				74,69	-1,80			152,86
9			8000	-258,35	84,6				266,75	-1,80			344,92
Sum				32,68									
Sum			63	48,67									
Sum			125	41,03									
Sum			250	36,12									
Sum			500	30,74									
Sum			1000	23,55									
Sum			2000	6,16									
Sum			4000	-51,43									
Sum			8000	-238,67									

- Data undefined due to calculation with octave data

Noise sensitive area: D Asuinrakennus D (Säilyntie 264)

Wind speed: 8,0 m/s

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	5618	5620		11,28	104,9		0,00	85,99	-	-	0,00	0,00	-
1			63	3,39	86,5				0,59	-3,45			83,13
1			125	6,09	93,7				2,11	-0,47			87,64
1			250	7,12	98,2				6,29	-1,26			91,03
1			500	2,68	99,9				13,26	-2,07			97,19
1			1000	-7,97	98,9				22,93	-2,07			106,85
1			2000	-38,17	95,1				49,34	-2,07			133,27
1			4000	-144,72	88,7				149,49	-2,07			233,41
1			8000	-538,43	79,4				533,90	-2,07			617,82
10	3183	3190		23,43	109,2	2	0,00	81,07	-	-	0,00	0,00	-
10			63	13,11	89,5				0,33	-3,00			78,41
10			125	15,58	95,7				1,20	-0,20			82,08
10			250	18,27	99,9				3,57	-0,98			83,66
10			500	18,39	103,2				7,53	-1,80			86,81
10			1000	14,27	104,6				13,01	-1,80			92,29
10			2000	-3,04	102,2				28,00	-1,80			107,28
10			4000	-68,69	93,4				84,84	-1,80			164,12
10			8000	-295,71	84,6				303,01	-1,80			382,28
11	3707	3712		21,28	109,2	2	0,00	82,39	-	-	0,00	0,00	-
11			63	11,74	89,5				0,39	-3,00			79,78
11			125	14,06	95,7				1,40	-0,20			83,59
11			250	16,37	99,9				4,16	-0,98			85,57
11			500	15,84	103,2				8,76	-1,80			89,36
11			1000	10,82	104,6				15,15	-1,80			95,74
11			2000	-8,95	102,2				32,59	-1,80			113,19
11			4000	-83,91	93,4				98,75	-1,80			179,34
11			8000	-346,69	84,6				352,67	-1,80			433,26
12	3621	3627		21,61	109,2	2	0,00	82,19	-	-	0,00	0,00	-

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
12			63	11,95	89,5				0,38	-3,00			79,57
12			125	14,29	95,7				1,36	-0,20			83,36
12			250	16,67	99,9				4,06	-0,98			85,27
12			500	16,24	103,2				8,56	-1,80			88,96
12			1000	11,37	104,6				14,80	-1,80			95,19
12			2000	-8,00	102,2				31,85	-1,80			112,24
12			4000	-81,45	93,4				96,49	-1,80			176,88
12			8000	-338,42	84,6				344,59	-1,80			424,99
13	2775	2782		25,32	109,2	2	0,00	79,89	-	-	0,00	0,00	-
13			63	14,34	89,5				0,29	-3,00			77,18
13			125	16,92	95,7				1,05	-0,20			80,74
13			250	19,92	99,9				3,12	-0,98			82,02
13			500	20,54	103,2				6,57	-1,80			84,66
13			1000	17,12	104,6				11,35	-1,80			89,44
13			2000	1,72	102,2				24,43	-1,80			102,52
13			4000	-56,67	93,4				74,01	-1,80			152,09
13			8000	-255,83	84,6				264,31	-1,80			342,40
2	5892	5894		10,69	104,9		0,00	86,41	-	-	0,00	0,00	-
2			63	3,07	86,5				0,62	-3,57			83,46
2			125	5,65	93,7				2,22	-0,54			88,09
2			250	6,47	98,2				6,60	-1,33			91,68
2			500	1,70	99,9				13,91	-2,14			98,18
2			1000	-9,43	98,9				24,05	-2,14			108,31
2			2000	-40,91	95,1				51,75	-2,14			136,01
2			4000	-152,34	88,7				156,78	-2,14			241,04
2			8000	-564,79	79,4				559,92	-2,14			644,18
3	4890	4893		12,95	104,9		0,00	84,79	-	-	0,00	0,00	-
3			63	4,29	86,5				0,51	-3,07			82,23
3			125	7,34	93,7				1,84	-0,24			86,39
3			250	8,91	98,2				5,48	-1,03			89,24
3			500	5,38	99,9				11,55	-1,84			94,50
3			1000	-4,02	98,9				19,96	-1,84			102,91
3			2000	-30,81	95,1				42,96	-1,84			125,91
3			4000	-124,40	88,7				130,15	-1,84			213,10
3			8000	-468,39	79,4				464,83	-1,84			547,78
4	5350	5352		11,87	104,9		0,00	85,57	-	-	0,00	0,00	-
4			63	3,71	86,5				0,56	-3,33			82,81
4			125	6,54	93,7				2,01	-0,39			87,19
4			250	7,77	98,2				5,99	-1,18			90,39
4			500	3,66	99,9				12,63	-1,99			96,21
4			1000	-6,53	98,9				21,84	-2,00			105,41
4			2000	-35,47	95,1				46,99	-2,00			130,57
4			4000	-137,25	88,7				142,37	-2,00			225,95
4			8000	-512,65	79,4				508,46	-2,00			592,04
5	3634	3640		21,56	109,2	2	0,00	82,22	-	-	0,00	0,00	-
5			63	11,92	89,5				0,38	-3,00			79,60
5			125	14,26	95,7				1,37	-0,20			83,39
5			250	16,62	99,9				4,08	-0,98			85,31
5			500	16,18	103,2				8,59	-1,80			89,01
5			1000	11,29	104,6				14,85	-1,80			95,27
5			2000	-8,14	102,2				31,96	-1,80			112,38
5			4000	-81,81	93,4				96,81	-1,80			177,23
5			8000	-339,61	84,6				345,76	-1,80			426,18
6	4610	4615		18,16	109,2	2	0,00	84,28	-	-	0,00	0,00	-
6			63	9,75	89,5				0,48	-3,00			81,77
6			125	11,83	95,7				1,74	-0,20			85,82
6			250	13,47	99,9				5,17	-0,98			88,47
6			500	11,82	103,2				10,89	-1,80			93,38
6			1000	5,25	104,6				18,83	-1,80			101,31
6			2000	-18,76	102,2				40,52	-1,80			123,00
6			4000	-109,81	93,4				122,75	-1,80			205,23
6			8000	-434,31	84,6				438,39	-1,80			520,87
7	4340	4345		19,03	109,2	2	0,00	83,76	-	-	0,00	0,00	-
7			63	10,30	89,5				0,46	-3,00			81,22

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
7			125	12,46	95,7				1,63	-0,20			85,20
7			250	14,29	99,9				4,87	-0,98			87,64
7			500	12,98	103,2				10,25	-1,80			92,22
7			1000	6,87	104,6				17,73	-1,80			99,69
7			2000	-15,87	102,2				38,15	-1,80			120,11
7			4000	-102,12	93,4				115,58	-1,80			197,54
7			8000	-408,19	84,6				412,80	-1,80			494,76
8	4077	4082		19,92	109,2	2	0,00	83,22	-	-	0,00	0,00	-
8			63	10,87	89,5				0,43	-3,00			80,65
8			125	13,10	95,7				1,53	-0,20			84,56
8			250	15,13	99,9				4,57	-0,98			86,81
8			500	14,14	103,2				9,63	-1,80			91,06
8			1000	8,48	104,6				16,66	-1,80			98,07
8			2000	-13,02	102,2				35,84	-1,80			117,26
8			4000	-94,58	93,4				108,59	-1,80			190,01
8			8000	-382,67	84,6				387,82	-1,80			469,23
9	2896	2903		24,74	109,2	2	0,00	80,26	-	-	0,00	0,00	-
9			63	13,96	89,5				0,30	-3,00			77,56
9			125	16,50	95,7				1,09	-0,20			81,15
9			250	19,41	99,9				3,25	-0,98			82,52
9			500	19,89	103,2				6,85	-1,80			85,31
9			1000	16,26	104,6				11,84	-1,80			90,30
9			2000	0,30	102,2				25,49	-1,80			103,94
9			4000	-60,25	93,4				77,22	-1,80			155,67
9			8000	-267,66	84,6				275,77	-1,80			354,22
Sum				32,00									
Sum			63	48,25									
Sum			125	40,57									
Sum			250	35,53									
Sum			500	29,94									
Sum			1000	22,45									
Sum			2000	4,34									
Sum			4000	-55,88									
Sum			8000	-254,45									

- Data undefined due to calculation with octave data

Noise sensitive area: E Lomarakennus E (Raudaskallion metsatie)

Wind speed: 8,0 m/s

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	4617	4620		13,70	104,9		0,00	84,29	-	-	0,00	0,00	-
1			63	4,74	86,5				0,49	-3,00			81,78
1			125	7,90	93,7				1,74	-0,20			85,83
1			250	9,67	98,2				5,17	-0,98			88,48
1			500	6,47	99,9				10,90	-1,80			93,40
1			1000	-2,46	98,9				18,85	-1,80			101,34
1			2000	-27,96	95,1				40,56	-1,80			123,06
1			4000	-116,69	88,7				122,89	-1,80			205,38
1			8000	-442,00	79,4				438,90	-1,80			521,39
10	3356	3362		22,68	109,2	2	0,00	81,53	-	-	0,00	0,00	-
10			63	12,63	89,5				0,35	-3,00			78,89
10			125	15,05	95,7				1,26	-0,20			82,60
10			250	17,62	99,9				3,77	-0,98			84,31
10			500	17,53	103,2				7,94	-1,80			87,67
10			1000	13,11	104,6				13,72	-1,80			93,45
10			2000	-5,01	102,2				29,52	-1,80			109,25
10			4000	-73,75	93,4				89,44	-1,80			169,17
10			8000	-312,59	84,6				319,43	-1,80			399,16
11	3569	3575		21,82	109,2	2	0,00	82,07	-	-	0,00	0,00	-
11			63	12,08	89,5				0,38	-3,00			79,44
11			125	14,44	95,7				1,34	-0,20			83,21
11			250	16,85	99,9				4,00	-0,98			85,09
11			500	16,49	103,2				8,44	-1,80			88,71

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
11			1000	11,70	104,6				14,59	-1,80			94,85
11			2000	-7,42	102,2				31,39	-1,80			111,66
11			4000	-79,94	93,4				95,10	-1,80			175,36
11			8000	-333,34	84,6				339,64	-1,80			419,90
12	3930	3935		20,45	109,2	2	0,00	82,90	-	-	0,00	0,00	-
12			63	11,21	89,5				0,41	-3,00			80,31
12			125	13,47	95,7				1,48	-0,20			84,18
12			250	15,62	99,9				4,41	-0,98			86,32
12			500	14,81	103,2				9,29	-1,80			90,39
12			1000	9,40	104,6				16,05	-1,80			97,15
12			2000	-11,41	102,2				34,55	-1,80			115,65
12			4000	-90,35	93,4				104,67	-1,80			185,77
12			8000	-368,36	84,6				373,83	-1,80			454,93
13	2762	2769		25,39	109,2	2	0,00	79,85	-	-	0,00	0,00	-
13			63	14,38	89,5				0,29	-3,00			77,14
13			125	16,96	95,7				1,04	-0,20			80,69
13			250	19,97	99,9				3,10	-0,98			81,96
13			500	20,61	103,2				6,53	-1,80			84,58
13			1000	17,21	104,6				11,30	-1,80			89,34
13			2000	1,88	102,2				24,31	-1,80			102,36
13			4000	-56,28	93,4				73,65	-1,80			151,70
13			8000	-254,53	84,6				263,05	-1,80			341,10
2	5031	5034		12,61	104,9		0,00	85,04	-	-	0,00	0,00	-
2			63	4,11	86,5				0,53	-3,16			82,41
2			125	7,09	93,7				1,89	-0,29			86,64
2			250	8,56	98,2				5,64	-1,08			89,60
2			500	4,85	99,9				11,88	-1,89			95,03
2			1000	-4,80	98,9				20,54	-1,89			103,68
2			2000	-32,24	95,1				44,20	-1,89			127,34
2			4000	-128,35	88,7				133,90	-1,89			217,04
2			8000	-481,97	79,4				478,21	-1,89			561,36
3	3943	3946		15,85	104,9		0,00	82,92	-	-	0,00	0,00	-
3			63	6,18	86,5				0,41	-3,00			80,34
3			125	9,52	93,7				1,48	-0,20			84,21
3			250	11,80	98,2				4,42	-0,98			86,36
3			500	9,43	99,9				9,31	-1,80			90,44
3			1000	1,66	98,9				16,10	-1,80			97,22
3			2000	-20,67	95,1				34,65	-1,80			115,77
3			4000	-97,39	88,7				104,97	-1,80			186,09
3			8000	-376,62	79,4				374,88	-1,80			456,01
4	4252	4254		14,83	104,9		0,00	83,58	-	-	0,00	0,00	-
4			63	5,50	86,5				0,45	-3,00			81,02
4			125	8,75	93,7				1,60	-0,20			84,98
4			250	10,80	98,2				4,76	-0,98			87,36
4			500	8,05	99,9				10,04	-1,80			91,82
4			1000	-0,25	98,9				17,36	-1,80			99,13
4			2000	-24,03	95,1				37,35	-1,80			119,13
4			4000	-106,25	88,7				113,17	-1,80			194,94
4			8000	-406,55	79,4				404,17	-1,80			485,94
5	3225	3231		23,24	109,2	2	0,00	81,19	-	-	0,00	0,00	-
5			63	12,99	89,5				0,34	-3,00			78,53
5			125	15,45	95,7				1,22	-0,20			82,21
5			250	18,11	99,9				3,62	-0,98			83,82
5			500	18,18	103,2				7,63	-1,80			87,02
5			1000	13,99	104,6				13,18	-1,80			92,57
5			2000	-3,52	102,2				28,37	-1,80			107,76
5			4000	-69,92	93,4				85,96	-1,80			165,34
5			8000	-299,80	84,6				306,98	-1,80			386,37
6	4493	4497		18,53	109,2	2	0,00	84,06	-	-	0,00	0,00	-
6			63	9,99	89,5				0,47	-3,00			81,53
6			125	12,10	95,7				1,69	-0,20			85,55
6			250	13,83	99,9				5,04	-0,98			88,11
6			500	12,32	103,2				10,61	-1,80			92,88
6			1000	5,95	104,6				18,35	-1,80			100,61

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
6			2000	-17,51	102,2				39,49	-1,80			121,75
6			4000	-106,47	93,4				119,63	-1,80			201,89
6			8000	-422,95	84,6				427,26	-1,80			509,52
7	4060	4065		19,98	109,2	2	0,00	83,18	-	-	0,00	0,00	-
7			63	10,91	89,5				0,43	-3,00			80,61
7			125	13,14	95,7				1,53	-0,20			84,52
7			250	15,19	99,9				4,55	-0,98			86,75
7			500	14,22	103,2				9,59	-1,80			90,98
7			1000	8,59	104,6				16,59	-1,80			97,97
7			2000	-12,84	102,2				35,69	-1,80			117,08
7			4000	-94,10	93,4				108,14	-1,80			189,52
7			8000	-381,03	84,6				386,21	-1,80			467,60
8	4136	4141		19,72	109,2	2	0,00	83,34	-	-	0,00	0,00	-
8			63	10,74	89,5				0,43	-3,00			80,78
8			125	12,95	95,7				1,56	-0,20			84,70
8			250	14,94	99,9				4,64	-0,98			86,99
8			500	13,88	103,2				9,77	-1,80			91,32
8			1000	8,12	104,6				16,89	-1,80			98,44
8			2000	-13,66	102,2				36,36	-1,80			117,90
8			4000	-96,26	93,4				110,15	-1,80			191,69
8			8000	-388,36	84,6				393,38	-1,80			474,93
9	2610	2618		26,16	109,2	2	0,00	79,36	-	-	0,00	0,00	-
9			63	14,89	89,5				0,27	-3,00			76,63
9			125	17,51	95,7				0,98	-0,20			80,15
9			250	20,63	99,9				2,93	-0,98			81,31
9			500	21,46	103,2				6,18	-1,80			83,74
9			1000	18,32	104,6				10,68	-1,80			88,24
9			2000	3,70	102,2				22,98	-1,80			100,54
9			4000	-51,77	93,4				69,63	-1,80			147,19
9			8000	-239,68	84,6				248,69	-1,80			326,25
Sum				32,54									
Sum			63	48,59									
Sum			125	40,98									
Sum			250	36,04									
Sum			500	30,55									
Sum			1000	23,23									
Sum			2000	5,81									
Sum			4000	-51,38									
Sum			8000	-238,44									

- Data undefined due to calculation with octave data

Noise sensitive area: F Lomarakennus F (Hirvinevanhaara 147)

Wind speed: 8,0 m/s

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	1851	1857		25,54	104,9		0,00	76,38	-	-	0,00	0,00	-
1			63	12,95	86,5				0,20	-3,00			73,57
1			125	16,85	93,7				0,70	-0,20			76,88
1			250	20,68	98,2				2,08	-0,98			77,47
1			500	20,91	99,9				4,38	-1,80			78,97
1			1000	16,73	98,9				7,58	-1,80			82,16
1			2000	4,21	95,1				16,31	-1,80			90,89
1			4000	-35,29	88,7				49,41	-1,80			123,99
1			8000	-171,65	79,4				176,46	-1,80			251,04
10	3311	3317		22,87	109,2	2	0,00	81,42	-	-	0,00	0,00	-
10			63	12,76	89,5				0,35	-3,00			78,76
10			125	15,19	95,7				1,25	-0,20			82,47
10			250	17,79	99,9				3,72	-0,98			84,15
10			500	17,75	103,2				7,83	-1,80			87,45
10			1000	13,41	104,6				13,53	-1,80			93,15
10			2000	-4,50	102,2				29,13	-1,80			108,74
10			4000	-72,43	93,4				88,24	-1,80			167,86
10			8000	-308,19	84,6				315,14	-1,80			394,76

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
11	2776	2783		25,32	109,2	2	0,00	79,89	-	-	0,00	0,00	-
11			63	14,34	89,5				0,29	-3,00			77,18
11			125	16,91	95,7				1,05	-0,20			80,74
11			250	19,92	99,9				3,12	-0,98			82,02
11			500	20,54	103,2				6,57	-1,80			84,66
11			1000	17,11	104,6				11,35	-1,80			89,44
11			2000	1,72	102,2				24,43	-1,80			102,52
11			4000	-56,69	93,4				74,02	-1,80			152,11
11			8000	-255,89	84,6				264,36	-1,80			342,45
12	3909	3914		20,53	109,2	2	0,00	82,85	-	-	0,00	0,00	-
12			63	11,26	89,5				0,41	-3,00			80,26
12			125	13,52	95,7				1,47	-0,20			84,13
12			250	15,69	99,9				4,38	-0,98			86,25
12			500	14,90	103,2				9,24	-1,80			90,29
12			1000	9,53	104,6				15,97	-1,80			97,02
12			2000	-11,18	102,2				34,37	-1,80			115,42
12			4000	-89,74	93,4				104,12	-1,80			185,17
12			8000	-366,33	84,6				371,85	-1,80			452,90
13	2712	2720		25,64	109,2	2	0,00	79,69	-	-	0,00	0,00	-
13			63	14,54	89,5				0,29	-3,00			76,98
13			125	17,14	95,7				1,02	-0,20			80,52
13			250	20,19	99,9				3,05	-0,98			81,75
13			500	20,89	103,2				6,42	-1,80			84,31
13			1000	17,57	104,6				11,10	-1,80			88,99
13			2000	2,47	102,2				23,88	-1,80			101,77
13			4000	-54,81	93,4				72,34	-1,80			150,23
13			8000	-249,68	84,6				258,36	-1,80			336,25
2	2349	2354		22,62	104,9		0,00	78,44	-	-	0,00	0,00	-
2			63	10,84	86,5				0,25	-3,00			75,68
2			125	14,61	93,7				0,89	-0,20			79,13
2			250	18,07	98,2				2,64	-0,98			80,09
2			500	17,68	99,9				5,56	-1,80			82,20
2			1000	12,64	98,9				9,61	-1,80			86,24
2			2000	-2,21	95,1				20,67	-1,80			97,31
2			4000	-50,56	88,7				62,62	-1,80			139,26
2			8000	-220,90	79,4				223,66	-1,80			300,29
3	1212	1221		30,44	104,9		0,00	72,74	-	-	0,00	0,00	-
3			63	16,66	86,5				0,13	-3,00			69,86
3			125	20,74	93,7				0,46	-0,20			72,99
3			250	25,04	98,2				1,37	-0,98			73,12
3			500	26,05	99,9				2,88	-1,80			73,82
3			1000	22,97	98,9				4,98	-1,80			75,92
3			2000	13,44	95,1				10,72	-1,80			81,66
3			4000	-14,72	88,7				32,48	-1,80			103,42
3			8000	-107,55	79,4				116,01	-1,80			186,94
4	1554	1561		27,61	104,9		0,00	74,87	-	-	0,00	0,00	-
4			63	14,49	86,5				0,16	-3,00			72,03
4			125	18,47	93,7				0,59	-0,20			75,26
4			250	22,52	98,2				1,75	-0,98			75,63
4			500	23,12	99,9				3,68	-1,80			76,76
4			1000	19,45	98,9				6,37	-1,80			79,44
4			2000	8,32	95,1				13,71	-1,80			86,78
4			4000	-25,90	88,7				41,53	-1,80			114,60
4			8000	-141,99	79,4				148,31	-1,80			221,38
5	2003	2012		29,67	109,2	2	0,00	77,07	-	-	0,00	0,00	-
5			63	17,23	89,5				0,21	-3,00			74,29
5			125	20,02	95,7				0,76	-0,20			77,63
5			250	23,59	99,9				2,25	-0,98			78,34
5			500	25,17	103,2				4,75	-1,80			80,03
5			1000	23,07	104,6				8,21	-1,80			83,48
5			2000	11,30	102,2				17,67	-1,80			92,94
5			4000	-33,38	93,4				53,53	-1,80			128,80
5			8000	-179,87	84,6				191,17	-1,80			266,44
6	3386	3392		22,56	109,2	2	0,00	81,61	-	-	0,00	0,00	-

To be continued on next page...

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
6			63	12,55	89,5				0,36	-3,00			78,97
6			125	14,96	95,7				1,28	-0,20			82,69
6			250	17,51	99,9				3,80	-0,98			84,42
6			500	17,38	103,2				8,01	-1,80			87,82
6			1000	12,91	104,6				13,84	-1,80			93,65
6			2000	-5,35	102,2				29,78	-1,80			109,59
6			4000	-74,62	93,4				90,23	-1,80			170,04
6			8000	-315,51	84,6				322,27	-1,80			402,08
7	2735	2742		25,52	109,2	2	0,00	79,76	-	-	0,00	0,00	-
7			63	14,47	89,5				0,29	-3,00			77,05
7			125	17,06	95,7				1,03	-0,20			80,60
7			250	20,09	99,9				3,07	-0,98			81,85
7			500	20,76	103,2				6,47	-1,80			84,44
7			1000	17,41	104,6				11,19	-1,80			89,15
7			2000	2,20	102,2				24,08	-1,80			102,04
7			4000	-55,49	93,4				72,95	-1,80			150,91
7			8000	-251,93	84,6				260,53	-1,80			338,49
8	3526	3532		21,99	109,2	2	0,00	81,96	-	-	0,00	0,00	-
8			63	12,19	89,5				0,37	-3,00			79,33
8			125	14,56	95,7				1,33	-0,20			83,09
8			250	17,00	99,9				3,96	-0,98			84,93
8			500	16,70	103,2				8,34	-1,80			88,50
8			1000	11,99	104,6				14,41	-1,80			94,57
8			2000	-6,93	102,2				31,01	-1,80			111,17
8			4000	-78,69	93,4				93,96	-1,80			174,12
8			8000	-329,15	84,6				335,56	-1,80			415,72
9	2137	2146		28,83	109,2	2	0,00	77,63	-	-	0,00	0,00	-
9			63	16,66	89,5				0,23	-3,00			74,86
9			125	19,41	95,7				0,81	-0,20			78,24
9			250	22,89	99,9				2,40	-0,98			79,05
9			500	24,30	103,2				5,06	-1,80			80,90
9			1000	21,97	104,6				8,75	-1,80			84,59
9			2000	9,57	102,2				18,84	-1,80			94,67
9			4000	-37,48	93,4				57,07	-1,80			132,90
9			8000	-193,10	84,6				203,84	-1,80			279,67
Sum				37,50									
Sum			63	51,71									
Sum			125	44,68									
Sum			250	40,67									
Sum			500	36,07									
Sum			1000	29,74									
Sum			2000	16,62									
Sum			4000	-15,29									
Sum			8000	-106,45									

- Data undefined due to calculation with octave data

Noise sensitive area: G Lomarakennus G (Pohjanneva)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
1	7227	7229		8,14	104,9		0,00	88,18	-	-	0,00	0,00	-
1			63	1,60	86,5				0,76	-4,02			84,92
1			125	3,64	93,7				2,72	-0,81			90,09
1			250	3,47	98,2				8,10	-1,60			94,68
1			500	-2,96	99,9				17,06	-2,41			102,83
1			1000	-16,37	98,9				29,49	-2,41			115,26
1			2000	-54,14	95,1				63,47	-2,41			149,24
1			4000	-189,35	88,7				192,28	-2,41			278,05
1			8000	-693,10	79,4				686,72	-2,41			772,49
10	2881	2888		24,81	109,2	2	0,00	80,21	-	-	0,00	0,00	-
10			63	14,00	89,5				0,30	-3,00			77,51
10			125	16,55	95,7				1,09	-0,20			81,10
10			250	19,48	99,9				3,23	-0,98			82,46

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DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

...continued from previous page

WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
10			500	19,97	103,2				6,81	-1,80			85,23
10			1000	16,36	104,6				11,78	-1,80			90,19
10			2000	0,48	102,2				25,35	-1,80			103,76
10			4000	-59,80	93,4				76,81	-1,80			155,22
10			8000	-266,17	84,6				274,33	-1,80			352,74
11	3655	3660		21,48	109,2	2	0,00	82,27	-	-	0,00	0,00	-
11			63	11,87	89,5				0,38	-3,00			79,65
11			125	14,20	95,7				1,38	-0,20			83,45
11			250	16,55	99,9				4,10	-0,98			85,38
11			500	16,09	103,2				8,64	-1,80			89,11
11			1000	11,16	104,6				14,93	-1,80			95,40
11			2000	-8,36	102,2				32,13	-1,80			112,60
11			4000	-82,39	93,4				97,35	-1,80			177,82
11			8000	-341,57	84,6				347,67	-1,80			428,14
12	2372	2380		27,45	109,2	2	0,00	78,53	-	-	0,00	0,00	-
12			63	15,74	89,5				0,25	-3,00			75,78
12			125	18,42	95,7				0,89	-0,20			79,23
12			250	21,73	99,9				2,67	-0,98			80,21
12			500	22,85	103,2				5,62	-1,80			82,35
12			1000	20,12	104,6				9,71	-1,80			86,44
12			2000	6,61	102,2				20,90	-1,80			97,63
12			4000	-44,61	93,4				63,31	-1,80			140,04
12			8000	-216,25	84,6				226,09	-1,80			302,82
13	3451	3456		22,30	109,2	2	0,00	81,77	-	-	0,00	0,00	-
13			63	12,38	89,5				0,36	-3,00			79,13
13			125	14,78	95,7				1,30	-0,20			82,88
13			250	17,28	99,9				3,87	-0,98			84,66
13			500	17,07	103,2				8,16	-1,80			88,13
13			1000	12,49	104,6				14,10	-1,80			94,07
13			2000	-6,07	102,2				30,34	-1,80			110,31
13			4000	-76,47	93,4				91,93	-1,80			171,90
13			8000	-321,72	84,6				328,32	-1,80			408,29
2	6896	6897		8,73	104,9		0,00	87,77	-	-	0,00	0,00	-
2			63	1,95	86,5				0,72	-3,92			84,57
2			125	4,12	93,7				2,59	-0,75			89,62
2			250	4,20	98,2				7,72	-1,54			93,96
2			500	-1,83	99,9				16,28	-2,35			101,70
2			1000	-14,67	98,9				28,14	-2,35			113,56
2			2000	-50,88	95,1				60,56	-2,35			145,98
2			4000	-180,19	88,7				183,47	-2,35			268,88
2			8000	-661,26	79,4				655,24	-2,35			740,66
3	6531	6533		9,41	104,9		0,00	87,30	-	-	0,00	0,00	-
3			63	2,34	86,5				0,69	-3,81			84,18
3			125	4,66	93,7				2,46	-0,68			89,08
3			250	5,01	98,2				7,32	-1,47			93,15
3			500	-0,56	99,9				15,42	-2,28			100,44
3			1000	-12,78	98,9				26,65	-2,29			111,67
3			2000	-47,27	95,1				57,36	-2,29			142,38
3			4000	-170,09	88,7				173,78	-2,29			258,79
3			8000	-626,25	79,4				620,63	-2,29			705,65
4	7424	7426		7,80	104,9		0,00	88,41	-	-	0,00	0,00	-
4			63	1,40	86,5				0,78	-4,07			85,12
4			125	3,37	93,7				2,79	-0,84			90,37
4			250	3,05	98,2				8,32	-1,63			95,10
4			500	-3,63	99,9				17,52	-2,44			103,50
4			1000	-17,38	98,9				30,30	-2,44			116,27
4			2000	-56,07	95,1				65,20	-2,44			151,17
4			4000	-194,79	88,7				197,52	-2,44			283,49
4			8000	-712,01	79,4				705,43	-2,44			791,40
5	4378	4382		18,91	109,2	2	0,00	83,83	-	-	0,00	0,00	-
5			63	10,23	89,5				0,46	-3,00			81,29
5			125	12,37	95,7				1,65	-0,20			85,29
5			250	14,18	99,9				4,91	-0,98			87,76
5			500	12,82	103,2				10,34	-1,80			92,38

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Calculated:
9.6.2020 21.23/3.3.247

DECIBEL - Detailed results

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609Noise calculation model: ISO 9613-2 General 8,0 m/s

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WTG No.	Distance [m]	Sound distance [m]	Frequency [Hz]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
5			1000	6,65	104,6				17,88	-1,80			99,91
5			2000	-16,27	102,2				38,47	-1,80			120,51
5			4000	-103,17	93,4				116,56	-1,80			198,59
5			8000	-411,75	84,6				416,28	-1,80			498,31
6	3757	3762		21,09	109,2	2	0,00	82,51	-	-	0,00	0,00	-
6			63	11,61	89,5				0,40	-3,00			79,90
6			125	13,93	95,7				1,41	-0,20			83,73
6			250	16,20	99,9				4,21	-0,98			85,74
6			500	15,61	103,2				8,88	-1,80			89,59
6			1000	10,50	104,6				15,35	-1,80			96,06
6			2000	-9,50	102,2				33,03	-1,80			113,74
6			4000	-85,36	93,4				100,08	-1,80			180,79
6			8000	-351,57	84,6				357,43	-1,80			438,14
7	4186	4191		19,55	109,2	2	0,00	83,45	-	-	0,00	0,00	-
7			63	10,63	89,5				0,44	-3,00			80,89
7			125	12,83	95,7				1,58	-0,20			84,83
7			250	14,78	99,9				4,69	-0,98			87,15
7			500	13,66	103,2				9,89	-1,80			91,54
7			1000	7,81	104,6				17,10	-1,80			98,74
7			2000	-14,20	102,2				36,79	-1,80			118,44
7			4000	-97,69	93,4				111,47	-1,80			193,12
7			8000	-393,20	84,6				398,12	-1,80			479,76
8	3099	3105		23,80	109,2	2	0,00	80,84	-	-	0,00	0,00	-
8			63	13,35	89,5				0,33	-3,00			78,17
8			125	15,84	95,7				1,17	-0,20			81,81
8			250	18,60	99,9				3,48	-0,98			83,33
8			500	18,83	103,2				7,33	-1,80			86,37
8			1000	14,85	104,6				12,67	-1,80			91,71
8			2000	-2,06	102,2				27,26	-1,80			106,30
8			4000	-66,20	93,4				82,58	-1,80			161,62
8			8000	-287,41	84,6				294,94	-1,80			373,98
9	4028	4032		20,10	109,2	2	0,00	83,11	-	-	0,00	0,00	-
9			63	10,99	89,5				0,42	-3,00			80,53
9			125	13,22	95,7				1,52	-0,20			84,43
9			250	15,30	99,9				4,52	-0,98			86,64
9			500	14,37	103,2				9,52	-1,80			90,83
9			1000	8,80	104,6				16,45	-1,80			97,76
9			2000	-12,47	102,2				35,40	-1,80			116,71
9			4000	-93,14	93,4				107,25	-1,80			188,56
9			8000	-377,79	84,6				383,05	-1,80			464,36
Sum				32,64									
Sum			63	48,56									
Sum			125	40,89									
Sum			250	36,01									
Sum			500	30,75									
Sum			1000	23,75									
Sum			2000	7,22									
Sum			4000	-45,45									
Sum			8000	-215,15									

- Data undefined due to calculation with octave data

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Calculated:
9.6.2020 21.23/3.3.247

DECIBEL - Assumptions for noise calculation

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609

Noise calculation model:
ISO 9613-2 General
Wind speed (in 10 m height):
8,0 m/s
Ground attenuation:
General, Ground factor: 0,4
Meteorological coefficient, C0:
0,0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Fixed penalty added to source noise of WTGs with pure tones
WTG catalogue
Height above ground level, when no value in NSA object:
4,0 m; Don't allow override of model height with height from NSA object
Uncertainty margin:
0,0 dB; Uncertainty margin in NSA has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)
Octave data required
Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

WTG: VESTAS V150-4.2 4200 150.0 !O!
Noise: Level 0 - - Mode 0/PO1 - 10-2017

Source	Source/Date	Creator	Edited
Manufacturer	18.10.2017	USER	9.6.2020 17.59

Performance Specification 0067-7067 V05

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data 63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	155,0	8,0	104,9	No	86,5	93,7	98,2	99,9	98,9	95,1	88,7	79,4

WTG: NORDEX N163/5,7MW 5700 163.0 !O!
Noise: N163-5,7MW Mode 0 no STE - 109.2 dB(A) + 2 dB

Source	Source/Date	Creator	Edited
F008_276_A14_EN	20.3.2020	USER	9.6.2020 17.19

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Penalty [dB]	Octave data 63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	198,5	8,0	109,2	Yes	2,0	89,5	95,7	99,9	103,2	104,6	102,2	93,4	84,6

Noise sensitive area: A Asuinrakennus A (Hakuperäntie 202)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: B Asuinrakennus B (Hakuperäntie 169)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Liisa Karhu / liisa.karhu@fcg.fi

DECIBEL - Assumptions for noise calculation

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609

Noise sensitive area: C Asuinrakennus C (Säilyntie 285)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: D Asuinrakennus D (Säilyntie 264)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: E Lomarakennus E (Raudaskallion metsatie)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: F Lomarakennus F (Hirvinevanhaara 147)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

Noise sensitive area: G Lomarakennus G (Pohjanneva)

Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand

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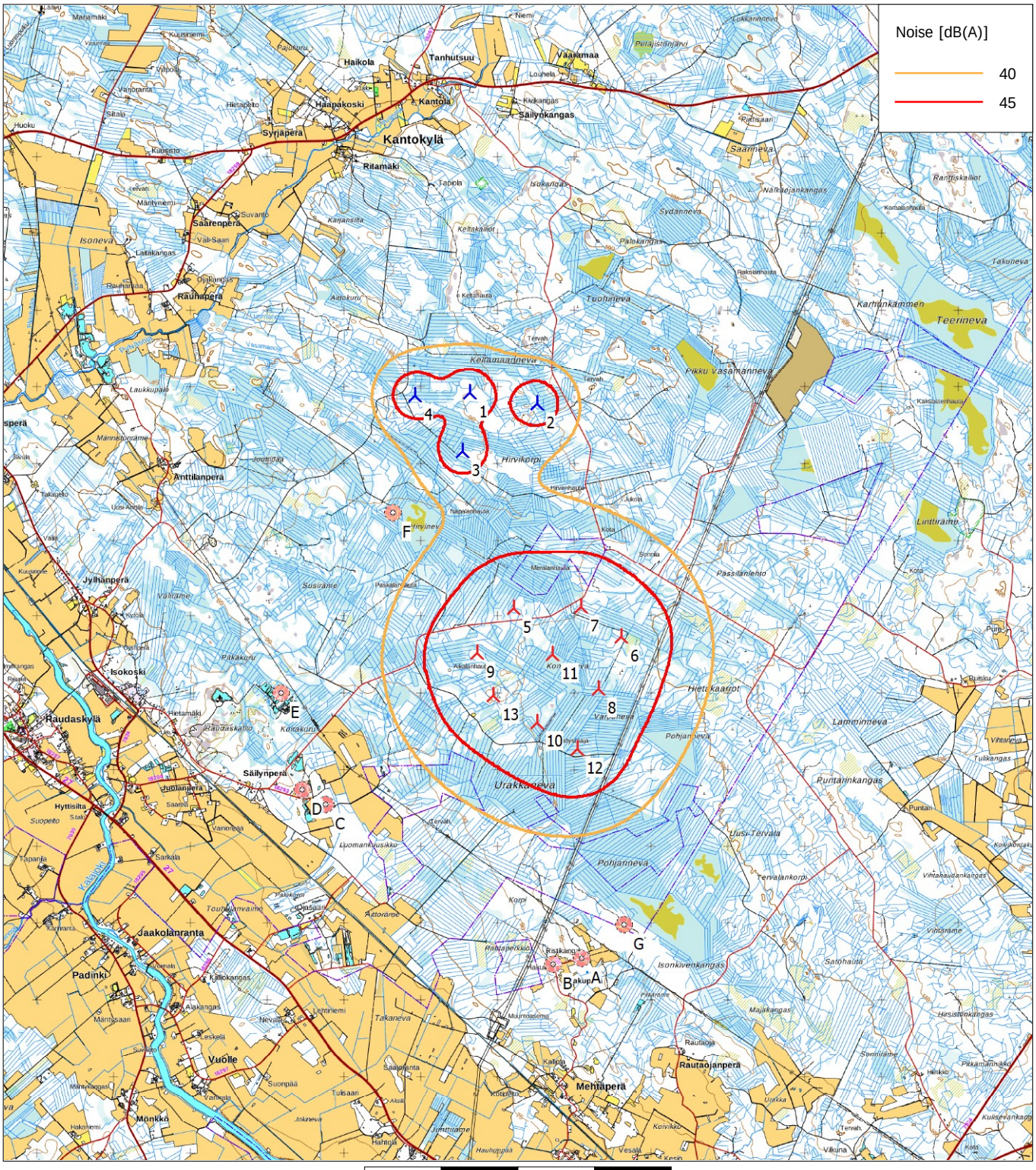
FI-00601 Helsinki
+358104095666
Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
9.6.2020 21.23/3.3.247

DECIBEL - Map 8,0 m/s

Calculation: Urakkaneva_N163-5.7MWx9xHH198,5_107.2 dB+2.0dB_20200609


Noise [dB(A)]
40
45
1
2
3
4
5
6
7
8
9
10
11
12
13
A
B
C
D
E
F
G
Urakkaneva
Kantokylä
Raudaskylä
Jaakolanranta
Mehtäpera
Rautaojanpera
Säilynpera
Rauhapera
Isokoski
Vuolle
Mönkkö
Padinki
Hirvikorpi
Keltamaanneva
Pikku Vasamanneva
Pohjanneva
Uusi-Tervala
Lamminneva
Teerineva
Puntalinkangas
Isonkivenkangas
Hietakaarrot
Passilanlehto
Susiraime
Lintiraime
Jylhänpera
Anttilanpera
Saarenpera
Haapakoski
Haikola
Tanhutsuu
Vaarnamaa
Säilynkangas
Syrjäpera
Ritamäki
Isoneva
Takaneva
Saarneva
Sydänneva
Karhunkammen
Takuneva
Ranttiskaliot
Nälkäojankangas
Palokangas
Tuohineva
Hirvineva
Vasamanneva
Pikku vasamanneva
Kaksisteenhauta
Kamalanhauta
Rakolanhauta
Kalliohauta
Keltakalliot
Isokangas
Kangansilta
Latakangas
Ojakangas
Rauhanmaa
Laukkupalo
Männistönraime
Takapelto
Uusi-Anttila
Jokimaa
Pitkäkuru
Rauduskallio
Hietamäki
Kokkakuru
Juolanpera
Hyttisilta
Suopelto
Sarkala
Tapanila
Ljuomanhuusikko
Attoraime
Tervalankorpi
Vihtahaudankangas
Vihtaraime
Satohaita
Majakangas
Hirsistönkangas
Pitkämänhaka
Kulisevankangas
Puntala
Puro
Ruisku
Tulikangas
Vihtaniva
Kokkilönlahti
Kaihanta
Kaihanta
Kaihanta

Urakkaneva_N163-5.7MWx9xHH198,5_20200514

Hirvineva_V150x4xHH155_2018

Urakkaneva laskentapisteet

Melutaso YM 2/2014

40 dB(A)

45 dB(A)

MML, mtk rakennuskanta 2020/05

Asuinrakennus

Liike- tai julkinen rakennus

Lomarakennus

A

B

C

D

E

F

G

1

2

3

4

5

6

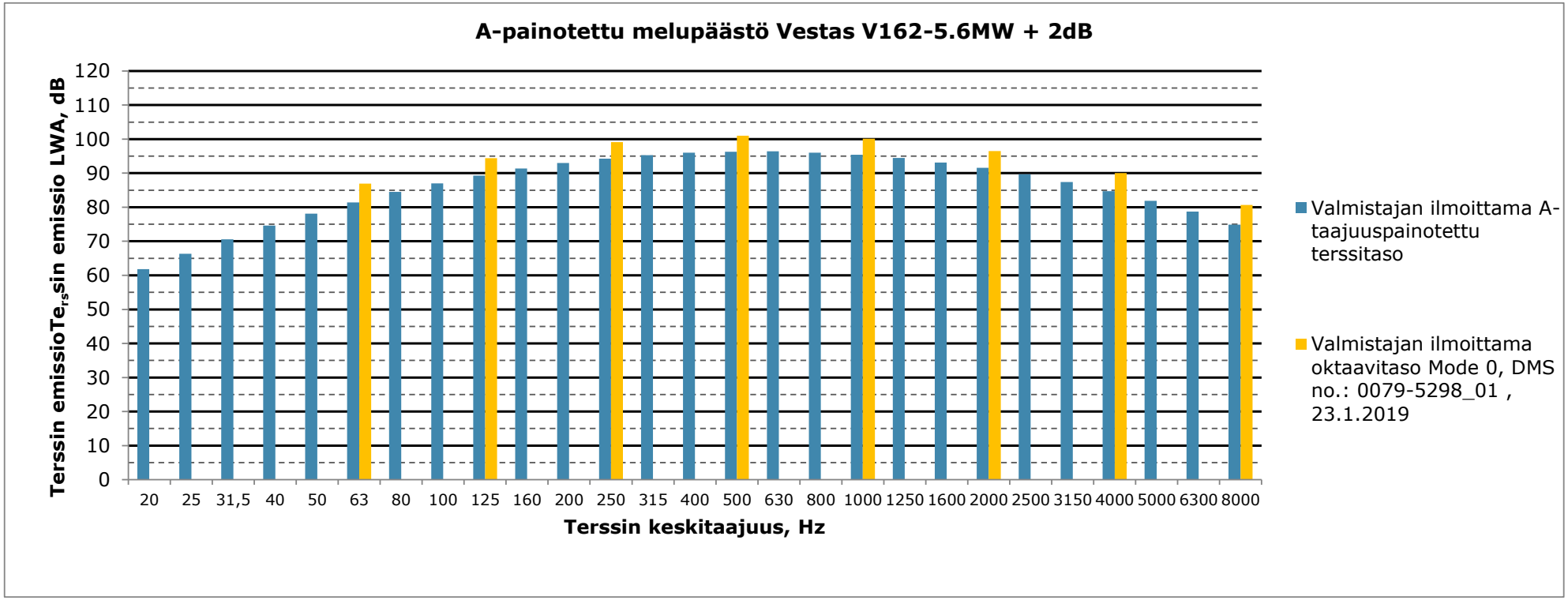
7

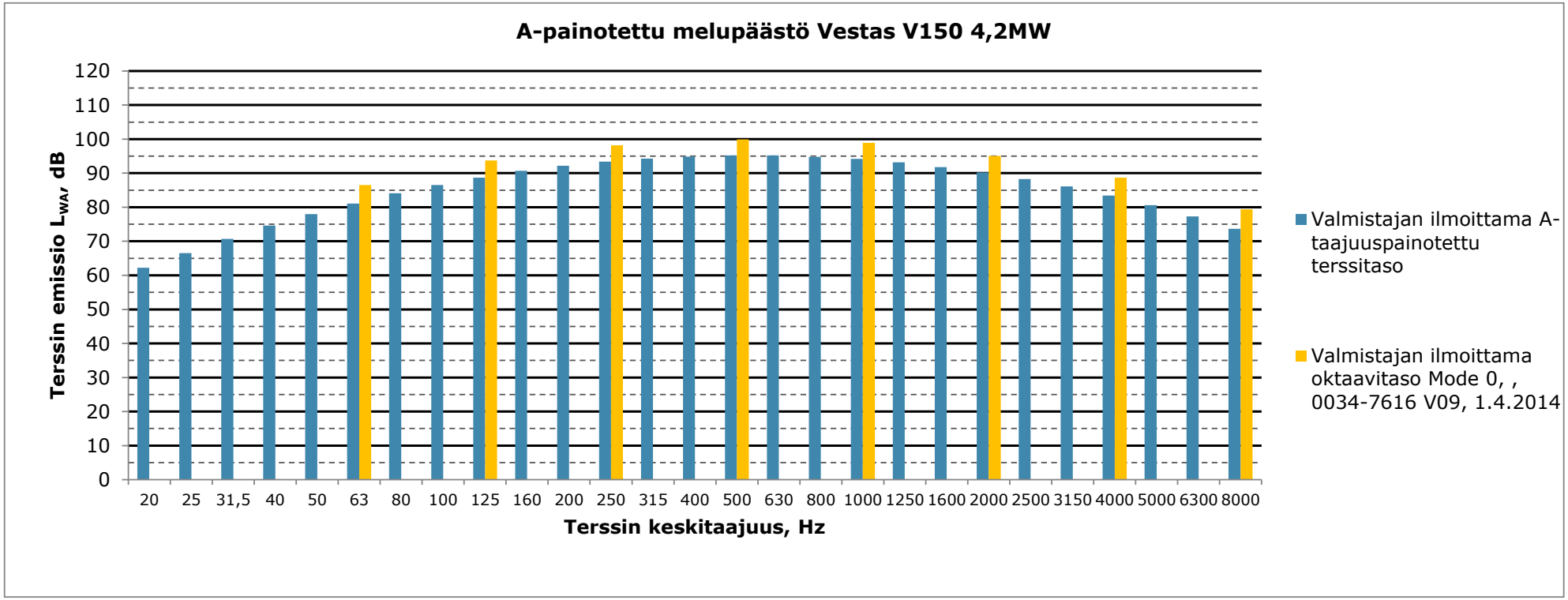
8

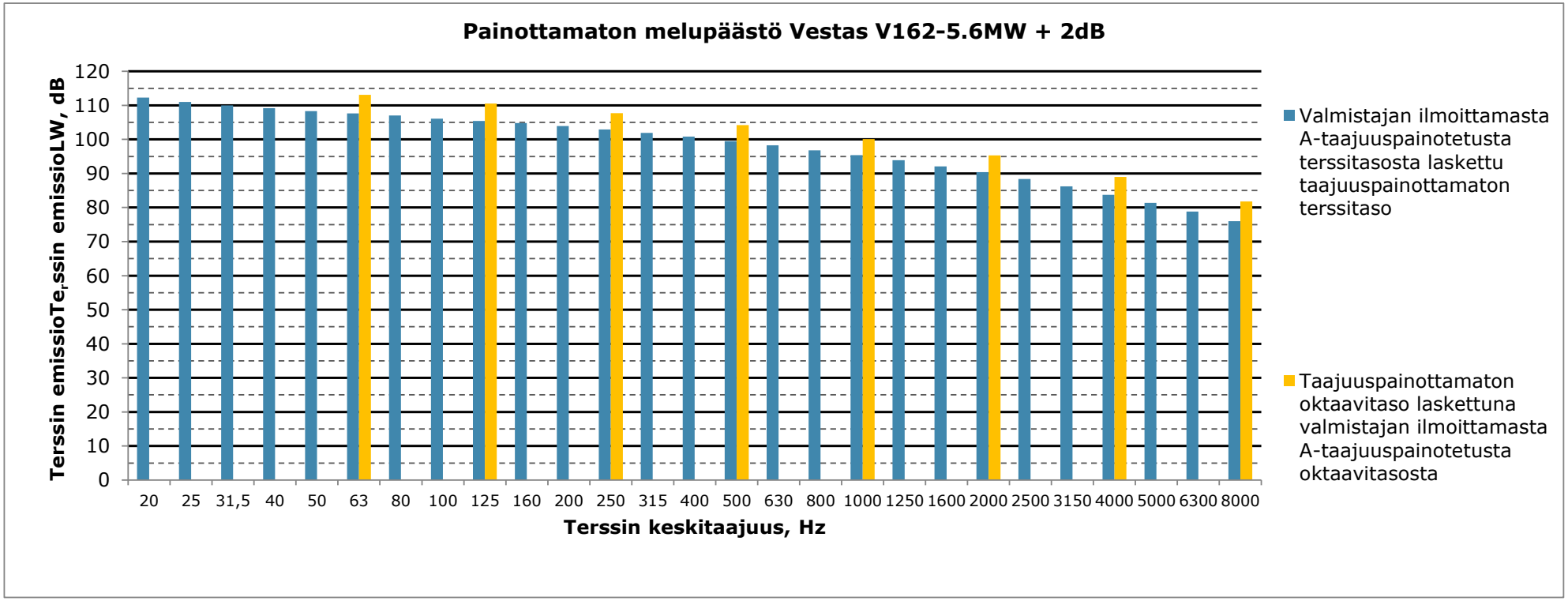
9

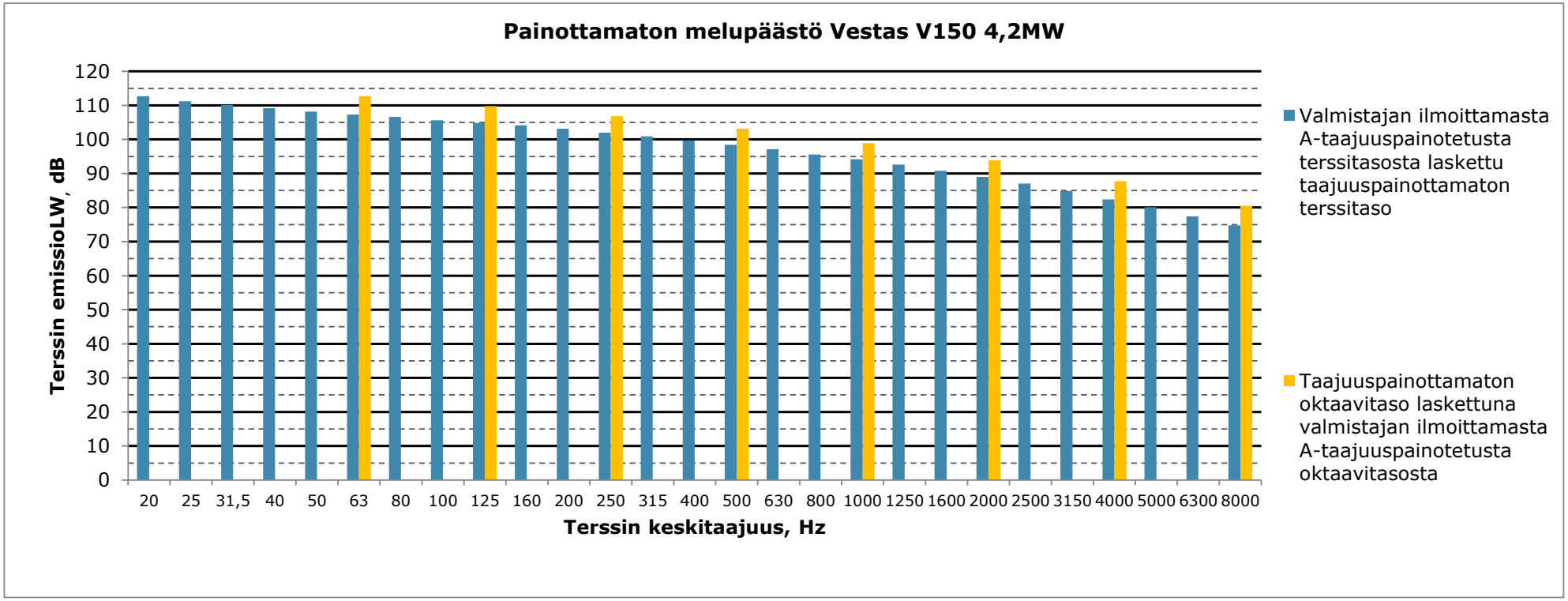
0 1 2 3 4 km

Liite 3: V162 - Matalataajuisen melun rakennuskohtaiset arvot

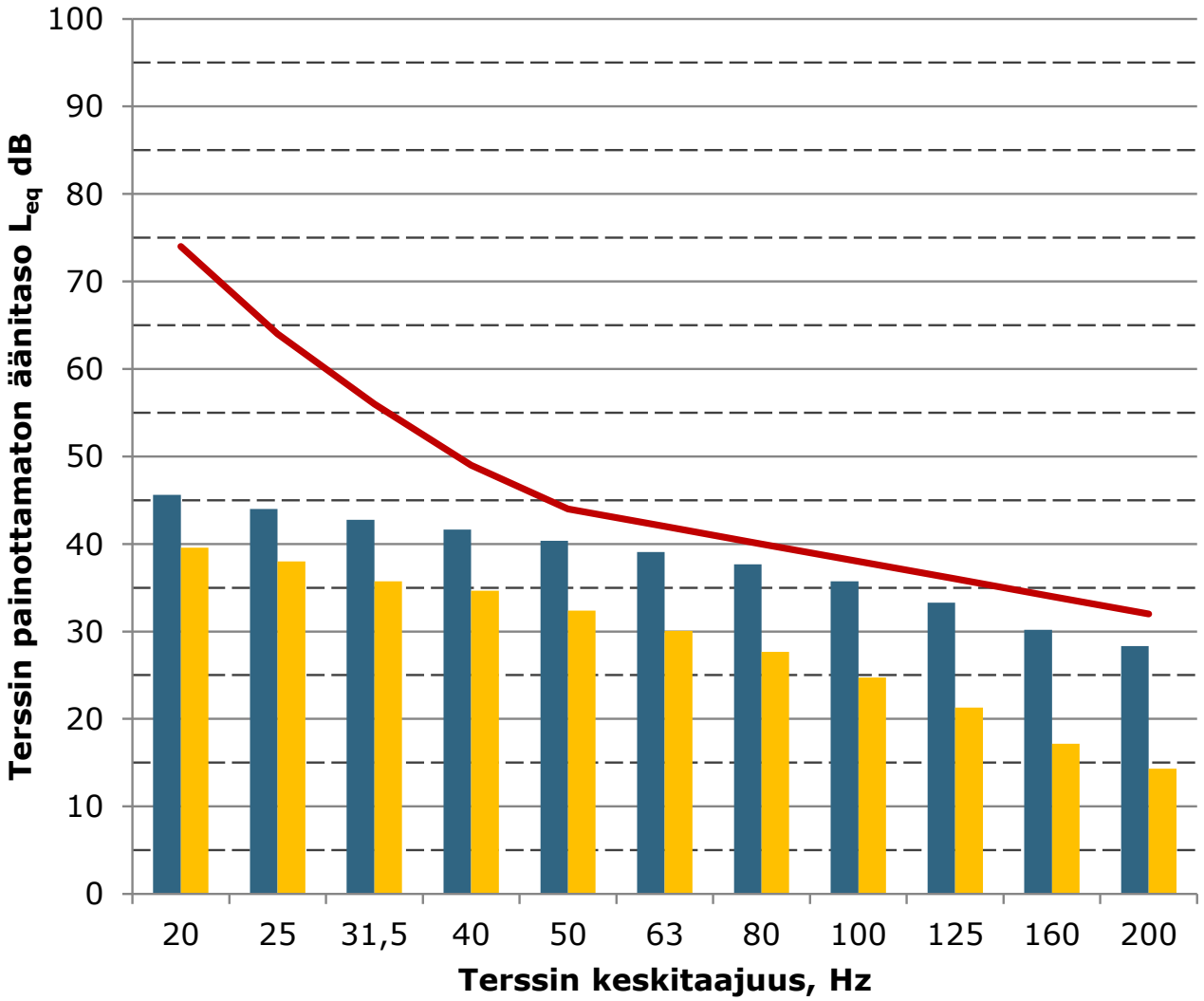

A-painotettu melupäästö Vestas V162-5.6MW + 2dB
Terssin emissioTe$_{rs}$sin emissio LWA, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso Mode 0, DMS no.: 0079-5298_01 , 23.1.2019

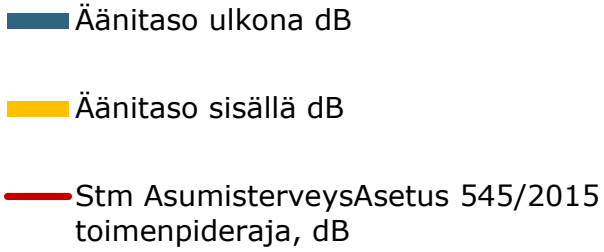

A-painotettu melupäästö Vestas V150 4,2MW
Terssin emissio L_{WA}, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso Mode 0, , 0034-7616 V09, 1.4.2014


Painottamaton melupäästö Vestas V162-5.6MW + 2dB
Terssin emissioTe,ssin emissioLW, dB
0
10
20
30
40
50
60
70
80
90
100
110
120
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta


Painottamaton melupäästö Vestas V150 4,2MW
Terssin emissioLW, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus A (Hakuperäntie 202), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan

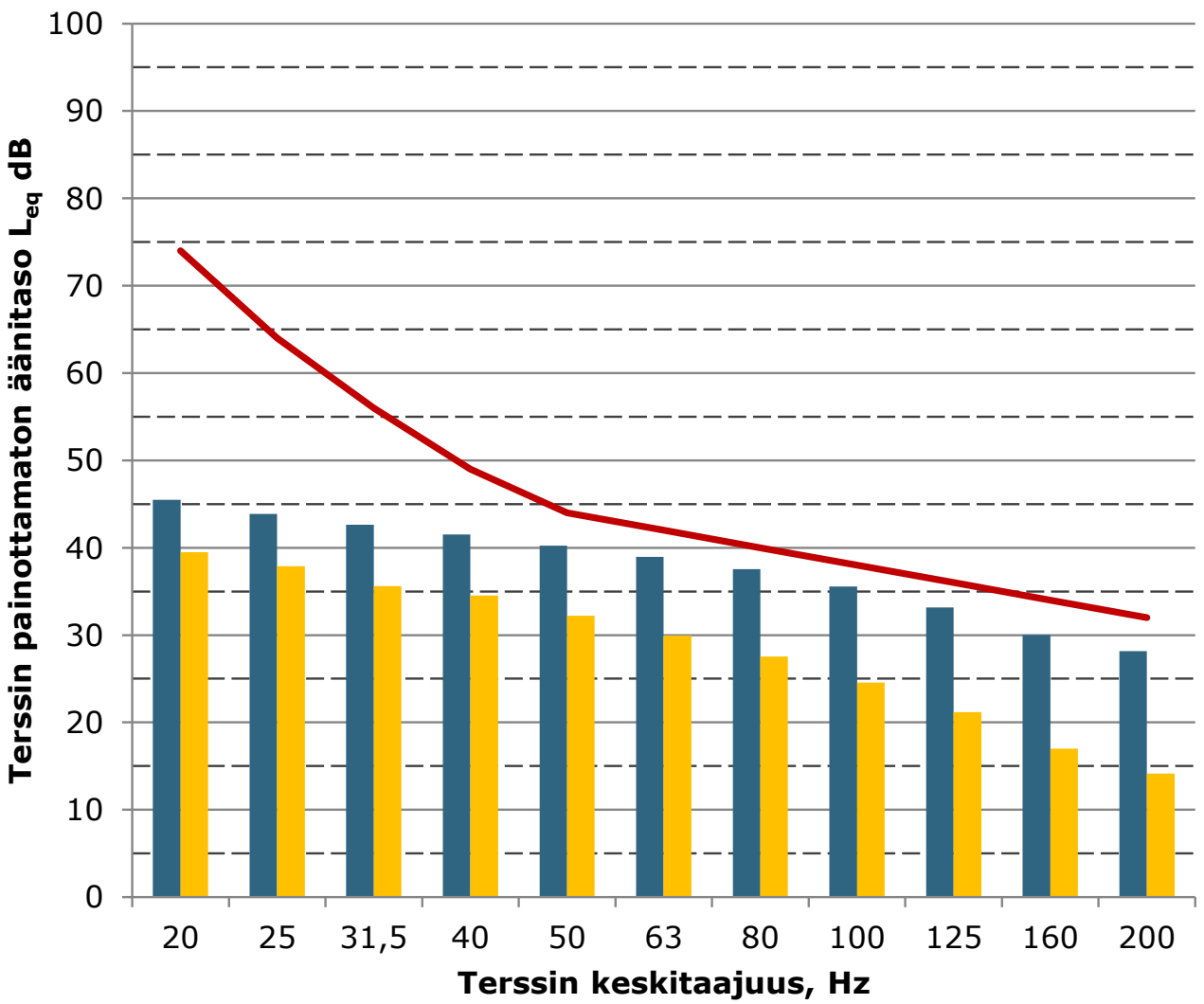


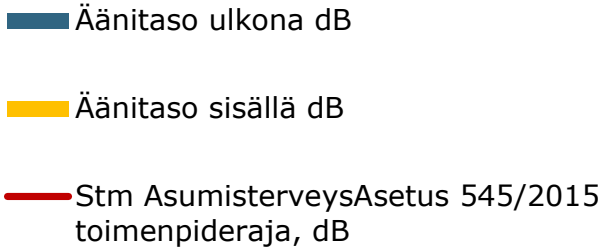


Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus B (Hakuperäntie 169), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan

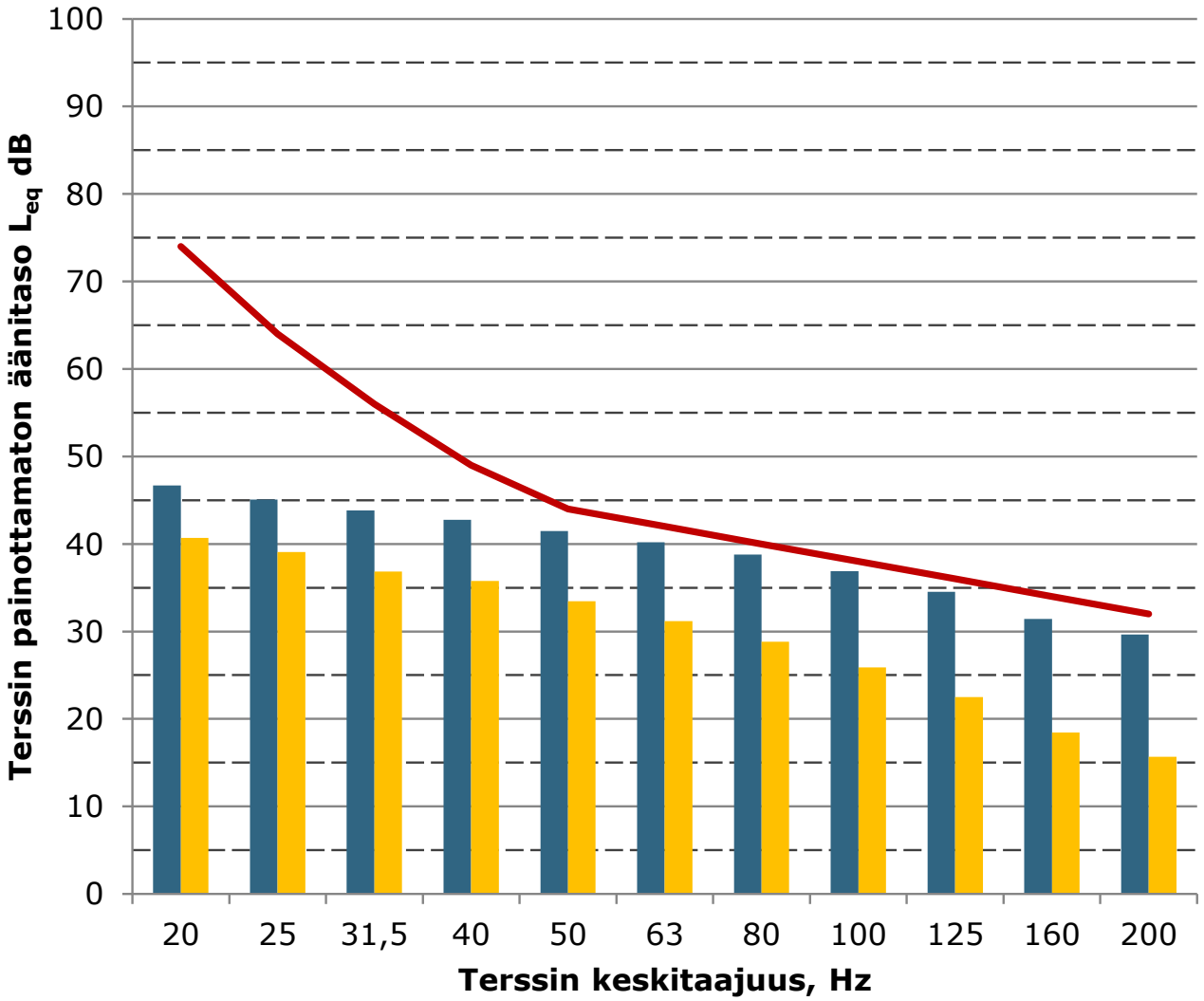


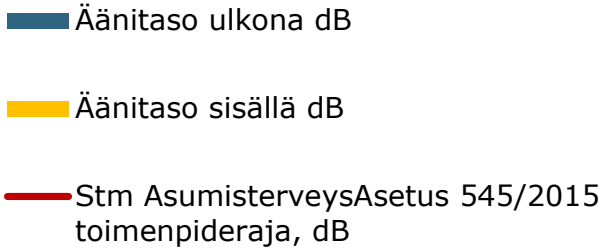


Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus C (Säilyntie 285), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan

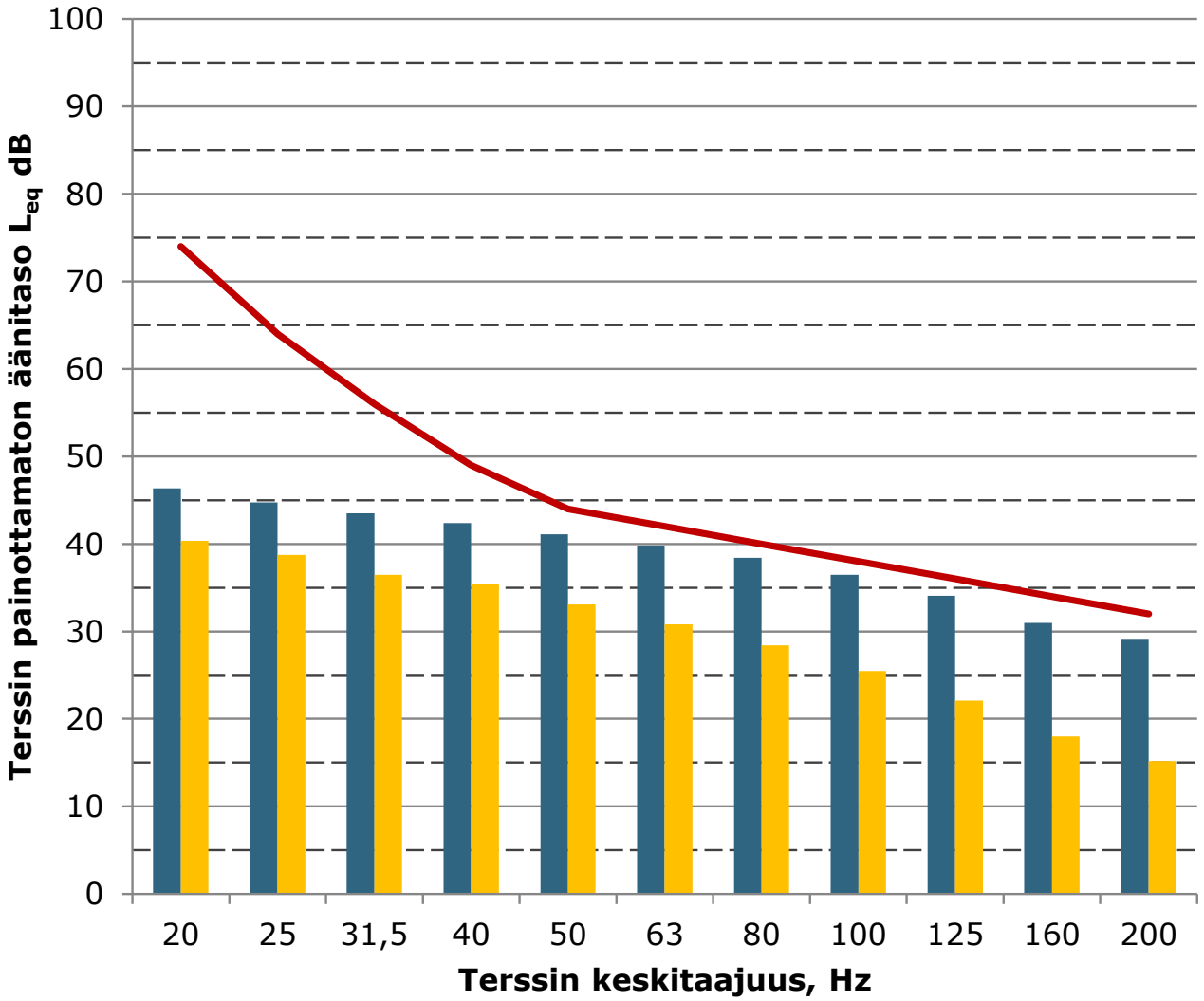




Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus D (Säilyntie 264), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan



Äänitaso ulkona dB

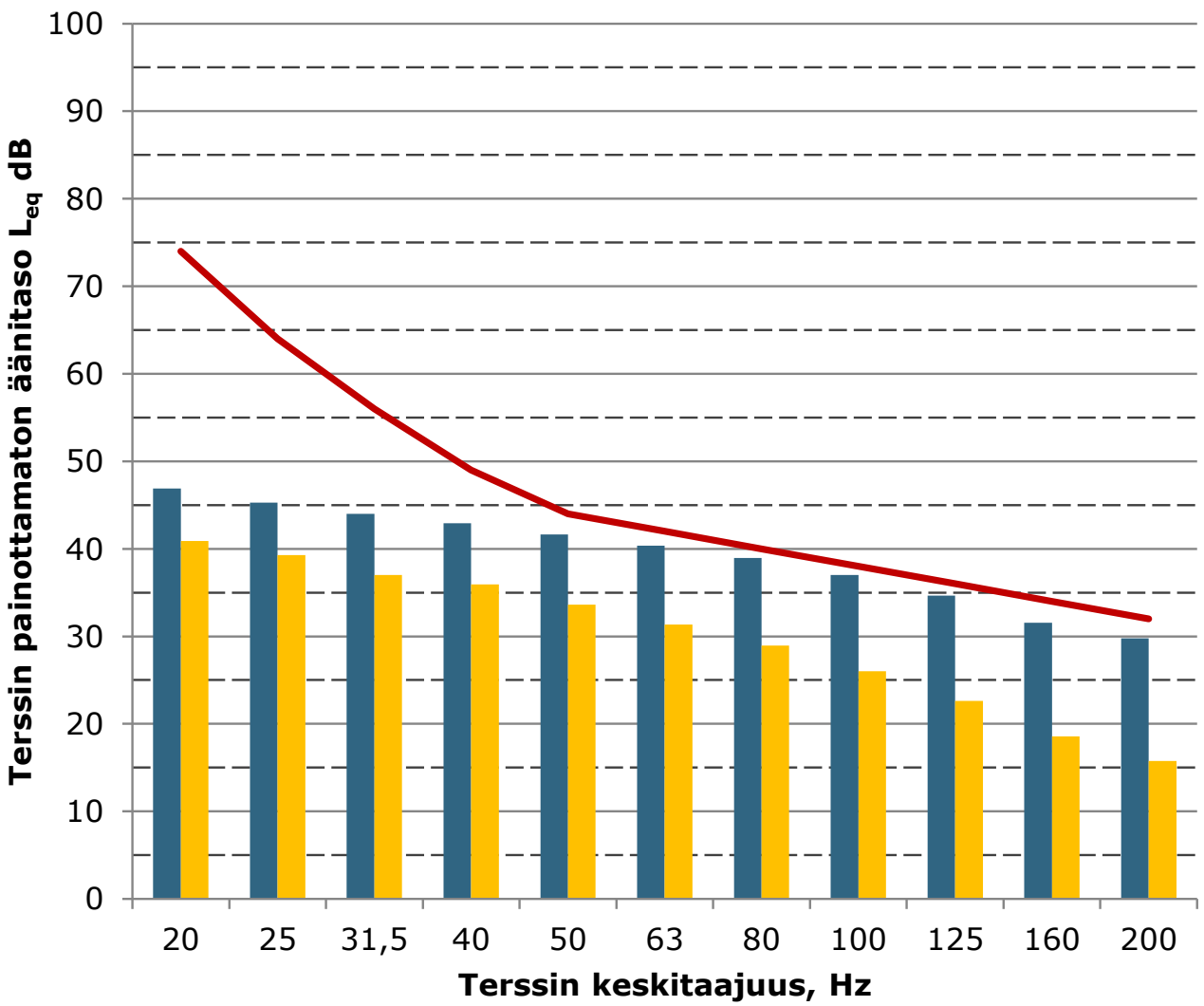
Äänitaso sisällä dB

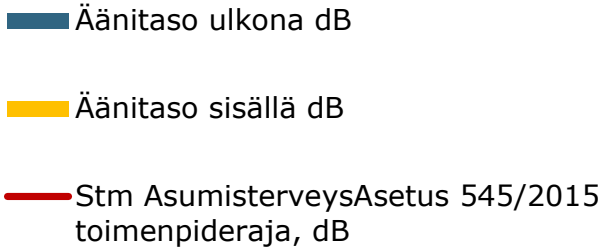
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB

Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus E (Raudaskallion metsatie), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan

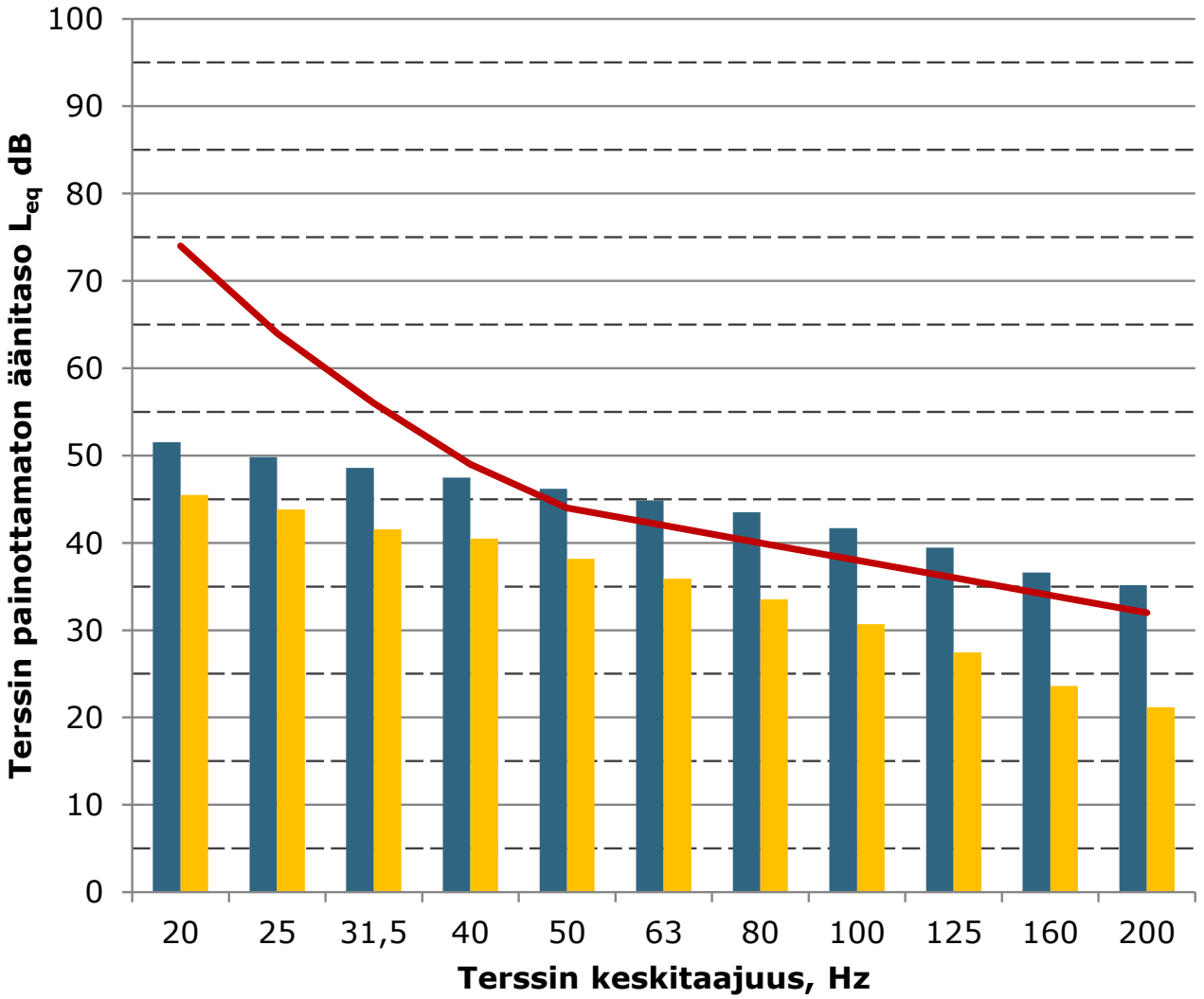


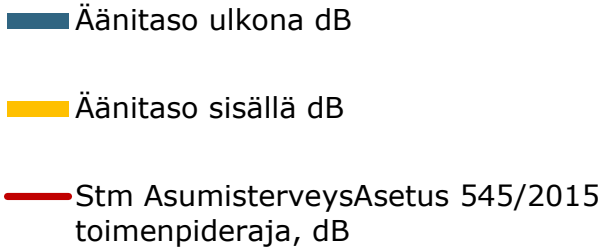


Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus F (Hirvinevanhaara 147), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan

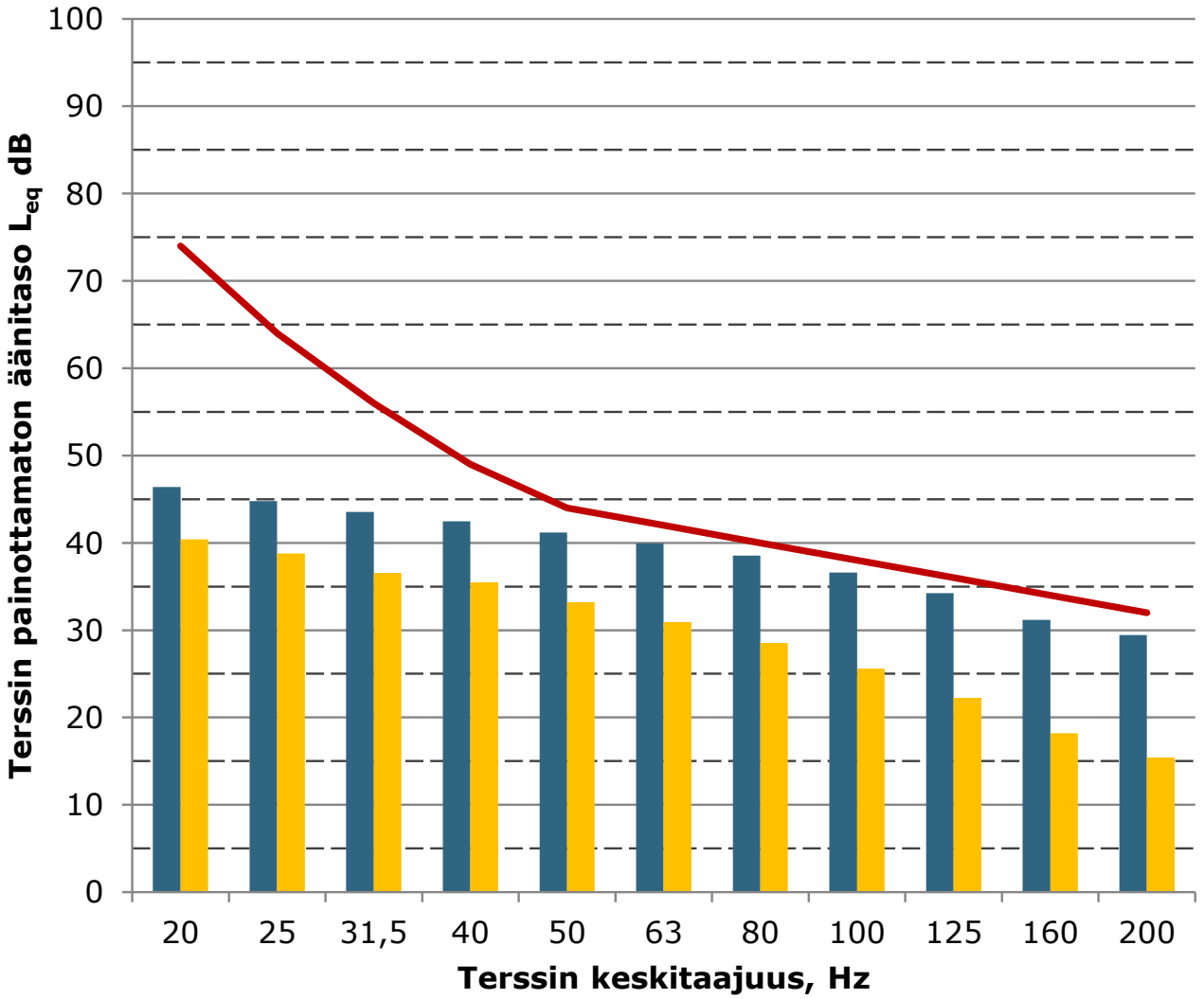


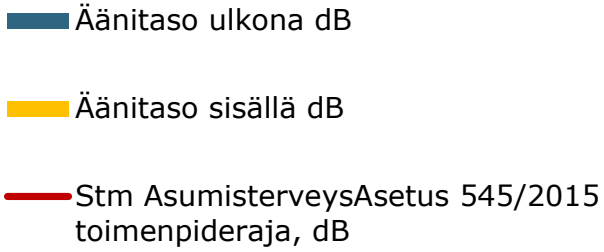


Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus G (Pohjanneva), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan

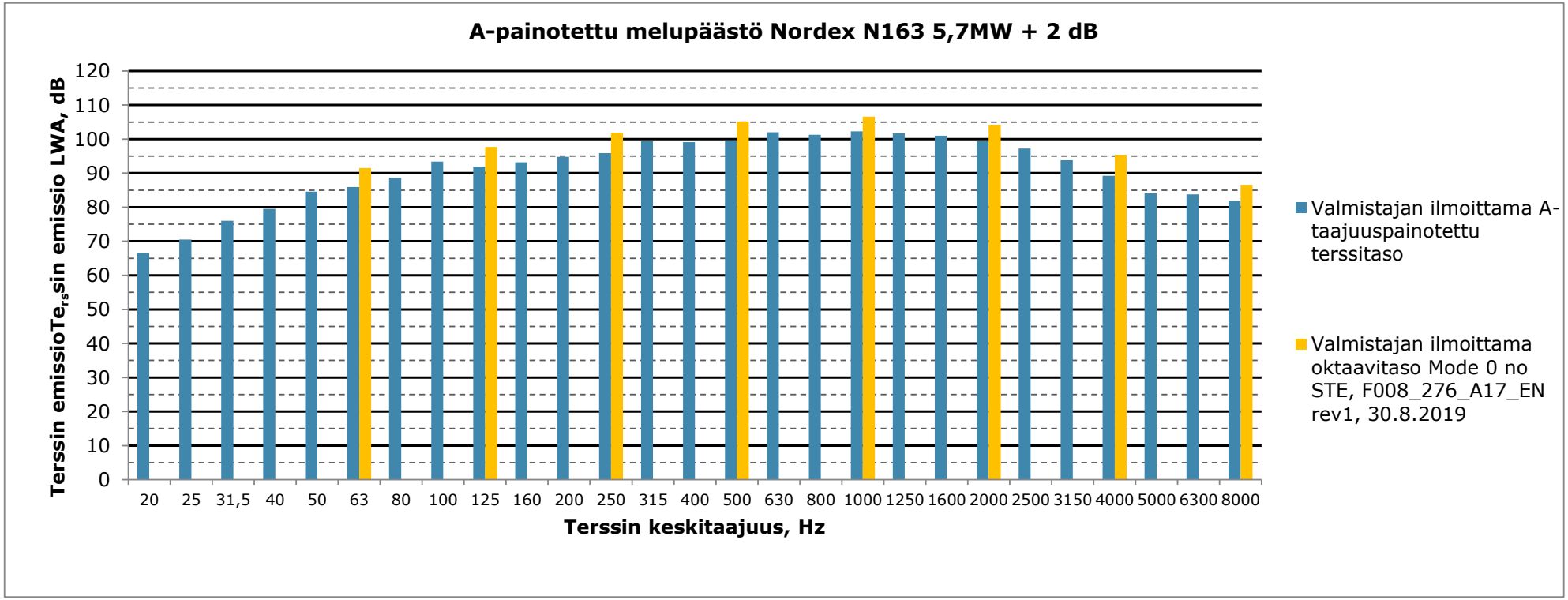


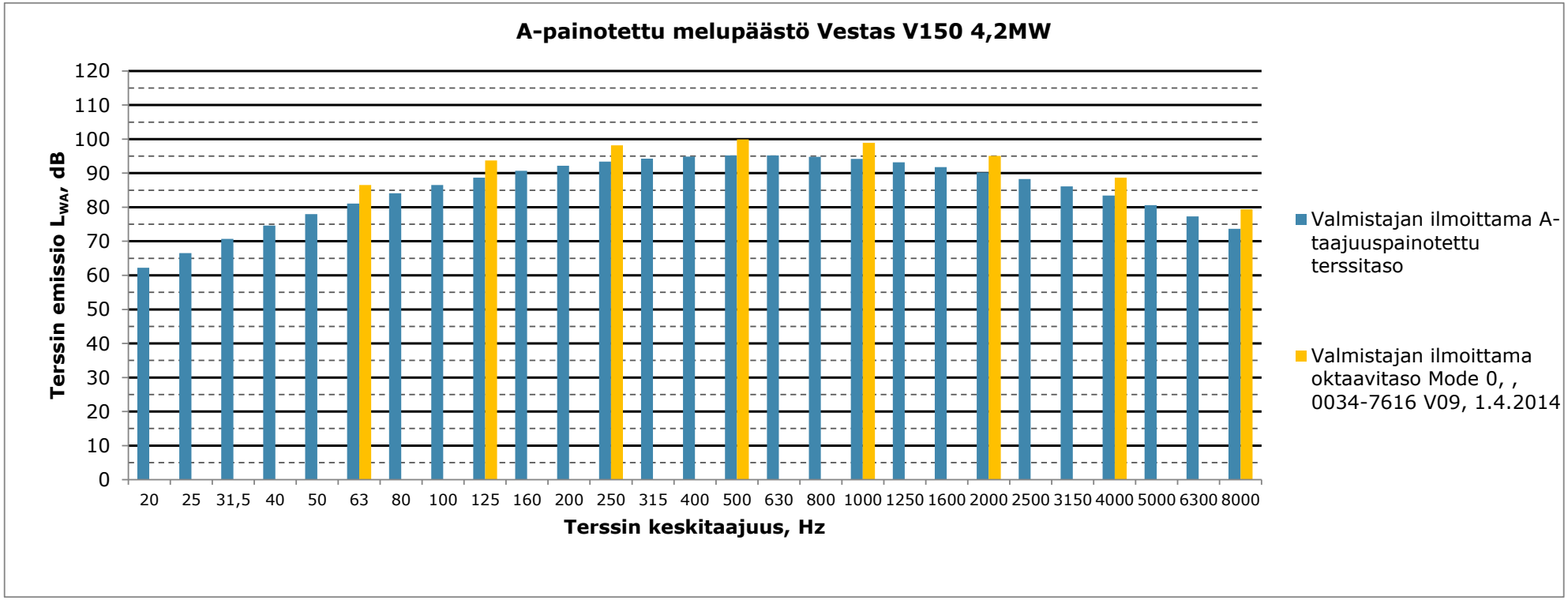


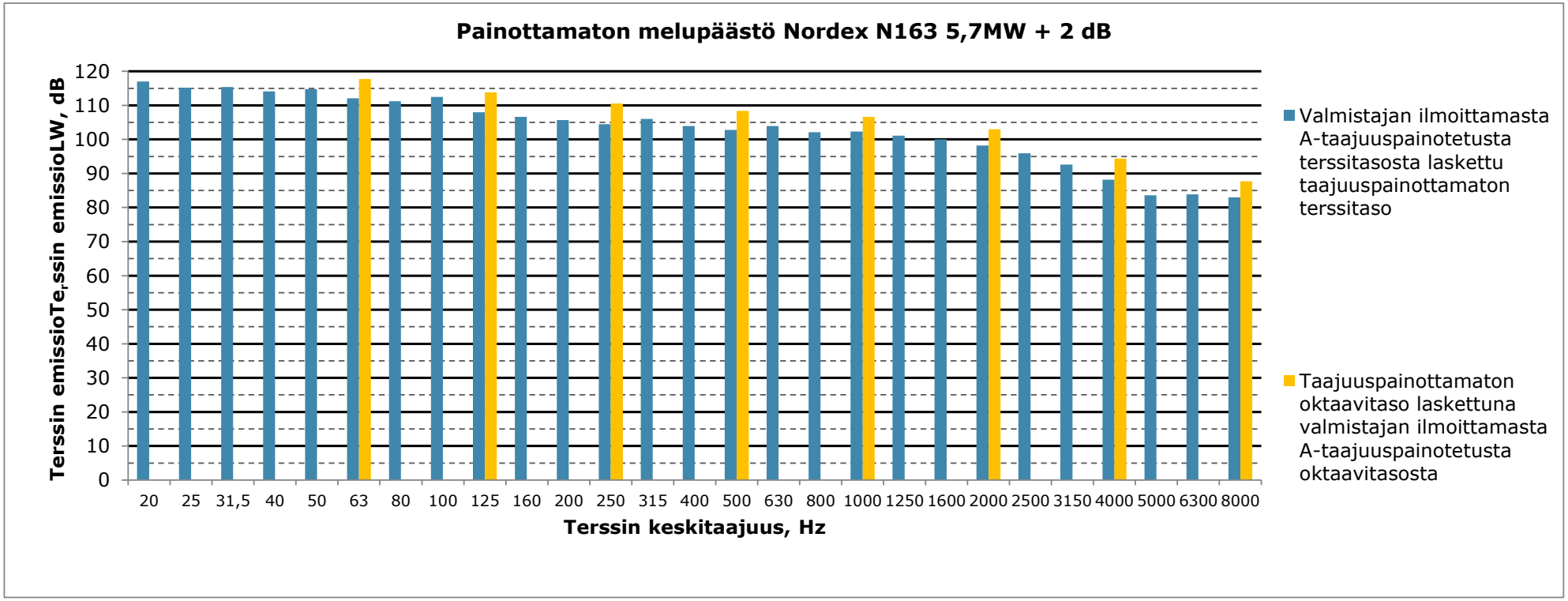
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl

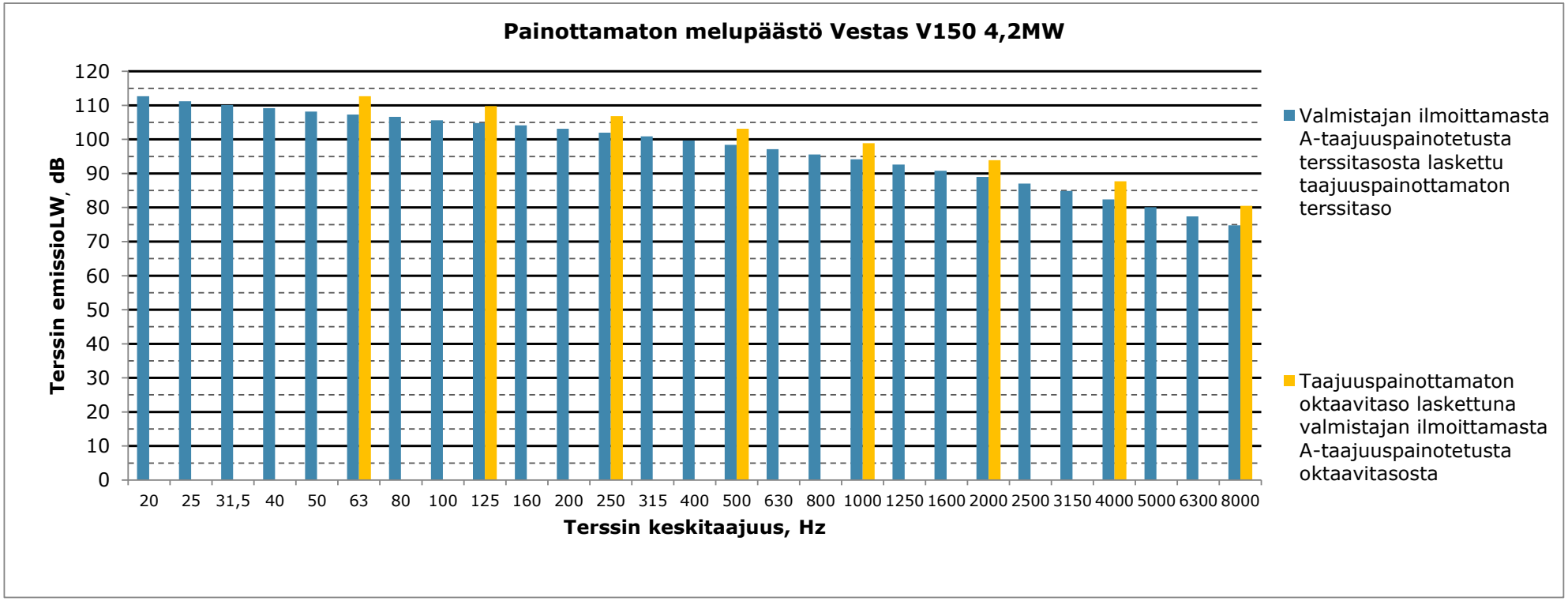
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Liite 4: N163 - Matalataajuisen melun rakennuskohtaiset arvot

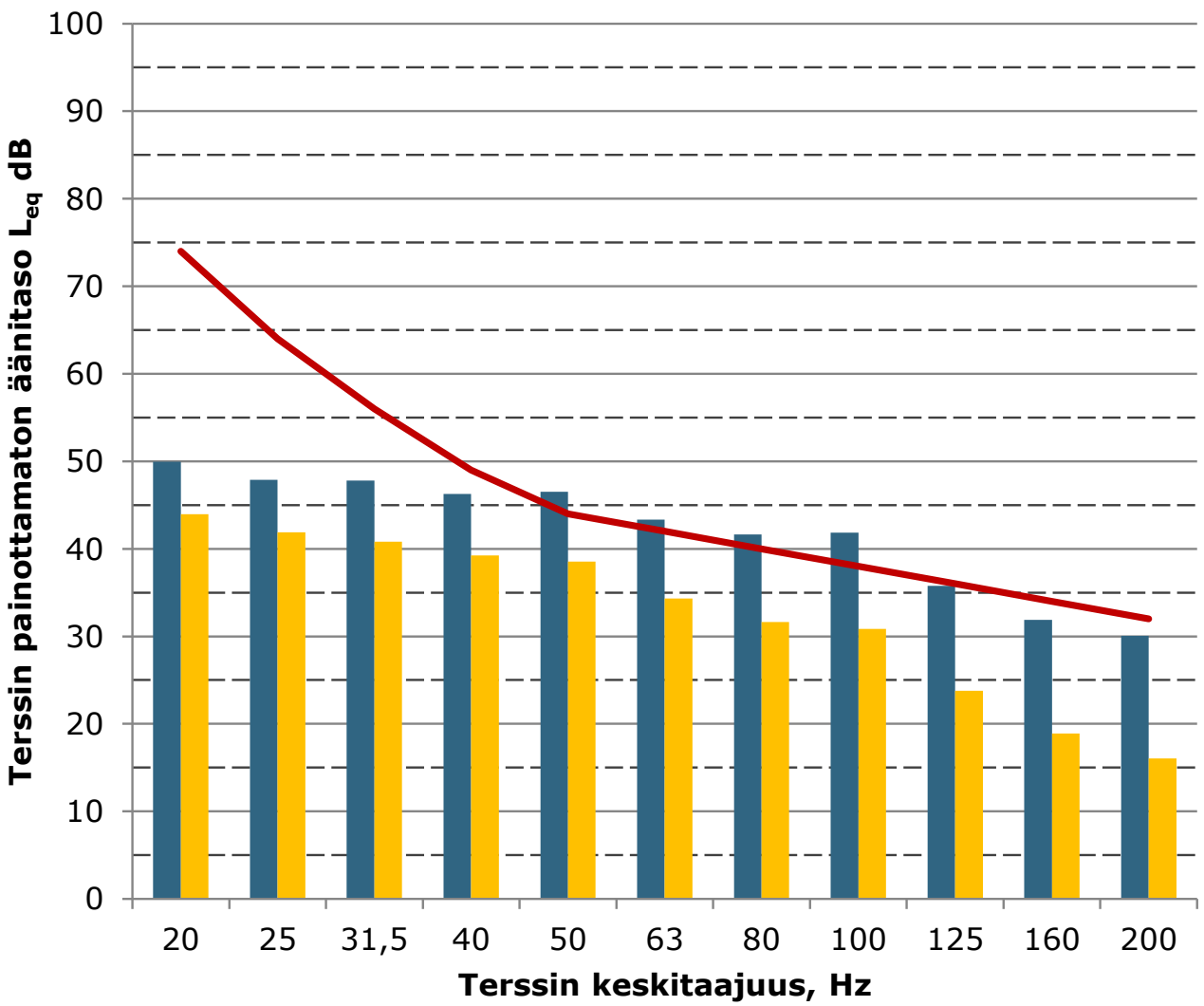

A-painotettu melupäästö Nordex N163 5,7MW + 2 dB
Terssin emissioTe$_{rs}$sin emissio LWA, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso Mode 0 no STE, F008_276_A17_EN rev1, 30.8.2019

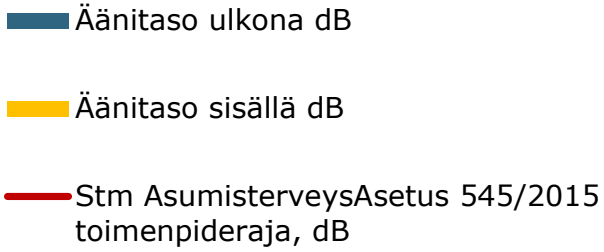

A-painotettu melupäästö Vestas V150 4,2MW
Terssin emissio L_{WA}, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso Mode 0, , 0034-7616 V09, 1.4.2014


Painottamaton melupäästö Nordex N163 5,7MW + 2 dB
Terssin emissioTe,ssin emissioLW, dB
0
10
20
30
40
50
60
70
80
90
100
110
120
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta


Painottamaton melupäästö Vestas V150 4,2MW
Terssin emissioLW, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus A (Hakuperäntie 202), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan



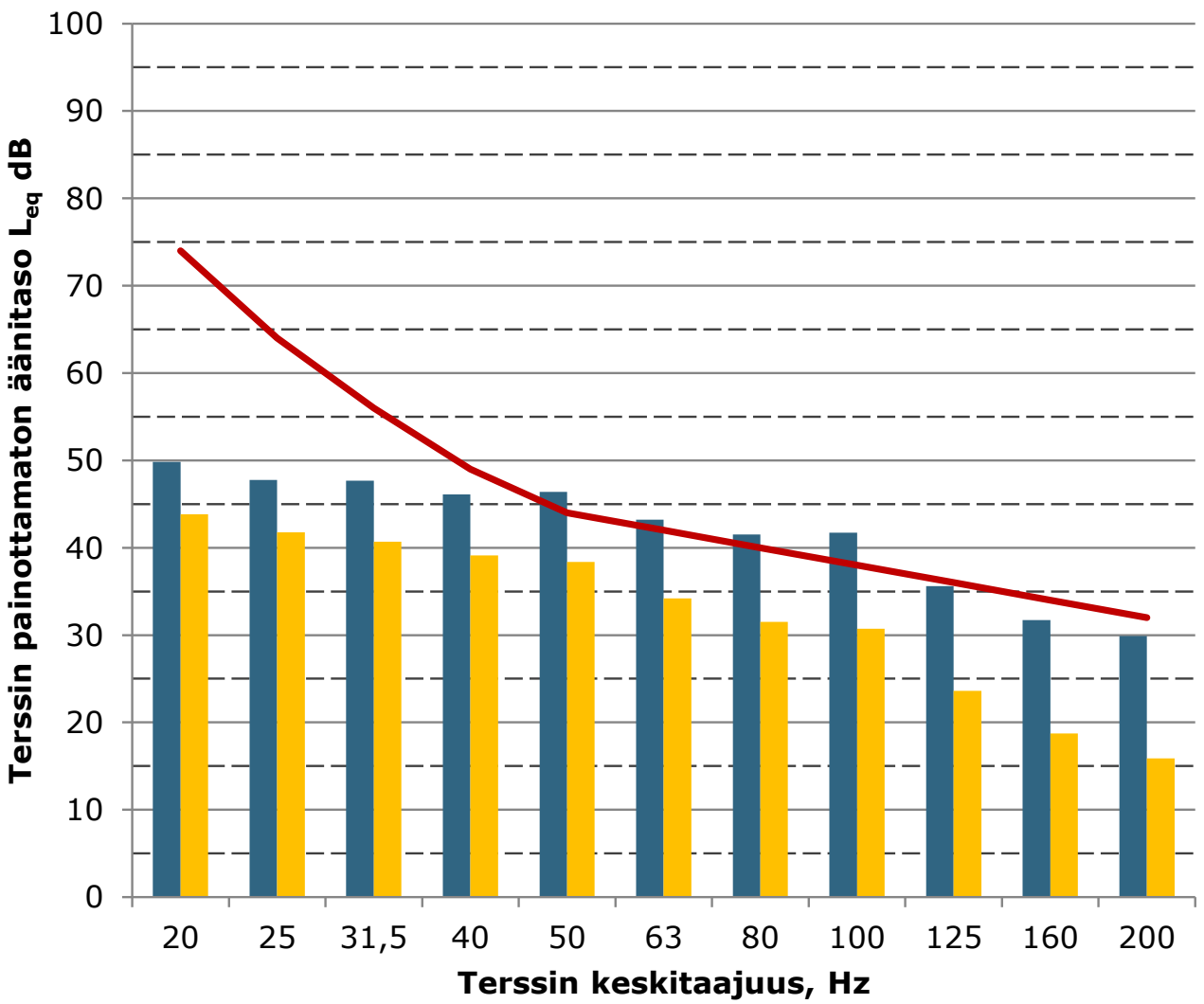


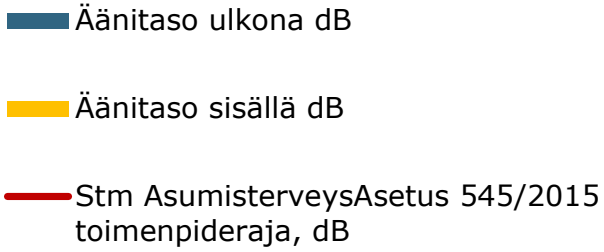
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Vestas V150 4,2MW	3,3 MW, 145 m,	4
Nordex N163 5,7MW + 2 dB	5,7 MW, 189,5 m,	9

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus B (Hakuperäntie 169), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan



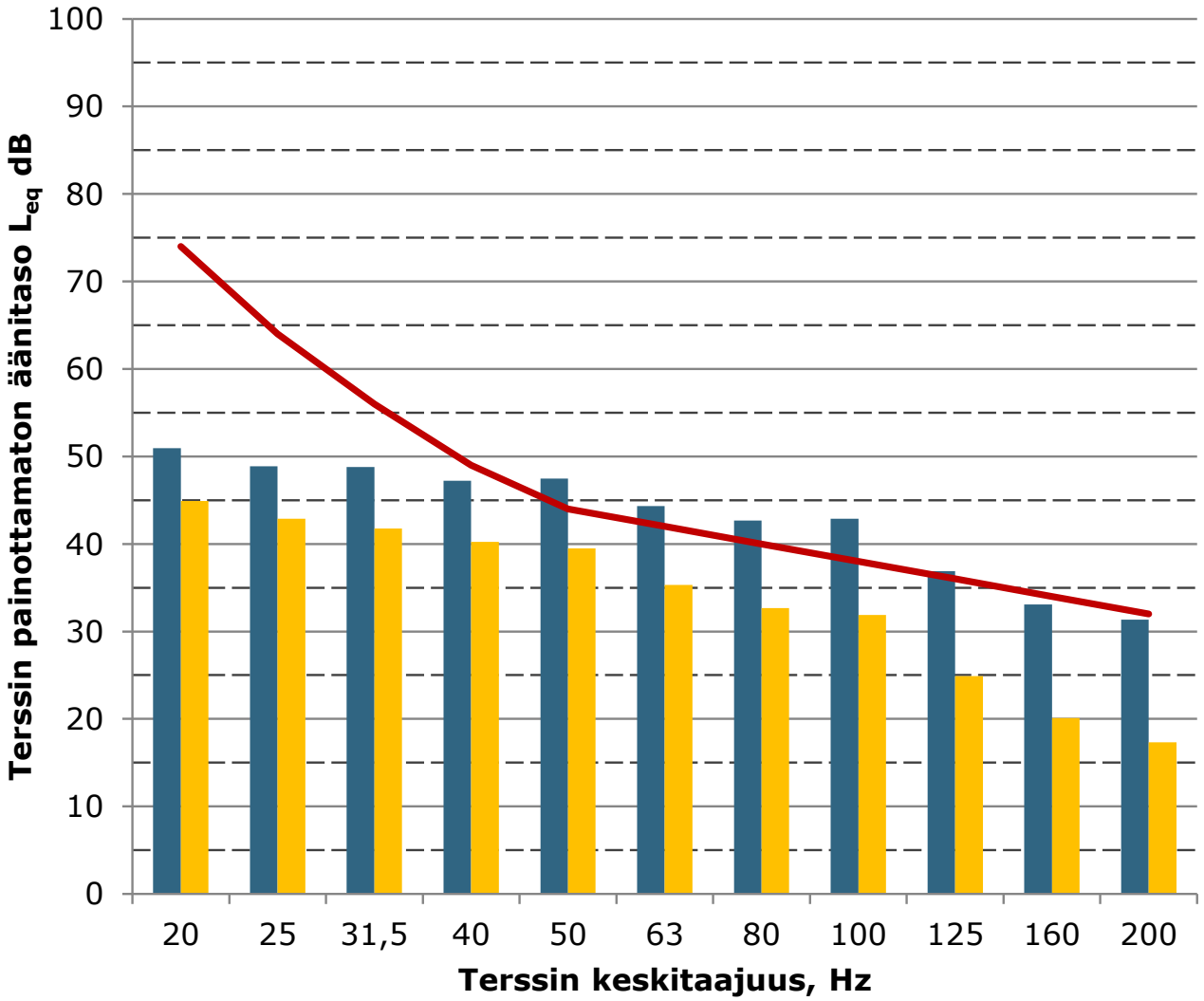


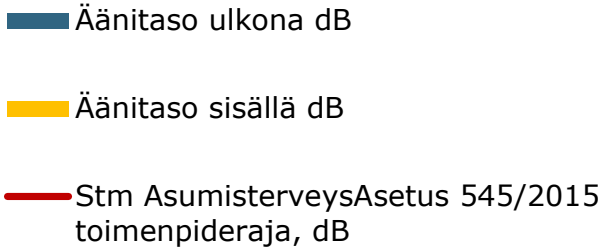
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Vestas V150 4,2MW	3,3 MW, 145 m,	4
Nordex N163 5,7MW + 2 dB	5,7 MW, 189,5 m,	9

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus C (Säilyntie 285), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan



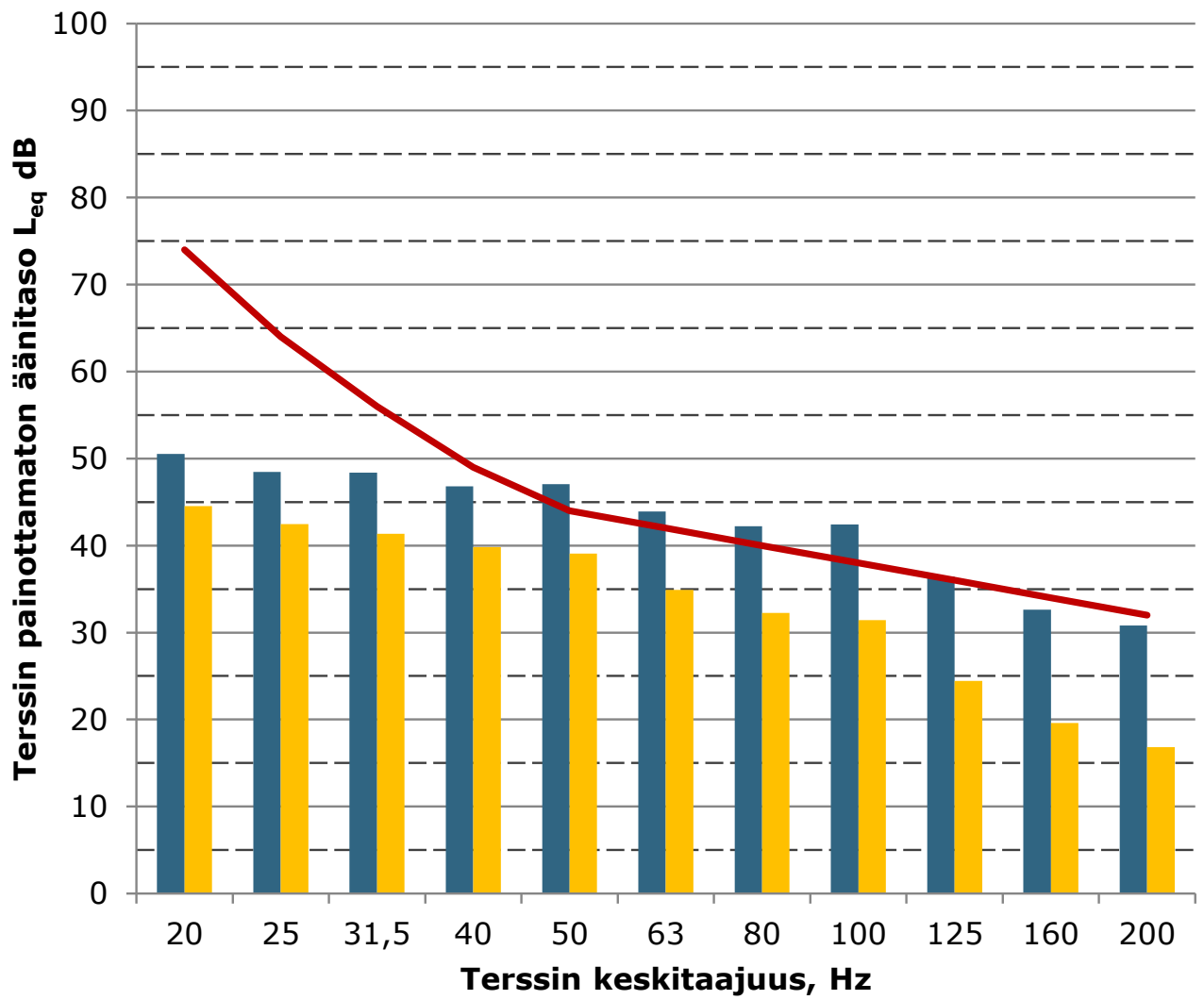


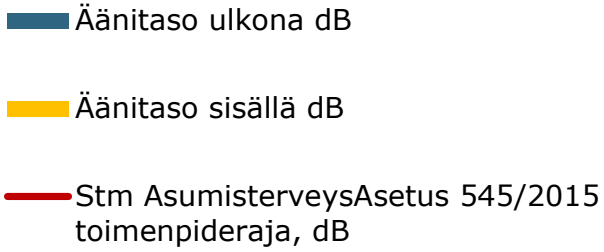
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Vestas V150 4,2MW	3,3 MW, 145 m,	4
Nordex N163 5,7MW + 2 dB	5,7 MW, 189,5 m,	9

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus D (Säilyntie 264), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan



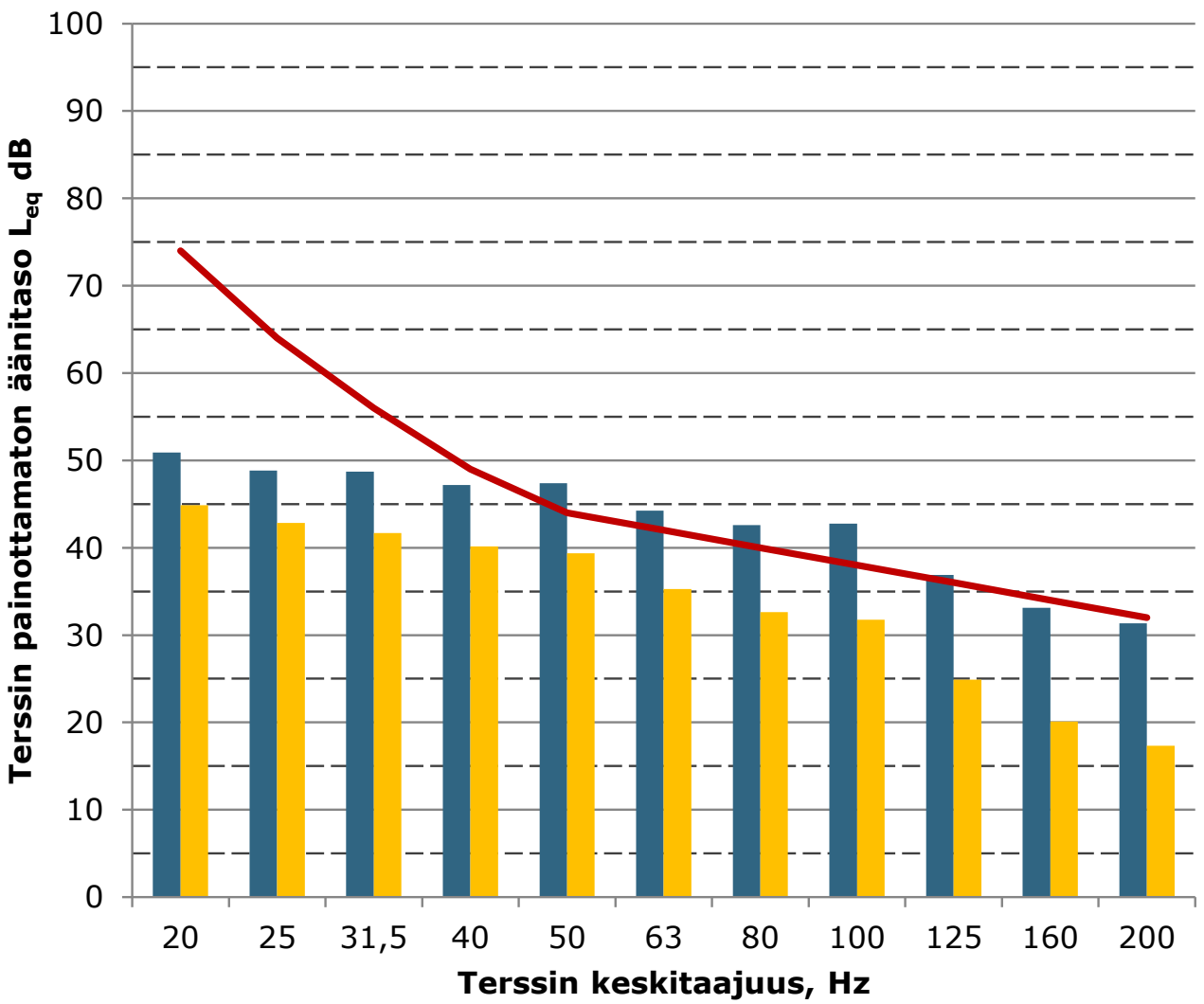


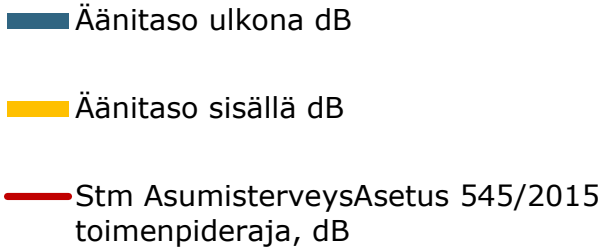
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Vestas V150 4,2MW	3,3 MW, 145 m,	4
Nordex N163 5,7MW + 2 dB	5,7 MW, 189,5 m,	9

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus E (Raudaskallion metsatie), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan



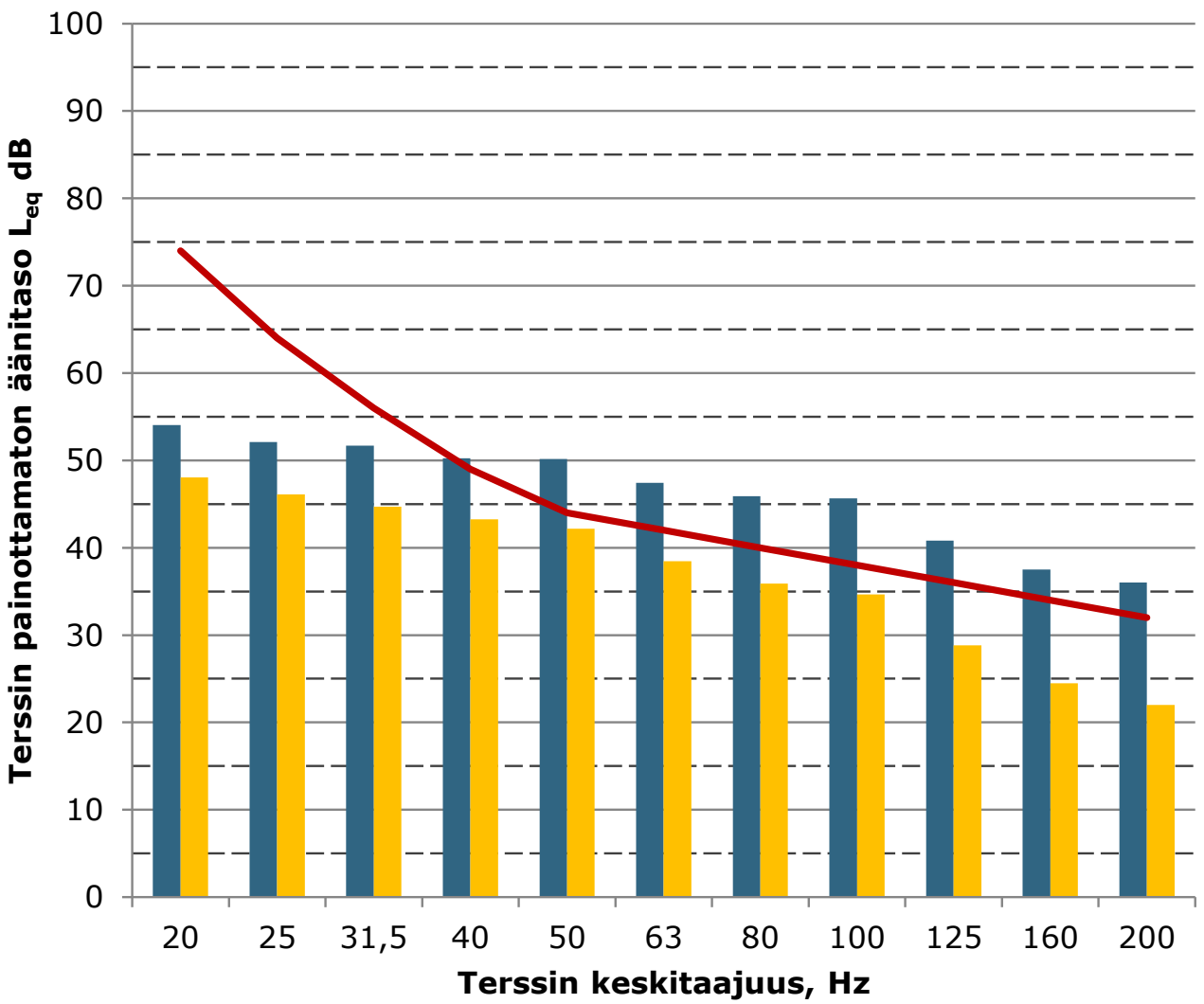


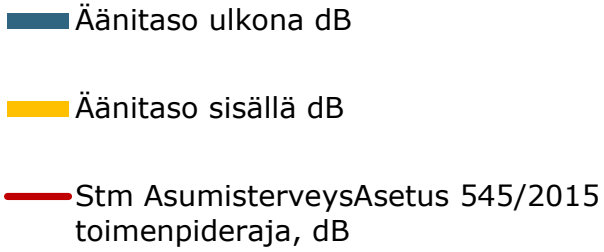
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Vestas V150 4,2MW	3,3 MW, 145 m,	4
Nordex N163 5,7MW + 2 dB	5,7 MW, 189,5 m,	9

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus F (Hirvinevanhaara 147), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan



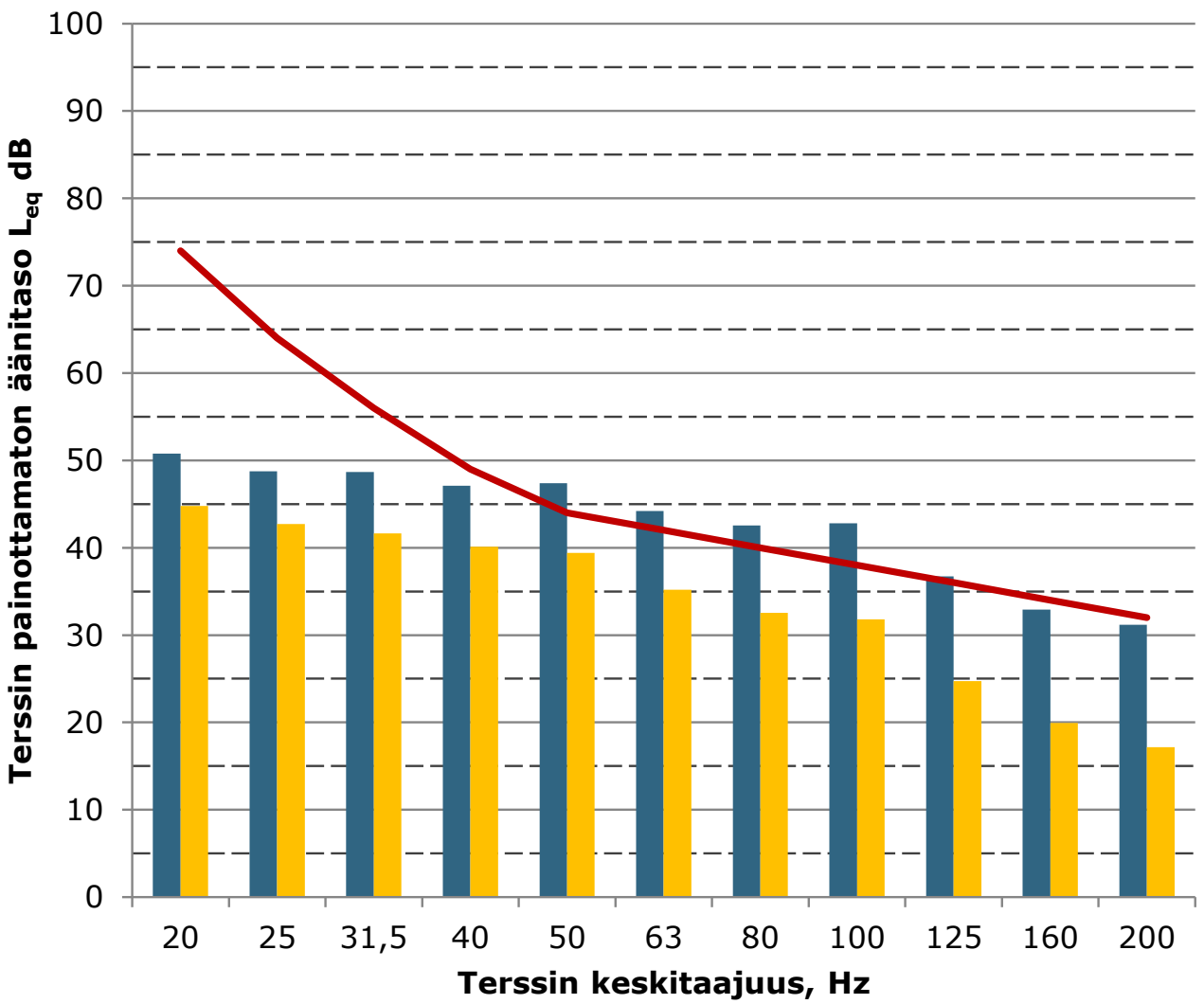


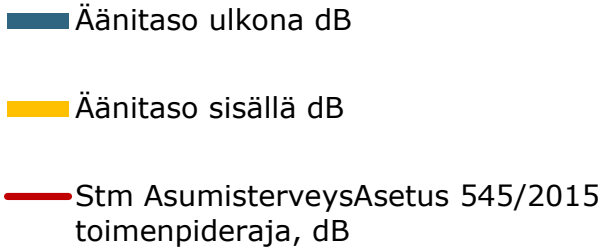
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Vestas V150 4,2MW	3,3 MW, 145 m,	4
Nordex N163 5,7MW + 2 dB	5,7 MW, 189,5 m,	9

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus G (Pohjanneva), ääneneristävyys Keränen,Hakala,Hongisto 2017, vähimmäisarvon estimaatti DL90 mukaan





Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Vestas V150 4,2MW	3,3 MW, 145 m,	4
Nordex N163 5,7MW + 2 dB	5,7 MW, 189,5 m,	9

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen": Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Liite 5: Varjostusmallinnusten tulokset ”real case, no forest”

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Main Result

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906

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

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

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

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Urakkaneva_2020052
Obstacles used in calculation
Eye height for map: 1,5 m
Grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89

WTGs

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	395638	7103907	90,4	VESTAS V150-4.2 4200 150.0 !O! h...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	1902	10,4
2	396514	7103767	95,0	VESTAS V150-4.2 4200 150.0 !O! h...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	1902	10,4
3	395550	7103150	89,6	VESTAS V150-4.2 4200 150.0 !O! h...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	1902	10,4
4	394929	7103873	86,8	VESTAS V150-4.2 4200 150.0 !O! h...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	1902	10,4
5	396213	7101101	93,0	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
6	397616	7100723	97,6	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
7	397086	7101114	95,0	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
8	397318	7100046	97,1	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
9	395742	7100512	93,3	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
10	396517	7099615	95,2	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
11	396717	7100499	95,4	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
12	397043	7099259	96,0	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
13	395944	7099965	95,0	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Asuinrakennus A (Hakuperäntie 202)	397098	7096526	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B (Hakuperäntie 169)	396724	7096452	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Asuinrakennus C (Säilyntie 285)	393762	7098532	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D (Säilyntie 264)	393460	7098729	84,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E (Raudaskallion metsatie)	393183	7099996	87,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Lomarakennus F (Hirvinevanhaara 147)	394644	7102345	90,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Lomarakennus G (Pohjanneva)	397651	7096966	97,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Main Result

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Asuinrakennus A (Hakuperäntie 202)	0:00
B	Asuinrakennus B (Hakuperäntie 169)	0:00
C	Asuinrakennus C (Säilyntie 285)	0:00
D	Asuinrakennus D (Säilyntie 264)	0:00
E	Lomarakennus E (Raudaskallion metsatie)	0:00
F	Lomarakennus F (Hirvinevanhaara 147)	10:19
G	Lomarakennus G (Pohjanneva)	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (79)	0:00	0:00
2	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (80)	0:00	0:00
3	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (81)	25:43	6:58
4	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (82)	0:00	0:00
5	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (89)	8:05	1:44
6	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (90)	0:00	0:00
7	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (91)	0:00	0:00
8	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (92)	0:00	0:00
9	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (93)	9:00	1:32
10	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (94)	0:00	0:00
11	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (95)	0:00	0:00
12	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (96)	0:00	0:00
13	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (97)	0:00	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

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Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 Shadow receptor: A - Asuinrakennus A (Hakuperäntie 202)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.11	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.00	09.34
	14.38	16.07	17.37	20.09	21.41	23.18	23.47	22.26	20.40	18.53	16.08	14.45
2	10.10	09.00	07.28	06.39	04.54	03.19	03.02	04.29	06.04	07.30	08.03	09.37
	14.40	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.43
3	10.09	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.42	16.14	17.43	20.15	21.47	23.23	23.44	22.20	20.32	18.46	16.01	14.41
4	10.08	08.54	07.21	06.32	04.48	03.14	03.06	04.36	06.10	07.35	08.10	09.42
	14.44	16.17	17.46	20.18	21.50	23.26	23.42	22.16	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.12	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.25	18.39	15.55	14.37
6	10.05	08.48	07.14	06.25	04.41	03.10	03.11	04.42	06.15	07.41	08.16	09.47
	14.48	16.23	17.52	20.24	21.57	23.31	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.08	03.13	04.45	06.18	07.44	08.19	09.50
	14.51	16.27	17.55	20.27	22.00	23.33	23.37	22.06	20.18	18.32	15.49	14.34
8	10.02	08.41	07.07	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.52
	14.53	16.30	17.58	20.30	22.03	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.00	08.38	07.04	06.15	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.54
	14.56	16.33	18.01	20.33	22.06	23.38	23.32	21.59	20.11	18.26	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.40	23.30	21.56	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.23	04.58	06.30	07.56	08.32	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.37	14.29
12	09.55	08.29	06.53	06.04	04.21	02.58	03.25	05.01	06.33	07.59	08.36	10.00
	15.04	16.43	18.10	20.42	22.16	23.44	23.25	21.49	20.01	18.15	15.34	14.28
13	09.53	08.25	06.50	06.00	04.18	02.56	03.28	05.04	06.35	08.02	08.39	10.02
	15.07	16.46	18.13	20.45	22.19	23.45	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.10	16.50	18.16	20.48	22.23	23.47	23.20	21.42	19.54	18.08	15.28	14.26
15	09.48	08.19	06.43	05.53	04.11	02.54	03.34	05.10	06.41	08.08	08.45	10.06
	15.13	16.53	18.19	20.51	22.26	23.48	23.17	21.39	19.50	18.05	15.25	14.26
16	09.46	08.15	06.39	05.50	04.08	02.54	03.37	05.13	06.44	08.11	08.48	10.07
	15.16	16.56	18.22	20.54	22.29	23.49	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.08
	15.19	16.59	18.25	20.57	22.32	23.50	23.12	21.32	19.43	17.58	15.19	14.25
18	09.41	08.09	06.32	05.43	04.02	02.53	03.43	05.19	06.50	08.17	08.55	10.09
	15.22	17.02	18.28	21.00	22.35	23.51	23.09	21.29	19.39	17.55	15.16	14.25
19	09.39	08.05	06.29	05.39	03.59	02.52	03.46	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.03	22.39	23.52	23.06	21.25	19.36	17.51	15.14	14.25
20	09.36	08.02	06.25	05.36	03.55	02.52	03.49	05.25	06.55	08.23	09.01	10.11
	15.28	17.09	18.34	21.06	22.42	23.53	23.03	21.22	19.32	17.48	15.11	14.25
21	09.34	07.59	06.22	05.32	03.52	02.52	03.52	05.28	06.58	08.26	09.04	10.12
	15.31	17.12	18.37	21.09	22.45	23.53	23.01	21.18	19.29	17.44	15.08	14.25
22	09.31	07.55	06.18	05.29	03.49	02.53	03.55	05.31	07.01	08.29	09.07	10.13
	15.34	17.15	18.40	21.13	22.48	23.53	22.58	21.15	19.25	17.41	15.06	14.25
23	09.29	07.52	06.15	05.25	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.13
	15.37	17.18	18.43	21.16	22.51	23.53	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.21	18.46	21.19	22.54	23.53	22.51	21.08	19.18	17.34	15.00	14.27
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.57	23.53	22.48	21.04	19.15	16.31	14.58	14.27
26	09.20	07.42	06.04	05.15	03.38	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.28	18.51	21.25	23.01	23.52	22.45	21.01	19.11	16.28	14.56	14.28
27	09.18	07.38	06.01	05.12	03.35	02.57	04.10	05.46	07.15	07.44	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.51	22.42	20.57	19.08	16.24	14.53	14.30
28	09.15	07.35	05.57	05.08	03.32	02.58	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.31	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.53	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.13
	15.57		20.00	21.34	23.09	23.50	22.36	20.50	19.00	16.18	14.49	14.32
30	09.09		06.50	05.01	03.27	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.12	23.48	22.33	20.47	18.57	16.14	14.47	14.34
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.04		20.06		23.15		22.29	20.43		16.11		14.35
Potential sun hours	173	238	363	451	568	621	607	508	393	305	199	139
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 Shadow receptor: B - Asuinrakennus B (Hakuperäntie 169)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.11	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.00	09.34
	14.38	16.07	17.37	20.09	21.41	23.18	23.47	22.26	20.40	18.54	16.08	14.45
2	10.10	09.00	07.28	06.39	04.54	03.19	03.03	04.29	06.04	07.30	08.03	09.37
	14.40	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.43
3	10.09	08.57	07.25	06.36	04.51	03.17	03.04	04.32	06.07	07.33	08.07	09.40
	14.42	16.14	17.43	20.15	21.47	23.23	23.44	22.20	20.33	18.46	16.02	14.41
4	10.08	08.54	07.21	06.32	04.48	03.14	03.06	04.36	06.10	07.35	08.10	09.42
	14.44	16.17	17.46	20.18	21.50	23.26	23.42	22.16	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.13	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.25	18.39	15.55	14.37
6	10.05	08.48	07.14	06.25	04.41	03.10	03.11	04.42	06.15	07.41	08.16	09.47
	14.48	16.23	17.52	20.24	21.57	23.31	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.08	03.13	04.45	06.18	07.44	08.19	09.50
	14.51	16.27	17.55	20.27	22.00	23.33	23.37	22.06	20.18	18.33	15.49	14.34
8	10.02	08.41	07.07	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.52
	14.53	16.30	17.58	20.30	22.03	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.00	08.38	07.04	06.15	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.54
	14.56	16.33	18.01	20.33	22.06	23.38	23.32	22.00	20.11	18.26	15.43	14.31
10	09.59	08.35	07.00	06.11	04.28	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.40	23.30	21.56	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.08	04.24	03.01	03.23	04.58	06.30	07.56	08.32	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.37	14.29
12	09.55	08.29	06.53	06.04	04.21	02.58	03.26	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.16	23.44	23.25	21.49	20.01	18.15	15.34	14.28
13	09.53	08.25	06.50	06.00	04.18	02.56	03.28	05.04	06.35	08.02	08.39	10.02
	15.07	16.46	18.13	20.45	22.19	23.45	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.10	16.50	18.16	20.48	22.23	23.47	23.20	21.42	19.54	18.08	15.28	14.26
15	09.48	08.19	06.43	05.53	04.11	02.54	03.34	05.10	06.41	08.08	08.45	10.06
	15.13	16.53	18.19	20.51	22.26	23.48	23.18	21.39	19.50	18.05	15.25	14.26
16	09.46	08.15	06.39	05.50	04.08	02.54	03.37	05.13	06.44	08.11	08.48	10.07
	15.16	16.56	18.22	20.54	22.29	23.49	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.08
	15.19	16.59	18.25	20.57	22.32	23.50	23.12	21.32	19.43	17.58	15.19	14.25
18	09.41	08.09	06.32	05.43	04.02	02.53	03.43	05.19	06.50	08.17	08.55	10.10
	15.22	17.02	18.28	21.00	22.35	23.51	23.09	21.29	19.39	17.55	15.16	14.25
19	09.39	08.05	06.29	05.39	03.59	02.52	03.46	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.03	22.39	23.52	23.06	21.25	19.36	17.51	15.14	14.25
20	09.36	08.02	06.25	05.36	03.55	02.52	03.49	05.25	06.55	08.23	09.01	10.11
	15.28	17.09	18.34	21.06	22.42	23.53	23.03	21.22	19.32	17.48	15.11	14.25
21	09.34	07.59	06.22	05.32	03.52	02.52	03.52	05.28	06.58	08.26	09.04	10.12
	15.31	17.12	18.37	21.09	22.45	23.53	23.01	21.18	19.29	17.44	15.08	14.25
22	09.31	07.55	06.18	05.29	03.49	02.53	03.55	05.31	07.01	08.29	09.07	10.13
	15.34	17.15	18.40	21.13	22.48	23.53	22.58	21.15	19.25	17.41	15.06	14.25
23	09.29	07.52	06.15	05.25	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.13
	15.37	17.18	18.43	21.16	22.51	23.53	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.21	18.46	21.19	22.54	23.53	22.51	21.08	19.18	17.34	15.00	14.27
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.57	23.53	22.48	21.04	19.15	16.31	14.58	14.28
26	09.20	07.42	06.04	05.15	03.38	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.52	22.45	21.01	19.11	16.28	14.56	14.28
27	09.18	07.38	06.01	05.12	03.35	02.57	04.10	05.46	07.15	07.44	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.51	22.42	20.57	19.08	16.24	14.53	14.30
28	09.15	07.35	05.57	05.08	03.32	02.58	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.31	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.53	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.13
	15.57		20.00	21.34	23.09	23.50	22.36	20.50	19.01	16.18	14.49	14.32
30	09.09		06.50	05.01	03.27	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.12	23.48	22.33	20.47	18.57	16.14	14.47	14.34
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.04		20.06		23.15		22.29	20.43		16.11		14.35
Potential sun hours	173	238	363	451	568	621	607	508	393	305	199	139
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 Shadow receptor: C - Asuinrakennus C (Säilyntie 285)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.01	09.35
	14.38	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.45
2	10.11	09.00	07.28	06.40	04.55	03.19	03.02	04.29	06.04	07.30	08.04	09.38
	14.40	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.43
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.33	06.07	07.33	08.07	09.40
	14.42	16.14	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.47	16.02	14.41
4	10.08	08.54	07.22	06.32	04.48	03.14	03.06	04.36	06.10	07.36	08.10	09.43
	14.44	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.13	07.39	08.13	09.46
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.40	15.55	14.37
6	10.06	08.48	07.15	06.25	04.41	03.10	03.10	04.42	06.16	07.42	08.17	09.48
	14.48	16.24	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.38	03.08	03.13	04.45	06.18	07.44	08.20	09.50
	14.51	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.19	18.33	15.49	14.34
8	10.03	08.42	07.08	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39	07.04	06.15	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.55
	14.56	16.33	18.01	20.33	22.07	23.38	23.33	22.00	20.12	18.26	15.43	14.31
10	09.59	08.35	07.01	06.11	04.28	03.02	03.20	04.55	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.08	04.24	03.00	03.23	04.58	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.37	14.29
12	09.55	08.29	06.54	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.34	14.28
13	09.53	08.26	06.50	06.01	04.18	02.56	03.28	05.04	06.36	08.02	08.39	10.03
	15.07	16.47	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.47	05.57	04.14	02.55	03.31	05.07	06.39	08.05	08.42	10.05
	15.10	16.50	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.54	04.11	02.54	03.34	05.10	06.41	08.08	08.46	10.06
	15.13	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.26
16	09.47	08.16	06.40	05.50	04.08	02.53	03.37	05.13	06.44	08.11	08.49	10.08
	15.16	16.56	18.22	20.54	22.30	23.50	23.15	21.36	19.47	18.02	15.22	14.25
17	09.44	08.12	06.36	05.47	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.09
	15.19	16.59	18.25	20.58	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.25
18	09.42	08.09	06.33	05.43	04.02	02.52	03.43	05.19	06.50	08.17	08.55	10.10
	15.22	17.03	18.28	21.01	22.36	23.52	23.10	21.29	19.40	17.55	15.16	14.25
19	09.39	08.06	06.29	05.40	03.59	02.52	03.46	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.04	22.39	23.53	23.07	21.26	19.36	17.51	15.14	14.25
20	09.37	08.02	06.26	05.36	03.55	02.52	03.49	05.25	06.56	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.33	17.48	15.11	14.25
21	09.34	07.59	06.22	05.33	03.52	02.52	03.52	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.19	19.29	17.45	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.55	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.06	14.25
23	09.29	07.52	06.15	05.26	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.14
	15.38	17.18	18.43	21.16	22.52	23.54	22.55	21.12	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.22	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.01	14.27
25	09.24	07.46	06.08	05.19	03.40	02.54	04.04	05.40	07.10	07.39	09.17	10.14
	15.44	17.25	18.49	21.22	22.58	23.53	22.49	21.05	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.38	02.55	04.07	05.43	07.13	07.42	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.56	14.28
27	09.18	07.39	06.01	05.12	03.35	02.56	04.10	05.46	07.16	07.45	09.23	10.14
	15.51	17.31	18.55	21.29	23.04	23.52	22.43	20.58	19.08	16.24	14.53	14.30
28	09.15	07.35	05.57	05.08	03.32	02.58	04.14	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.54	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.14
	15.57		20.01	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.49	14.32
30	09.09		06.50	05.01	03.27	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.04	21.38	23.13	23.49	22.33	20.47	18.57	16.15	14.47	14.34
31	09.06		06.47		03.24		04.23	05.58		07.57		10.13
	16.04		20.07		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	568	622	607	508	393	305	199	138
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 Shadow receptor: D - Asuinrakennus D (Säilyntie 264)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.01	09.35
	14.38	16.07	17.37	20.10	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.45
2	10.11	09.00	07.28	06.40	04.55	03.19	03.02	04.29	06.04	07.30	08.04	09.38
	14.40	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.43
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.33	06.07	07.33	08.07	09.40
	14.42	16.14	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.47	16.02	14.41
4	10.08	08.54	07.22	06.32	04.48	03.14	03.06	04.36	06.10	07.36	08.10	09.43
	14.44	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.13	07.39	08.13	09.46
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.40	15.55	14.37
6	10.06	08.48	07.15	06.25	04.41	03.10	03.10	04.42	06.16	07.42	08.17	09.48
	14.48	16.24	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.38	03.08	03.13	04.45	06.19	07.44	08.20	09.50
	14.51	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.19	18.33	15.49	14.34
8	10.03	08.42	07.08	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39	07.04	06.15	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.55
	14.56	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.12	18.26	15.43	14.31
10	09.59	08.35	07.01	06.11	04.28	03.02	03.20	04.55	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.08	04.24	03.00	03.23	04.58	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.05	18.19	15.37	14.29
12	09.55	08.29	06.54	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.34	14.28
13	09.53	08.26	06.50	06.01	04.18	02.56	03.28	05.04	06.36	08.02	08.39	10.03
	15.07	16.47	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.47	05.57	04.14	02.55	03.31	05.07	06.39	08.05	08.42	10.05
	15.10	16.50	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.54	04.11	02.54	03.34	05.10	06.41	08.08	08.46	10.06
	15.13	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.26
16	09.47	08.16	06.40	05.50	04.08	02.53	03.37	05.13	06.44	08.11	08.49	10.08
	15.16	16.56	18.22	20.55	22.30	23.50	23.15	21.36	19.47	18.02	15.22	14.25
17	09.44	08.13	06.36	05.47	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.09
	15.19	16.59	18.25	20.58	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.25
18	09.42	08.09	06.33	05.43	04.02	02.52	03.43	05.19	06.50	08.17	08.55	10.10
	15.22	17.03	18.28	21.01	22.36	23.52	23.10	21.29	19.40	17.55	15.16	14.25
19	09.39	08.06	06.29	05.40	03.59	02.52	03.46	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.04	22.39	23.53	23.07	21.26	19.36	17.51	15.14	14.25
20	09.37	08.02	06.26	05.36	03.55	02.52	03.49	05.25	06.56	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.33	17.48	15.11	14.25
21	09.34	07.59	06.22	05.33	03.52	02.52	03.52	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.19	19.29	17.45	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.55	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.26	17.41	15.06	14.25
23	09.29	07.52	06.15	05.26	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.14
	15.38	17.18	18.43	21.16	22.52	23.54	22.55	21.12	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.22	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.01	14.27
25	09.24	07.46	06.08	05.19	03.40	02.54	04.04	05.40	07.10	07.39	09.17	10.14
	15.44	17.25	18.49	21.22	22.58	23.53	22.49	21.05	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.38	02.55	04.07	05.43	07.13	07.42	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.56	14.28
27	09.18	07.39	06.01	05.12	03.35	02.56	04.10	05.46	07.16	07.45	09.23	10.14
	15.51	17.31	18.55	21.29	23.04	23.52	22.43	20.58	19.08	16.24	14.53	14.30
28	09.15	07.35	05.57	05.08	03.32	02.58	04.14	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.54	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.14
	15.57		20.01	21.35	23.10	23.50	22.36	20.51	19.01	16.18	14.49	14.32
30	09.09		06.50	05.01	03.27	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.04	21.38	23.13	23.49	22.33	20.47	18.57	16.15	14.47	14.34
31	09.06		06.47		03.24		04.23	05.58		07.57		10.13
	16.04		20.07		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	568	622	607	508	393	305	199	138
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 Shadow receptor: E - Lomarakennus E (Raudaskallion metsatie)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.01	09.35
	14.38	16.07	17.37	20.10	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.44
2	10.11	09.01	07.29	06.40	04.54	03.19	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.13	21.45	23.22	23.47	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.41
	14.41	16.14	17.43	20.16	21.48	23.24	23.45	22.20	20.33	18.47	16.02	14.41
4	10.09	08.54	07.22	06.32	04.48	03.14	03.06	04.36	06.10	07.36	08.10	09.43
	14.44	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.13	07.39	08.13	09.46
	14.46	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.40	15.55	14.37
6	10.06	08.48	07.15	06.25	04.41	03.09	03.10	04.42	06.16	07.42	08.17	09.48
	14.48	16.24	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.38	03.07	03.13	04.45	06.19	07.45	08.20	09.51
	14.51	16.27	17.55	20.27	22.01	23.34	23.38	22.07	20.19	18.33	15.49	14.34
8	10.03	08.42	07.08	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.37	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39	07.04	06.15	04.31	03.04	03.17	04.51	06.24	07.50	08.26	09.55
	14.56	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.12	18.26	15.43	14.31
10	09.59	08.35	07.01	06.11	04.28	03.02	03.20	04.54	06.27	07.53	08.30	09.57
	14.58	16.37	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.08	04.24	03.00	03.23	04.58	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.05	18.19	15.37	14.29
12	09.55	08.29	06.54	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.34	14.28
13	09.53	08.26	06.50	06.01	04.18	02.56	03.28	05.04	06.36	08.02	08.39	10.03
	15.07	16.47	18.13	20.45	22.20	23.46	23.24	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.47	05.57	04.14	02.55	03.31	05.07	06.39	08.05	08.43	10.05
	15.10	16.50	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.54	04.11	02.54	03.34	05.10	06.41	08.08	08.46	10.06
	15.13	16.53	18.19	20.52	22.26	23.49	23.18	21.40	19.50	18.05	15.25	14.25
16	09.47	08.16	06.40	05.50	04.08	02.53	03.37	05.13	06.44	08.11	08.49	10.08
	15.16	16.56	18.22	20.55	22.30	23.50	23.16	21.36	19.47	18.02	15.22	14.25
17	09.44	08.13	06.36	05.47	04.05	02.53	03.39	05.16	06.47	08.14	08.52	10.09
	15.19	16.59	18.25	20.58	22.33	23.51	23.13	21.33	19.43	17.58	15.19	14.25
18	09.42	08.09	06.33	05.43	04.02	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.22	17.03	18.28	21.01	22.36	23.52	23.10	21.29	19.40	17.55	15.16	14.25
19	09.40	08.06	06.29	05.40	03.58	02.52	03.45	05.22	06.53	08.20	08.59	10.11
	15.25	17.06	18.31	21.04	22.39	23.53	23.07	21.26	19.36	17.51	15.14	14.24
20	09.37	08.03	06.26	05.36	03.55	02.52	03.48	05.25	06.56	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.43	23.54	23.04	21.22	19.33	17.48	15.11	14.25
21	09.35	07.59	06.22	05.33	03.52	02.52	03.52	05.28	06.59	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.19	19.29	17.45	15.08	14.25
22	09.32	07.56	06.19	05.29	03.49	02.52	03.55	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.26	17.41	15.06	14.25
23	09.29	07.52	06.15	05.26	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.12	19.22	17.38	15.03	14.26
24	09.27	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.36	09.14	10.14
	15.41	17.22	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.19	03.40	02.54	04.04	05.40	07.10	07.39	09.17	10.15
	15.44	17.25	18.49	21.22	22.58	23.54	22.49	21.05	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.13	07.42	09.20	10.15
	15.47	17.28	18.52	21.26	23.01	23.53	22.46	21.01	19.11	16.28	14.56	14.28
27	09.18	07.39	06.01	05.12	03.35	02.56	04.10	05.46	07.16	07.45	09.23	10.15
	15.51	17.31	18.55	21.29	23.04	23.52	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.52	22.40	20.54	19.04	16.21	14.51	14.31
29	09.12		06.54	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.14
	15.57		20.01	21.35	23.10	23.51	22.36	20.51	19.01	16.18	14.49	14.32
30	09.09		06.50	05.01	03.26	03.00	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.04	21.38	23.13	23.49	22.33	20.47	18.57	16.15	14.47	14.34
31	09.07		06.47		03.24		04.23	05.58		07.57		10.13
	16.04		20.07		23.16		22.30	20.44		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 Shadow receptor: F - Lomarakennus F (Hirvinevanhaara 147)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January			February			March			April			May			June		
1	10.12			09.04		10.06 (9)	07.32		08.52 (5)	06.43		04.58			03.21		04.33 (3)
	14.37			16.07	20	10.26 (9)	17.37	7	08.59 (5)	20.09		21.41			23.19	26	04.59 (3)
2	10.11			09.01		10.05 (9)	07.28			06.39		04.54			03.18		04.32 (3)
	14.39			16.10	21	10.26 (9)	17.40			20.12		21.45			23.22	27	04.59 (3)
3	10.10			08.58		10.05 (9)	07.25			06.36		04.51			03.16		04.33 (3)
	14.41			16.13	21	10.26 (9)	17.43			20.15		21.48			23.25	27	05.00 (3)
4	10.09			08.54		10.07 (9)	07.22			06.32		04.47			03.13		04.32 (3)
	14.43			16.17	20	10.27 (9)	17.46			20.18		21.51			23.27	28	05.00 (3)
5	10.08			08.51		10.07 (9)	07.18			06.29		04.44			03.11		04.32 (3)
	14.45			16.20	20	10.27 (9)	17.49			20.21		21.54			23.30	29	05.01 (3)
6	10.06			08.48		10.07 (9)	07.15			06.25		04.41			03.09		04.32 (3)
	14.48			16.23	19	10.26 (9)	17.52			20.24		21.57			23.32	29	05.01 (3)
7	10.05			08.45		10.08 (9)	07.11			06.22		04.37			03.07		04.33 (3)
	14.50			16.27	17	10.25 (9)	17.55			20.27		22.01			23.35	29	05.02 (3)
8	10.03			08.42		10.10 (9)	07.08			06.18		04.34			03.05		04.32 (3)
	14.53			16.30	15	10.25 (9)	17.58			20.30		22.04			23.37	29	05.01 (3)
9	10.01			08.39		10.11 (9)	07.04			06.15		04.31			03.03		04.32 (3)
	14.55			16.33	12	10.23 (9)	18.01			20.33		22.07			23.39	30	05.02 (3)
10	09.59			08.35		10.13 (9)	07.01			06.11		04.27			03.01		04.32 (3)
	14.58			16.36	7	10.20 (9)	18.04			20.36		22.10			23.41	30	05.02 (3)
11	09.58			08.32			06.57			06.08		04.24			03.00		04.33 (3)
	15.01			16.40			18.07			20.39		22.14			23.43	30	05.03 (3)
12	09.56			08.29			06.54			06.04		04.21			02.57		04.32 (3)
	15.03			16.43			18.10			20.42		22.17			23.45	31	05.03 (3)
13	09.54			08.26			06.50			06.00		04.17			02.55		04.32 (3)
	15.06			16.46			18.13			20.45		22.20			23.47	31	05.03 (3)
14	09.51			08.22			06.47			05.57		04.14			02.54		04.33 (3)
	15.09			16.50			18.16			20.48		22.23			23.48	31	05.04 (3)
15	09.49			08.19		08.58 (5)	06.43			05.53		04.11			02.53		04.33 (3)
	15.12			16.53	1	08.59 (5)	18.19			20.52		22.27			23.50	31	05.04 (3)
16	09.47			08.16		08.54 (5)	06.40			05.50		04.08			02.53		04.33 (3)
	15.15			16.56	9	09.03 (5)	18.22			20.55		22.30			23.51	31	05.04 (3)
17	09.45			08.13		08.50 (5)	06.36			05.46		04.04			02.52		04.34 (3)
	15.18			16.59	14	09.04 (5)	18.25			20.58		22.33			23.52	31	05.05 (3)
18	09.42			08.09		08.48 (5)	06.33			05.43		04.01			02.52		04.33 (3)
	15.21			17.02	17	09.05 (5)	18.28			21.01		22.36			23.53	31	05.04 (3)
19	09.40			08.06		08.47 (5)	06.29			05.39		03.58			02.51		04.33 (3)
	15.24			17.06	20	09.07 (5)	18.31			21.04		22.39			23.53	31	05.04 (3)
20	09.37			08.03		08.46 (5)	06.25			05.36		03.55			02.51		04.33 (3)
	15.28			17.09	21	09.07 (5)	18.34			21.07		22.43			23.54	32	05.05 (3)
21	09.35			07.59		08.46 (5)	06.22			05.32		03.52			02.51		04.34 (3)
	15.31			17.12	21	09.07 (5)	18.37			21.10		22.46			23.54	32	05.06 (3)
22	09.32			07.56		08.46 (5)	06.18			05.29		03.49			02.52		04.34 (3)
	15.34			17.15	22	09.08 (5)	18.40			21.13		22.49			23.55	32	05.06 (3)
23	09.29			07.52		08.46 (5)	06.15			05.25		03.46		04.43 (3)	02.52		04.34 (3)
	15.37			17.18	21	09.07 (5)	18.43			21.16		22.52	3	04.46 (3)	23.55	32	05.06 (3)
24	09.27			07.49		08.45 (5)	06.11			05.22		03.43		04.40 (3)	02.53		04.35 (3)
	15.40			17.21	21	09.06 (5)	18.46			21.19		22.55	10	04.50 (3)	23.54	31	05.06 (3)
25	09.24		10.17 (9)	07.46		08.47 (5)	06.08			05.18		03.40		04.38 (3)	02.53		04.35 (3)
	15.44	2	10.19 (9)	17.25	20	09.07 (5)	18.49			21.22		22.58	14	04.52 (3)	23.54	31	05.06 (3)
26	09.21		10.13 (9)	07.42		08.47 (5)	06.04			05.15		03.37		04.37 (3)	02.54		04.35 (3)
	15.47	8	10.21 (9)	17.28	18	09.05 (5)	18.52			21.26		23.01	17	04.54 (3)	23.54	31	05.06 (3)
27	09.18		10.09 (9)	07.39		08.47 (5)	06.01			05.11		03.34		04.36 (3)	02.56		04.36 (3)
	15.50	13	10.22 (9)	17.31	17	09.04 (5)	18.55			21.29		23.05	19	04.55 (3)	23.53	31	05.07 (3)
28	09.15		10.06 (9)	07.35		08.49 (5)	05.57			05.08		03.31		04.35 (3)	02.57		04.35 (3)
	15.54	17	10.23 (9)	17.34	14	09.03 (5)	18.58			21.32		23.08	21	04.56 (3)	23.52	31	05.06 (3)
29	09.12		10.07 (9)				06.54			05.05		03.29		04.34 (3)	02.58		04.36 (3)
	15.57	18	10.25 (9)				20.01			21.35		23.11	22	04.56 (3)	23.51	30	05.06 (3)
30	09.10		10.06 (9)				06.50			05.01		03.26		04.33 (3)	03.00		04.36 (3)
	16.00	19	10.25 (9)				20.04			21.38		23.13	24	04.57 (3)	23.50	30	05.06 (3)
31	09.07		10.06 (9)				06.46					03.23		04.34 (3)			
	16.03	20	10.26 (9)				20.07					23.16	24	04.58 (3)			
Potential sun hours	172			238			363			451		569			622		
Total, worst case		97			408			7					154			905	
Sun reduction		0,18			0,33			0,32					0,47			0,48	
Oper. time red.		0,99			0,99			0,99					0,99			0,99	
Wind dir. red.		0,67			0,65			0,64					0,61			0,61	
Total reduction		0,12			0,22			0,21					0,29			0,29	
Total, real		12			88			1					44			265	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 Shadow receptor: F - Lomarakennus F (Hirvinevanhaara 147)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	July			August	September	October			November			December
1	03.00		04.36 (3)	04.26	06.01	07.27			08.01		09.42 (9)	09.35
	23.48	30	05.06 (3)	22.27	20.40	18.54			16.08	8	09.50 (9)	14.44
2	03.02		04.37 (3)	04.29	06.04	07.30			08.04		09.40 (9)	09.38
	23.47	30	05.07 (3)	22.24	20.36	18.50			16.05	13	09.53 (9)	14.42
3	03.03		04.37 (3)	04.32	06.07	07.33			08.07		09.39 (9)	09.41
	23.45	30	05.07 (3)	22.20	20.33	18.47			16.01	15	09.54 (9)	14.40
4	03.05		04.37 (3)	04.35	06.10	07.36			08.10		09.38 (9)	09.43
	23.44	30	05.07 (3)	22.17	20.29	18.43			15.58	18	09.56 (9)	14.38
5	03.07		04.38 (3)	04.38	06.13	07.39			08.13		09.38 (9)	09.46
	23.42	29	05.07 (3)	22.14	20.26	18.40			15.55	18	09.56 (9)	14.37
6	03.10		04.38 (3)	04.42	06.15	07.42			08.17		09.36 (9)	09.48
	23.40	29	05.07 (3)	22.10	20.22	18.36			15.52	20	09.56 (9)	14.35
7	03.12		04.39 (3)	04.45	06.18	07.44			08.20		09.36 (9)	09.51
	23.38	28	05.07 (3)	22.07	20.19	18.33			15.49	21	09.57 (9)	14.33
8	03.14		04.39 (3)	04.48	06.21	07.47			08.23		09.36 (9)	09.53
	23.36	29	05.08 (3)	22.03	20.15	18.29			15.46	21	09.57 (9)	14.32
9	03.17		04.39 (3)	04.51	06.24	07.50			08.26		09.36 (9)	09.55
	23.34	28	05.07 (3)	22.00	20.12	18.26			15.43	21	09.57 (9)	14.31
10	03.19		04.40 (3)	04.54	06.27	07.53			08.30		09.36 (9)	09.58
	23.31	27	05.07 (3)	21.57	20.08	18.22			15.39	21	09.57 (9)	14.29
11	03.22		04.41 (3)	04.57	06.30	07.56			08.33		09.37 (9)	10.00
	23.29	26	05.07 (3)	21.53	20.04	18.19			15.36	19	09.56 (9)	14.28
12	03.25		04.41 (3)	05.00	06.33	07.59			08.36		09.38 (9)	10.02
	23.26	25	05.06 (3)	21.50	20.01	18.15			15.33	19	09.57 (9)	14.27
13	03.28		04.42 (3)	05.04	06.36	08.02		09.24 (5)	08.39		09.39 (9)	10.03
	23.24	24	05.06 (3)	21.46	19.57	18.12	10	09.34 (5)	15.30	18	09.57 (9)	14.26
14	03.30		04.43 (3)	05.07	06.38	08.05		09.21 (5)	08.43		09.39 (9)	10.05
	23.21	23	05.06 (3)	21.43	19.54	18.08	15	09.36 (5)	15.27	17	09.56 (9)	14.26
15	03.33		04.43 (3)	05.10	06.41	08.08		09.19 (5)	08.46		09.42 (9)	10.07
	23.19	22	05.05 (3)	21.40	19.50	18.05	18	09.37 (5)	15.25	13	09.55 (9)	14.25
16	03.36		04.44 (3)	05.13	06.44	08.11		09.18 (5)	08.49		09.46 (9)	10.08
	23.16	20	05.04 (3)	21.36	19.47	18.01	19	09.37 (5)	15.22	7	09.53 (9)	14.25
17	03.39		04.45 (3)	05.16	06.47	08.14		09.18 (5)	08.52		09.51 (9)	10.09
	23.13	18	05.03 (3)	21.33	19.43	17.58	20	09.38 (5)	15.19	2	09.53 (9)	14.24
18	03.42		04.47 (3)	05.19	06.50	08.17		09.17 (5)	08.56			10.11
	23.10	16	05.03 (3)	21.29	19.40	17.55	21	09.38 (5)	15.16			14.24
19	03.45		04.49 (3)	05.22	06.53	08.20		09.16 (5)	08.59			10.12
	23.07	12	05.01 (3)	21.26	19.36	17.51	22	09.38 (5)	15.13			14.24
20	03.48		04.51 (3)	05.25	06.56	08.23		09.17 (5)	09.02			10.13
	23.04	8	04.59 (3)	21.22	19.33	17.48	21	09.38 (5)	15.11			14.24
21	03.51			05.28	06.58	08.26		09.17 (5)	09.05			10.13
	23.01			21.19	19.29	17.44	21	09.38 (5)	15.08			14.24
22	03.54			05.31	07.01	08.29		09.16 (5)	09.08			10.14
	22.58			21.15	19.25	17.41	20	09.36 (5)	15.05			14.25
23	03.57			05.34	07.04	08.32		09.18 (5)	09.11			10.14
	22.55			21.12	19.22	17.38	18	09.36 (5)	15.03			14.25
24	04.00			05.37	07.07	08.36		09.18 (5)	09.14			10.15
	22.52			21.08	19.18	17.34	17	09.35 (5)	15.00			14.26
25	04.04			05.40	07.10	07.39		08.21 (5)	09.18			10.15
	22.49			21.05	19.15	16.31	13	08.34 (5)	14.58			14.27
26	04.07			05.43	07.13	07.42		08.24 (5)	09.21			10.15
	22.46			21.01	19.11	16.28	7	08.31 (5)	14.55			14.28
27	04.10			05.46	07.16	07.45			09.24			10.15
	22.43			20.58	19.08	16.24			14.53			14.29
28	04.13			05.49	07.18	07.48			09.27			10.15
	22.40			20.54	19.04	16.21			14.51			14.30
29	04.16			05.52	07.21	07.51			09.30			10.14
	22.37			20.51	19.01	16.18			14.48			14.32
30	04.19			05.55	07.24	07.54			09.32			10.14
	22.33			20.47	18.57	16.14			14.46			14.33
31	04.23			05.58		07.57						10.13
	22.30			20.43		16.11						14.35
Potential sun hours	607			508	393	305			199			138
Total, worst case		484					242			271		
Sun reduction		0,38					0,35			0,24		
Oper. time red.		0,99					0,99			0,99		
Wind dir. red.		0,61					0,64			0,67		
Total reduction		0,23					0,22			0,16		
Total, real		112					54			43		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 Shadow receptor: G - Lomarakennus G (Pohjanneva)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.11	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.00	09.34
	14.38	16.07	17.37	20.09	21.41	23.18	23.47	22.26	20.40	18.53	16.08	14.44
2	10.10	09.00	07.28	06.39	04.54	03.19	03.02	04.29	06.04	07.30	08.03	09.37
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.09	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.32	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.23	23.44	22.20	20.32	18.46	16.01	14.41
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.35	08.10	09.42
	14.44	16.17	17.46	20.18	21.50	23.26	23.42	22.16	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.12	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.25	18.39	15.55	14.37
6	10.05	08.48	07.14	06.25	04.41	03.10	03.10	04.42	06.15	07.41	08.16	09.47
	14.48	16.23	17.52	20.24	21.57	23.31	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.44	07.11	06.22	04.37	03.08	03.13	04.45	06.18	07.44	08.19	09.50
	14.51	16.27	17.55	20.27	22.00	23.33	23.37	22.06	20.18	18.32	15.49	14.34
8	10.02	08.41	07.07	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.52
	14.53	16.30	17.58	20.30	22.03	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.00	08.38	07.04	06.14	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.54
	14.56	16.33	18.01	20.33	22.06	23.38	23.32	21.59	20.11	18.25	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.40	23.30	21.56	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.23	04.57	06.30	07.56	08.32	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.37	14.29
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.35	10.01
	15.04	16.43	18.10	20.42	22.16	23.44	23.25	21.49	20.01	18.15	15.34	14.28
13	09.53	08.25	06.50	06.00	04.18	02.56	03.28	05.04	06.35	08.02	08.39	10.02
	15.07	16.46	18.13	20.45	22.19	23.45	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.10	16.50	18.16	20.48	22.23	23.47	23.20	21.42	19.53	18.08	15.28	14.26
15	09.48	08.19	06.43	05.53	04.11	02.54	03.34	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.48	23.18	21.39	19.50	18.05	15.25	14.26
16	09.46	08.15	06.39	05.50	04.08	02.53	03.37	05.13	06.44	08.11	08.48	10.07
	15.15	16.56	18.22	20.54	22.29	23.49	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.08
	15.18	16.59	18.25	20.57	22.32	23.50	23.12	21.32	19.43	17.58	15.19	14.25
18	09.41	08.09	06.32	05.43	04.02	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.22	17.02	18.28	21.00	22.35	23.51	23.09	21.29	19.39	17.54	15.16	14.25
19	09.39	08.05	06.29	05.39	03.58	02.52	03.45	05.22	06.52	08.20	08.58	10.11
	15.25	17.06	18.31	21.03	22.39	23.52	23.06	21.25	19.36	17.51	15.13	14.25
20	09.36	08.02	06.25	05.36	03.55	02.52	03.48	05.25	06.55	08.23	09.01	10.11
	15.28	17.09	18.34	21.06	22.42	23.53	23.03	21.22	19.32	17.48	15.11	14.25
21	09.34	07.59	06.22	05.32	03.52	02.52	03.52	05.28	06.58	08.26	09.04	10.12
	15.31	17.12	18.37	21.09	22.45	23.53	23.01	21.18	19.29	17.44	15.08	14.25
22	09.31	07.55	06.18	05.29	03.49	02.52	03.55	05.31	07.01	08.29	09.07	10.13
	15.34	17.15	18.40	21.13	22.48	23.53	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.13
	15.37	17.18	18.43	21.16	22.51	23.53	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.21	18.46	21.19	22.54	23.53	22.51	21.08	19.18	17.34	15.00	14.27
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.57	23.53	22.48	21.04	19.15	16.31	14.58	14.27
26	09.20	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.28	18.51	21.25	23.01	23.52	22.45	21.01	19.11	16.28	14.55	14.28
27	09.18	07.38	06.00	05.11	03.35	02.56	04.10	05.46	07.15	07.44	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.51	22.42	20.57	19.07	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.58	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.31	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.53	05.05	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.13
	15.57		20.00	21.34	23.09	23.50	22.36	20.50	19.00	16.18	14.49	14.32
30	09.09		06.50	05.01	03.26	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.12	23.48	22.33	20.47	18.57	16.14	14.46	14.34
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.04		20.06		23.15		22.29	20.43		16.11		14.35
Potential sun hours	172	238	363	451	568	621	607	508	393	305	199	139
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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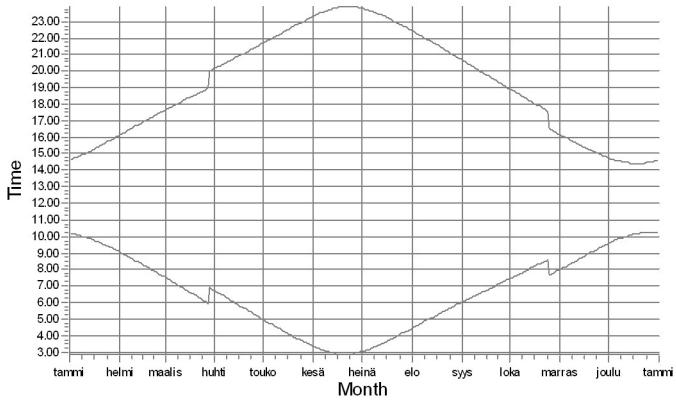
Calculated:
10.6.2020 15.54/3.3.247

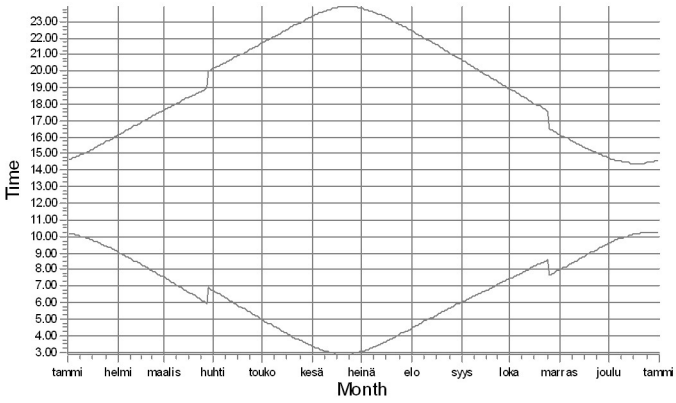
SHADOW - Calendar, graphical

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906

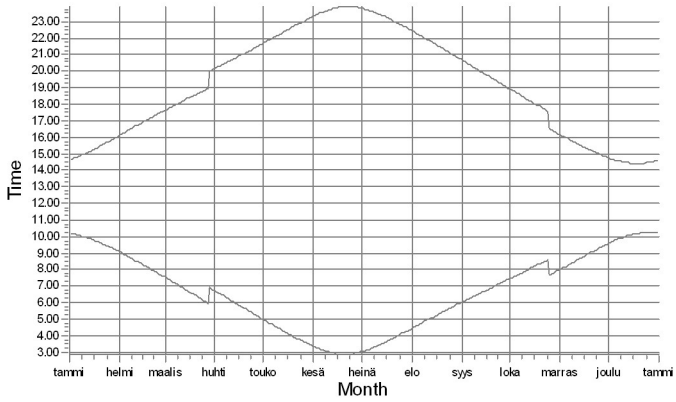
A: Asuinrakennus A (Hakuperäntie 202)



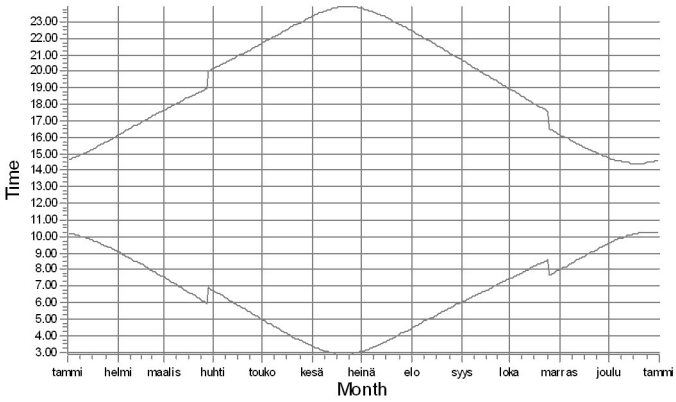
B: Asuinrakennus B (Hakuperäntie 169)



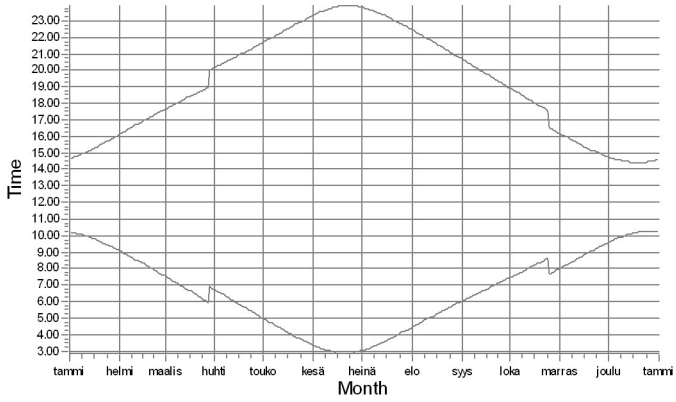
C: Asuinrakennus C (Säilyntie 285)



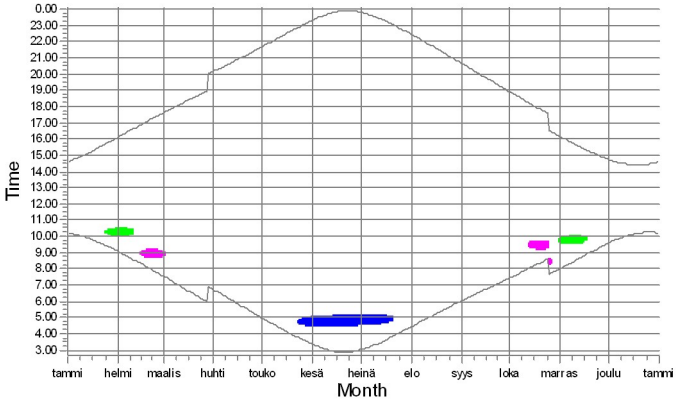
D: Asuinrakennus D (Säilyntie 264)



E: Lomarakennus E (Raudaskallion metsatie)



F: Lomarakennus F (Hirvinevanhaara 147)



WTGs

3: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230

9: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (93)

5: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (89)

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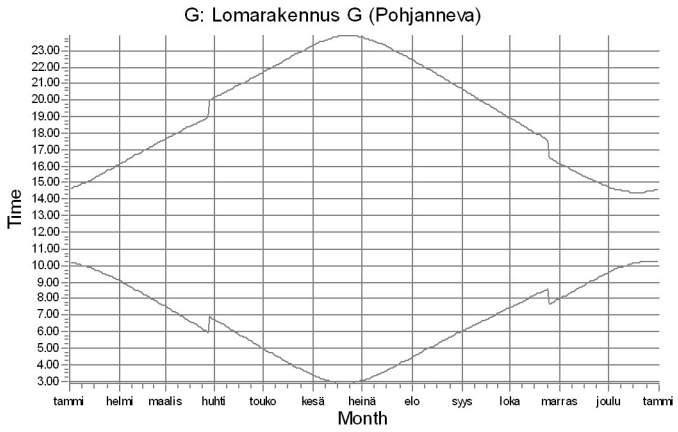
SHADOW - Calendar, graphical

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906



WTGs

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Calculated:
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SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 1 - VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (79)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.57	03.20	03.01	04.26	06.01	07.27	08.01	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.49	22.27	20.40	18.54	16.08	14.44
2	10.11	09.01	07.28	06.39	04.54	03.18	03.01	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.45	23.22	23.47	22.24	20.36	18.50	16.04	14.42
3	10.10	08.58	07.25	06.36	04.51	03.15	03.03	04.32	06.07	07.33	08.07	09.41
	14.41	16.13	17.43	20.15	21.48	23.25	23.46	22.20	20.33	18.47	16.01	14.40
4	10.09	08.54	07.21	06.32	04.47	03.13	03.05	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.44	22.17	20.29	18.43	15.58	14.38
5	10.08	08.51	07.18	06.29	04.44	03.11	03.07	04.38	06.12	07.39	08.14	09.46
	14.45	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.40	15.55	14.36
6	10.06	08.48	07.15	06.25	04.40	03.09	03.09	04.41	06.15	07.41	08.17	09.49
	14.47	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.05	08.45	07.11	06.22	04.37	03.06	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.26	17.55	20.27	22.01	23.35	23.38	22.07	20.19	18.33	15.49	14.33
8	10.03	08.42	07.08	06.18	04.34	03.04	03.14	04.48	06.21	07.47	08.23	09.53
	14.52	16.30	17.58	20.30	22.04	23.37	23.36	22.04	20.15	18.29	15.45	14.32
9	10.01	08.39	07.04	06.14	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.56
	14.55	16.33	18.01	20.33	22.07	23.39	23.34	22.00	20.12	18.26	15.42	14.30
10	10.00	08.36	07.01	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.30	09.58
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.39	14.29
11	09.58	08.32	06.57	06.07	04.24	02.58	03.22	04.57	06.30	07.56	08.33	10.00
	15.00	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.04	18.19	15.36	14.28
12	09.56	08.29	06.54	06.04	04.20	02.56	03.24	05.00	06.33	07.59	08.36	10.02
	15.03	16.43	18.10	20.42	22.17	23.45	23.27	21.50	20.01	18.15	15.33	14.27
13	09.54	08.26	06.50	06.00	04.17	02.55	03.27	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.47	23.24	21.46	19.57	18.12	15.30	14.26
14	09.52	08.22	06.47	05.57	04.14	02.54	03.30	05.06	06.38	08.05	08.43	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.25
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.07
	15.12	16.53	18.19	20.51	22.27	23.50	23.19	21.40	19.50	18.05	15.24	14.25
16	09.47	08.16	06.40	05.50	04.07	02.52	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.55	22.30	23.51	23.16	21.36	19.47	18.01	15.21	14.24
17	09.45	08.13	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.10
	15.18	16.59	18.25	20.58	22.33	23.52	23.13	21.33	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.51	03.42	05.19	06.50	08.17	08.56	10.11
	15.21	17.02	18.28	21.01	22.36	23.53	23.10	21.29	19.40	17.54	15.16	14.24
19	09.40	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.59	10.12
	15.24	17.05	18.31	21.04	22.40	23.54	23.07	21.26	19.36	17.51	15.13	14.24
20	09.37	08.03	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.13
	15.27	17.09	18.34	21.07	22.43	23.54	23.05	21.22	19.32	17.48	15.10	14.24
21	09.35	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.55	23.02	21.19	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.51	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.55	22.59	21.15	19.25	17.41	15.05	14.24
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.15
	15.37	17.18	18.43	21.16	22.52	23.55	22.56	21.12	19.22	17.37	15.02	14.25
24	09.27	07.49	06.11	05.22	03.43	02.52	04.00	05.37	07.07	08.35	09.15	10.15
	15.40	17.21	18.46	21.19	22.55	23.55	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.18	03.40	02.53	04.03	05.40	07.10	07.39	09.18	10.15
	15.43	17.24	18.49	21.22	22.59	23.54	22.49	21.05	19.15	16.31	14.57	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.06	05.43	07.13	07.42	09.21	10.15
	15.47	17.27	18.52	21.26	23.02	23.54	22.46	21.01	19.11	16.27	14.55	14.27
27	09.18	07.39	06.01	05.11	03.34	02.55	04.10	05.46	07.15	07.45	09.24	10.15
	15.50	17.31	18.55	21.29	23.05	23.53	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.56	04.13	05.49	07.18	07.48	09.27	10.15
	15.53	17.34	18.58	21.32	23.08	23.52	22.40	20.54	19.04	16.21	14.50	14.30
29	09.13		06.53	05.04	03.28	02.58	04.16	05.52	07.21	07.51	09.30	10.14
	15.57		20.01	21.35	23.11	23.51	22.37	20.51	19.01	16.17	14.48	14.31
30	09.10		06.50	05.01	03.26	02.59	04.19	05.55	07.24	07.54	09.32	10.14
	16.00		20.04	21.38	23.14	23.50	22.33	20.47	18.57	16.14	14.46	14.33
31	09.07		06.46		03.23		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.34
Potential sun hours	172	238	363	451	569	623	608	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 2 - VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (80)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.57	03.20	03.01	04.25	06.01	07.27	08.01	09.35
	14.37	16.06	17.37	20.09	21.41	23.19	23.49	22.27	20.40	18.53	16.08	14.44
2	10.11	09.01	07.28	06.39	04.54	03.18	03.01	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.45	23.22	23.47	22.24	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.15	03.03	04.32	06.07	07.33	08.07	09.41
	14.41	16.13	17.43	20.15	21.48	23.25	23.46	22.20	20.33	18.46	16.01	14.40
4	10.09	08.54	07.21	06.32	04.47	03.13	03.05	04.35	06.09	07.36	08.10	09.43
	14.43	16.16	17.46	20.18	21.51	23.27	23.44	22.17	20.29	18.43	15.58	14.38
5	10.08	08.51	07.18	06.29	04.44	03.11	03.07	04.38	06.12	07.38	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.39	15.55	14.36
6	10.06	08.48	07.14	06.25	04.40	03.09	03.09	04.41	06.15	07.41	08.17	09.48
	14.47	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.05	08.45	07.11	06.21	04.37	03.06	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.26	17.55	20.27	22.01	23.35	23.38	22.07	20.19	18.32	15.48	14.33
8	10.03	08.42	07.07	06.18	04.34	03.04	03.14	04.48	06.21	07.47	08.23	09.53
	14.52	16.30	17.58	20.30	22.04	23.37	23.36	22.03	20.15	18.29	15.45	14.32
9	10.01	08.39	07.04	06.14	04.30	03.03	03.16	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.34	22.00	20.11	18.25	15.42	14.30
10	10.00	08.35	07.01	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.30	09.58
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.39	14.29
11	09.58	08.32	06.57	06.07	04.24	02.58	03.22	04.57	06.30	07.56	08.33	10.00
	15.00	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.04	18.18	15.36	14.28
12	09.56	08.29	06.53	06.04	04.20	02.56	03.24	05.00	06.33	07.59	08.36	10.02
	15.03	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.33	14.27
13	09.54	08.26	06.50	06.00	04.17	02.55	03.27	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.47	23.24	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.54	03.30	05.06	06.38	08.05	08.43	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.25
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.07
	15.12	16.53	18.19	20.51	22.27	23.50	23.19	21.39	19.50	18.05	15.24	14.25
16	09.47	08.16	06.39	05.50	04.07	02.52	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.30	23.51	23.16	21.36	19.47	18.01	15.21	14.24
17	09.45	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.58	22.33	23.52	23.13	21.33	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.51	03.42	05.19	06.50	08.17	08.55	10.11
	15.21	17.02	18.28	21.01	22.36	23.53	23.10	21.29	19.39	17.54	15.16	14.24
19	09.40	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.59	10.12
	15.24	17.05	18.31	21.04	22.40	23.54	23.07	21.26	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.13
	15.27	17.09	18.34	21.07	22.43	23.54	23.04	21.22	19.32	17.48	15.10	14.24
21	09.35	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.30	17.12	18.37	21.10	22.46	23.55	23.01	21.19	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.51	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.55	22.58	21.15	19.25	17.41	15.05	14.24
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.55	22.55	21.12	19.22	17.37	15.02	14.25
24	09.27	07.49	06.11	05.22	03.43	02.52	04.00	05.37	07.07	08.35	09.14	10.15
	15.40	17.21	18.46	21.19	22.55	23.55	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.18	03.40	02.53	04.03	05.40	07.10	07.39	09.18	10.15
	15.43	17.24	18.49	21.22	22.58	23.54	22.49	21.05	19.15	16.31	14.57	14.26
26	09.21	07.42	06.04	05.15	03.37	02.54	04.06	05.43	07.13	07.42	09.21	10.15
	15.47	17.27	18.52	21.25	23.02	23.54	22.46	21.01	19.11	16.27	14.55	14.27
27	09.18	07.39	06.01	05.11	03.34	02.55	04.10	05.46	07.15	07.45	09.24	10.15
	15.50	17.31	18.55	21.29	23.05	23.53	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.56	04.13	05.49	07.18	07.48	09.27	10.15
	15.53	17.34	18.58	21.32	23.08	23.52	22.40	20.54	19.04	16.21	14.50	14.30
29	09.12		06.53	05.04	03.28	02.58	04.16	05.52	07.21	07.51	09.30	10.14
	15.57		20.00	21.35	23.11	23.51	22.37	20.50	19.01	16.17	14.48	14.31
30	09.10		06.50	05.01	03.26	02.59	04.19	05.55	07.24	07.54	09.32	10.14
	16.00		20.03	21.38	23.14	23.50	22.33	20.47	18.57	16.14	14.46	14.33
31	09.07		06.46		03.23		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.34
Potential sun hours	172	238	363	451	569	623	608	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 3 - VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (81)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.58	03.21 04.33-04.59/26	03.00 04.36-05.06/30	04.26	06.01	07.27	08.01	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.49	22.27	20.40	18.54	16.08	14.44
2	10.11	09.01	07.28	06.39	04.54	03.18 04.32-04.59/27	03.01 04.37-05.07/30	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.45	23.22	23.47	22.24	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16 04.33-05.00/27	03.03 04.37-05.07/30	04.32	06.07	07.33	08.07	09.41
	14.41	16.13	17.43	20.15	21.48	23.25	23.46	22.20	20.33	18.47	16.01	14.40
4	10.09	08.54	07.21	06.32	04.47	03.13 04.32-05.00/28	03.05 04.37-05.07/30	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.44	22.17	20.29	18.43	15.58	14.38
5	10.08	08.51	07.18	06.29	04.44	03.11 04.32-05.01/29	03.07 04.38-05.07/29	04.38	06.12	07.39	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.40	15.55	14.36
6	10.06	08.48	07.15	06.25	04.40	03.09 04.32-05.01/29	03.09 04.38-05.07/29	04.41	06.15	07.41	08.17	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.05	08.45	07.11	06.22	04.37	03.07 04.33-05.02/29	03.12 04.39-05.07/28	04.45	06.18	07.44	08.20	09.51
	14.50	16.26	17.55	20.27	22.01	23.35	23.38	22.07	20.19	18.33	15.49	14.33
8	10.03	08.42	07.08	06.18	04.34	03.05 04.32-05.01/29	03.14 04.39-05.08/29	04.48	06.21	07.47	08.23	09.53
	14.52	16.30	17.58	20.30	22.04	23.37	23.36	22.03	20.15	18.29	15.45	14.32
9	10.01	08.39	07.04	06.15	04.30	03.03 04.32-05.02/30	03.17 04.39-05.07/28	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.34	22.00	20.12	18.26	15.42	14.30
10	10.00	08.35	07.01	06.11	04.27	03.01 04.32-05.02/30	03.19 04.40-05.07/27	04.54	06.27	07.53	08.30	09.58
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.39	14.29
11	09.58	08.32	06.57	06.07	04.24	02.58 04.33-05.03/30	03.22 04.41-05.07/26	04.57	06.30	07.56	08.33	10.00
	15.00	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.04	18.19	15.36	14.28
12	09.56	08.29	06.54	06.04	04.20	02.56 04.32-05.03/31	03.25 04.41-05.06/25	05.00	06.33	07.59	08.36	10.02
	15.03	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.33	14.27
13	09.54	08.26	06.50	06.00	04.17	02.55 04.32-05.03/31	03.27 04.42-05.06/24	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.47	23.24	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.47	05.57	04.14	02.54 04.33-05.04/31	03.30 04.43-05.06/23	05.07	06.38	08.05	08.43	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.25
15	09.49	08.19	06.43	05.53	04.11	02.53 04.33-05.04/31	03.33 04.43-05.05/22	05.10	06.41	08.08	08.46	10.07
	15.12	16.53	18.19	20.51	22.27	23.50	23.19	21.40	19.50	18.05	15.24	14.25
16	09.47	08.16	06.40	05.50	04.07	02.52 04.33-05.04/31	03.36 04.44-05.04/20	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.55	22.30	23.51	23.16	21.36	19.47	18.01	15.22	14.24
17	09.45	08.13	06.36	05.46	04.04	02.52 04.34-05.05/31	03.39 04.45-05.03/18	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.58	22.33	23.52	23.13	21.33	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.51 04.33-05.04/31	03.42 04.47-05.03/16	05.19	06.50	08.17	08.56	10.11
	15.21	17.02	18.28	21.01	22.36	23.53	23.10	21.29	19.40	17.54	15.16	14.24
19	09.40	08.06	06.29	05.39	03.58	02.51 04.33-05.04/31	03.45 04.49-05.01/12	05.22	06.53	08.20	08.59	10.12
	15.24	17.05	18.31	21.04	22.40	23.54	23.07	21.26	19.36	17.51	15.13	14.24
20	09.37	08.03	06.25	05.36	03.55	02.51 04.33-05.05/32	03.48 04.51-04.59/8	05.25	06.55	08.23	09.02	10.13
	15.27	17.09	18.34	21.07	22.43	23.54	23.04	21.22	19.32	17.48	15.10	14.24
21	09.35	07.59	06.22	05.32	03.52	02.51 04.34-05.06/32	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.19	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.51 04.34-05.06/32	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.55	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46 04.43-04.46/3	02.52 04.34-05.06/32	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.55	22.55	21.12	19.22	17.37	15.02	14.25
24	09.27	07.49	06.11	05.22	03.43 04.40-04.50/10	02.52 04.35-05.06/31	04.00	05.37	07.07	08.35	09.14	10.15
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.18	03.40 04.38-04.52/14	02.53 04.35-05.06/31	04.03	05.40	07.10	07.39	09.18	10.15
	15.44	17.24	18.49	21.22	22.58	23.54	22.49	21.05	19.15	16.31	14.57	14.27
26	09.21	07.42	06.04	05.15	03.37 04.37-04.54/17	02.54 04.35-05.06/31	04.07	05.43	07.13	07.42	09.21	10.15
	15.47	17.28	18.52	21.26	23.02	23.54	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34 04.36-04.55/19	02.55 04.36-05.07/31	04.10	05.46	07.15	07.45	09.24	10.15
	15.50	17.31	18.55	21.29	23.05	23.53	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31 04.35-04.56/21	02.57 04.35-05.06/31	04.13	05.49	07.18	07.48	09.27	10.15
	15.53	17.34	18.58	21.32	23.08	23.52	22.40	20.54	19.04	16.21	14.50	14.30
29	09.12		06.54	05.04	03.28 04.34-04.56/22	02.58 04.36-05.06/30	04.16	05.52	07.21	07.51	09.30	10.14
	15.57		20.01	21.35	23.11	23.51	22.37	20.51	19.01	16.18	14.48	14.31
30	09.10		06.50	05.01	03.26 04.33-04.57/24	03.00 04.36-05.06/30	04.19	05.55	07.24	07.54	09.32	10.14
	16.00		20.04	21.38	23.13	23.50	22.33	20.47	18.57	16.14	14.46	14.33
31	09.07		06.46		03.23 04.34-04.58/24		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	623	608	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	154	905	484	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 4 - VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (82)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.58	03.20	03.01	04.26	06.01	07.27	08.01	09.35
	14.37	16.07	17.37	20.10	21.41	23.19	23.49	22.27	20.40	18.54	16.08	14.44
2	10.11	09.01	07.28	06.39	04.54	03.18	03.01	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.45	23.22	23.47	22.24	20.36	18.50	16.04	14.42
3	10.10	08.58	07.25	06.36	04.51	03.16	03.03	04.32	06.07	07.33	08.07	09.41
	14.41	16.13	17.43	20.15	21.48	23.25	23.46	22.20	20.33	18.47	16.01	14.40
4	10.09	08.55	07.22	06.32	04.47	03.13	03.05	04.35	06.10	07.36	08.10	09.44
	14.43	16.17	17.46	20.18	21.51	23.28	23.44	22.17	20.29	18.43	15.58	14.38
5	10.08	08.51	07.18	06.29	04.44	03.11	03.07	04.38	06.12	07.39	08.14	09.46
	14.45	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.40	15.55	14.36
6	10.06	08.48	07.15	06.25	04.40	03.09	03.09	04.41	06.15	07.42	08.17	09.49
	14.48	16.23	17.52	20.24	21.58	23.33	23.40	22.10	20.22	18.36	15.52	14.35
7	10.05	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.27	17.55	20.27	22.01	23.35	23.38	22.07	20.19	18.33	15.49	14.33
8	10.03	08.42	07.08	06.18	04.34	03.05	03.14	04.48	06.21	07.47	08.23	09.53
	14.52	16.30	17.58	20.30	22.04	23.37	23.36	22.04	20.15	18.29	15.45	14.32
9	10.01	08.39	07.04	06.15	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.56
	14.55	16.33	18.01	20.33	22.07	23.39	23.34	22.00	20.12	18.26	15.42	14.30
10	10.00	08.36	07.01	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.30	09.58
	14.58	16.36	18.04	20.36	22.11	23.41	23.31	21.57	20.08	18.22	15.39	14.29
11	09.58	08.32	06.57	06.07	04.24	02.58	03.22	04.57	06.30	07.56	08.33	10.00
	15.00	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.04	18.19	15.36	14.28
12	09.56	08.29	06.54	06.04	04.20	02.56	03.25	05.00	06.33	07.59	08.36	10.02
	15.03	16.43	18.10	20.42	22.17	23.45	23.27	21.50	20.01	18.15	15.33	14.27
13	09.54	08.26	06.50	06.00	04.17	02.55	03.27	05.03	06.36	08.02	08.39	10.04
	15.06	16.46	18.13	20.45	22.20	23.47	23.24	21.47	19.57	18.12	15.30	14.26
14	09.52	08.23	06.47	05.57	04.14	02.54	03.30	05.07	06.38	08.05	08.43	10.05
	15.09	16.49	18.16	20.49	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.25
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.07
	15.12	16.53	18.19	20.52	22.27	23.50	23.19	21.40	19.50	18.05	15.24	14.25
16	09.47	08.16	06.40	05.50	04.07	02.52	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.55	22.30	23.51	23.16	21.36	19.47	18.01	15.22	14.24
17	09.45	08.13	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.10
	15.18	16.59	18.25	20.58	22.33	23.52	23.13	21.33	19.43	17.58	15.19	14.24
18	09.42	08.09	06.33	05.43	04.01	02.51	03.42	05.19	06.50	08.17	08.56	10.11
	15.21	17.02	18.28	21.01	22.36	23.53	23.10	21.29	19.40	17.54	15.16	14.24
19	09.40	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.59	10.12
	15.24	17.06	18.31	21.04	22.40	23.54	23.07	21.26	19.36	17.51	15.13	14.24
20	09.37	08.03	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.13
	15.27	17.09	18.34	21.07	22.43	23.54	23.05	21.22	19.33	17.48	15.10	14.24
21	09.35	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.55	23.02	21.19	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.51	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.55	22.59	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.15
	15.37	17.18	18.43	21.16	22.52	23.55	22.56	21.12	19.22	17.38	15.02	14.25
24	09.27	07.49	06.11	05.22	03.43	02.52	04.00	05.37	07.07	08.36	09.15	10.15
	15.40	17.21	18.46	21.19	22.55	23.55	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.18	03.40	02.53	04.03	05.40	07.10	07.39	09.18	10.15
	15.44	17.24	18.49	21.22	22.59	23.54	22.49	21.05	19.15	16.31	14.57	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.07	05.43	07.13	07.42	09.21	10.15
	15.47	17.28	18.52	21.26	23.02	23.54	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.55	04.10	05.46	07.16	07.45	09.24	10.15
	15.50	17.31	18.55	21.29	23.05	23.53	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.56	04.13	05.49	07.18	07.48	09.27	10.15
	15.53	17.34	18.58	21.32	23.08	23.52	22.40	20.54	19.04	16.21	14.50	14.30
29	09.13		06.54	05.04	03.28	02.58	04.16	05.52	07.21	07.51	09.30	10.14
	15.57		20.01	21.35	23.11	23.51	22.37	20.51	19.01	16.18	14.48	14.31
30	09.10		06.50	05.01	03.26	02.59	04.19	05.55	07.24	07.54	09.33	10.14
	16.00		20.04	21.38	23.14	23.50	22.33	20.47	18.57	16.14	14.46	14.33
31	09.07		06.46		03.23		04.22	05.58		07.58		10.13
	16.03		20.07		23.17		22.30	20.44		16.11		14.35
Potential sun hours	172	238	363	451	569	623	608	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 5 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (89)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February		March		April	May	June	July	August	September	October		November	December
1	10.12	09.03		07.32	08.52-08.59/7	06.43	04.58	03.21	03.00	04.26	06.01	07.27		08.00	09.35
	14.37	16.07		17.37		20.09	21.41	23.19	23.48	22.27	20.40	18.54		16.08	14.44
2	10.11	09.00		07.28		06.39	04.54	03.18	03.02	04.29	06.04	07.30		08.04	09.38
	14.39	16.10		17.40		20.12	21.44	23.22	23.47	22.23	20.36	18.50		16.05	14.42
3	10.10	08.57		07.25		06.36	04.51	03.16	03.04	04.32	06.07	07.33		08.07	09.40
	14.41	16.13		17.43		20.15	21.48	23.24	23.45	22.20	20.33	18.46		16.01	14.40
4	10.09	08.54		07.21		06.32	04.47	03.13	03.06	04.35	06.10	07.36		08.10	09.43
	14.43	16.17		17.46		20.18	21.51	23.27	23.43	22.17	20.29	18.43		15.58	14.38
5	10.07	08.51		07.18		06.29	04.44	03.11	03.08	04.38	06.12	07.38		08.13	09.46
	14.45	16.20		17.49		20.21	21.54	23.29	23.42	22.13	20.26	18.39		15.55	14.37
6	10.06	08.48		07.14		06.25	04.41	03.09	03.10	04.42	06.15	07.41		08.17	09.48
	14.48	16.23		17.52		20.24	21.57	23.32	23.40	22.10	20.22	18.36		15.52	14.35
7	10.04	08.45		07.11		06.22	04.37	03.07	03.12	04.45	06.18	07.44		08.20	09.51
	14.50	16.27		17.55		20.27	22.00	23.34	23.38	22.07	20.19	18.32		15.49	14.33
8	10.03	08.42		07.07		06.18	04.34	03.05	03.14	04.48	06.21	07.47		08.23	09.53
	14.53	16.30		17.58		20.30	22.04	23.37	23.35	22.03	20.15	18.29		15.46	14.32
9	10.01	08.39		07.04		06.15	04.30	03.03	03.17	04.51	06.24	07.50		08.26	09.55
	14.55	16.33		18.01		20.33	22.07	23.39	23.33	22.00	20.11	18.26		15.42	14.31
10	09.59	08.35		07.00		06.11	04.27	03.01	03.20	04.54	06.27	07.53		08.29	09.57
	14.58	16.36		18.04		20.36	22.10	23.41	23.31	21.56	20.08	18.22		15.39	14.29
11	09.57	08.32		06.57		06.07	04.24	03.00	03.22	04.57	06.30	07.56		08.33	09.59
	15.01	16.40		18.07		20.39	22.13	23.43	23.29	21.53	20.04	18.19		15.36	14.28
12	09.55	08.29		06.53		06.04	04.21	02.57	03.25	05.00	06.33	07.59		08.36	10.01
	15.03	16.43		18.10		20.42	22.17	23.45	23.26	21.50	20.01	18.15		15.33	14.27
13	09.53	08.26		06.50		06.00	04.17	02.56	03.28	05.04	06.35	08.02	09.24-09.34/10	08.39	10.03
	15.06	16.46		18.13		20.45	22.20	23.46	23.24	21.46	19.57	18.12		15.30	14.26
14	09.51	08.22		06.46		05.57	04.14	02.54	03.30	05.07	06.38	08.05	09.21-09.36/15	08.42	10.05
	15.09	16.49		18.16		20.48	22.23	23.48	23.21	21.43	19.54	18.08		15.27	14.26
15	09.49	08.19	08.58-08.59/1	06.43		05.53	04.11	02.53	03.33	05.10	06.41	08.08	09.19-09.37/18	08.46	10.06
	15.12	16.53		18.19		20.51	22.26	23.49	23.18	21.39	19.50	18.05		15.25	14.25
16	09.47	08.16	08.54-09.03/9	06.39		05.50	04.08	02.53	03.36	05.13	06.44	08.11	09.18-09.37/19	08.49	10.08
	15.15	16.56		18.22		20.54	22.30	23.50	23.16	21.36	19.47	18.01		15.22	14.25
17	09.44	08.12	08.50-09.04/14	06.36		05.46	04.04	02.52	03.39	05.16	06.47	08.14	09.18-09.38/20	08.52	10.09
	15.18	16.59		18.25		20.57	22.33	23.51	23.13	21.32	19.43	17.58		15.19	14.24
18	09.42	08.09	08.48-09.05/17	06.32		05.43	04.01	02.52	03.42	05.19	06.50	08.17	09.17-09.38/21	08.55	10.10
	15.21	17.02		18.28		21.01	22.36	23.52	23.10	21.29	19.39	17.54		15.16	14.24
19	09.39	08.06	08.47-09.07/20	06.29		05.39	03.58	02.51	03.45	05.22	06.53	08.20	09.16-09.38/22	08.58	10.11
	15.24	17.05		18.31		21.04	22.39	23.53	23.07	21.25	19.36	17.51		15.13	14.24
20	09.37	08.02	08.46-09.07/21	06.25		05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.17-09.38/21	09.02	10.12
	15.28	17.09		18.34		21.07	22.42	23.54	23.04	21.22	19.32	17.48		15.11	14.24
21	09.34	07.59	08.46-09.07/21	06.22		05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.17-09.38/21	09.05	10.13
	15.31	17.12		18.37		21.10	22.46	23.54	23.01	21.18	19.29	17.44		15.08	14.24
22	09.32	07.56	08.46-09.08/22	06.18		05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.16-09.36/20	09.08	10.14
	15.34	17.15		18.40		21.13	22.49	23.54	22.58	21.15	19.25	17.41		15.05	14.25
23	09.29	07.52	08.46-09.07/21	06.15		05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.18-09.36/18	09.11	10.14
	15.37	17.18		18.43		21.16	22.52	23.54	22.55	21.11	19.22	17.38		15.03	14.25
24	09.26	07.49	08.45-09.06/21	06.11		05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.18-09.35/17	09.14	10.14
	15.40	17.21		18.46		21.19	22.55	23.54	22.52	21.08	19.18	17.34		15.00	14.26
25	09.24	07.45	08.47-09.07/20	06.08		05.18	03.40	02.54	04.04	05.40	07.10	07.38	08.21-08.34/13	09.17	10.15
	15.44	17.24		18.49		21.22	22.58	23.54	22.49	21.04	19.15	16.31		14.58	14.27
26	09.21	07.42	08.47-09.05/18	06.04		05.15	03.37	02.55	04.07	05.43	07.13	07.42	08.24-08.31/7	09.20	10.15
	15.47	17.28		18.52		21.25	23.01	23.53	22.46	21.01	19.11	16.27		14.55	14.28
27	09.18	07.39	08.47-09.04/17	06.01		05.11	03.34	02.56	04.10	05.46	07.15	07.45		09.23	10.15
	15.50	17.31		18.55		21.28	23.04	23.52	22.43	20.57	19.08	16.24		14.53	14.29
28	09.15	07.35	08.49-09.03/14	05.57		05.08	03.31	02.57	04.13	05.49	07.18	07.48		09.26	10.14
	15.53	17.34		18.58		21.32	23.07	23.52	22.40	20.54	19.04	16.21		14.51	14.30
29	09.12			06.53		05.04	03.29	02.58	04.16	05.52	07.21	07.51		09.29	10.14
	15.57			20.00		21.35	23.10	23.51	22.36	20.50	19.01	16.18		14.48	14.32
30	09.09			06.50		05.01	03.26	03.00	04.19	05.55	07.24	07.54		09.32	10.13
	16.00			20.03		21.38	23.13	23.49	22.33	20.47	18.57	16.14		14.46	14.33
31	09.06			06.46			03.23		04.23	05.58		07.57			10.13
	16.03			20.06			23.16		22.30	20.43		16.11			14.35
Potential sun hours	172	238		363		451	569	622	607	508	393	305		199	138
Sum of minutes with flicker	0	236		7		0	0	0	0	0	0	242		0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 6 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (90)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.57	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.26	20.40	18.53	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.03	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.13	03.05	04.35	06.09	07.35	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.45
	14.45	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.25	18.39	15.55	14.36
6	10.06	08.48	07.14	06.25	04.40	03.09	03.10	04.41	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.21	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.26	17.55	20.27	22.00	23.34	23.37	22.07	20.18	18.32	15.49	14.33
8	10.03	08.42	07.07	06.18	04.34	03.05	03.14	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.45	14.32
9	10.01	08.38	07.04	06.14	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.25	15.42	14.31
10	09.59	08.35	07.00	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.18	15.36	14.28
12	09.55	08.29	06.53	06.04	04.20	02.57	03.25	05.00	06.32	07.59	08.36	10.01
	15.03	16.43	18.10	20.42	22.16	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.25	06.50	06.00	04.17	02.55	03.28	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.54	03.30	05.07	06.38	08.05	08.42	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.24	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.52	08.20	08.58	10.11
	15.24	17.05	18.31	21.03	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.12
	15.27	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.10	14.24
21	09.34	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.37	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.53	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.27	18.51	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.38	06.00	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.53	17.34	18.57	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.50	14.30
29	09.12		06.53	05.04	03.29	02.58	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.00	16.17	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 7 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (91)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.57	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.53	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.22	23.47	22.23	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.03	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.13	03.05	04.35	06.09	07.35	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.36
6	10.06	08.48	07.14	06.25	04.40	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.26	17.55	20.27	22.00	23.34	23.38	22.07	20.18	18.32	15.49	14.33
8	10.03	08.42	07.07	06.18	04.34	03.05	03.14	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.37	23.35	22.03	20.15	18.29	15.45	14.32
9	10.01	08.38	07.04	06.14	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.25	15.42	14.31
10	09.59	08.35	07.00	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.18	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.03	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.26	06.50	06.00	04.17	02.55	03.27	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.54	03.30	05.07	06.38	08.05	08.42	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.24	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.30	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.52	08.20	08.58	10.11
	15.24	17.05	18.31	21.04	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.12
	15.27	17.09	18.34	21.07	22.42	23.54	23.04	21.22	19.32	17.48	15.10	14.24
21	09.34	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.18	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.37	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.53	04.04	05.40	07.10	07.38	09.17	10.15
	15.44	17.24	18.49	21.22	22.58	23.54	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.07	05.43	07.12	07.41	09.20	10.15
	15.47	17.27	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.39	06.00	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.53	17.34	18.57	21.32	23.07	23.52	22.39	20.54	19.04	16.21	14.50	14.30
29	09.12		06.53	05.04	03.29	02.58	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.51	22.36	20.50	19.00	16.17	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 8 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (92)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.26	20.40	18.53	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.09	07.35	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.45
	14.45	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.06	20.18	18.32	15.49	14.33
8	10.02	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.14	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.38	23.33	22.00	20.11	18.25	15.42	14.31
10	09.59	08.35	07.00	06.11	04.27	03.01	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.18	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.03	16.43	18.10	20.42	22.16	23.44	23.26	21.49	20.01	18.15	15.33	14.27
13	09.53	08.25	06.50	06.00	04.17	02.56	03.28	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.55	03.30	05.07	06.38	08.05	08.42	10.04
	15.09	16.49	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.46	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.12	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.52	08.20	08.58	10.11
	15.24	17.05	18.31	21.03	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.01	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.37	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.27	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.38	06.00	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.53	17.34	18.57	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.53	05.04	03.29	02.58	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.00	16.17	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.23	05.58		07.57		10.12
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 9 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (93)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03 10.06-10.26/20	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00 09.42-09.50/8	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.44
2	10.11	09.00 10.05-10.26/21	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04 09.40-09.53/13	09.38
	14.39	16.10	17.40	20.12	21.44	23.22	23.47	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57 10.05-10.26/21	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07 09.39-09.54/15	09.40
	14.41	16.13	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.47	16.01	14.40
4	10.09	08.54 10.07-10.27/20	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.36	08.10 09.38-09.56/18	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51 10.07-10.27/20	07.18	06.29	04.44	03.11	03.08	04.39	06.12	07.38	08.13 09.38-09.56/18	09.46
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.40	15.55	14.37
6	10.06	08.48 10.07-10.26/19	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.17 09.36-09.56/20	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45 10.08-10.25/17	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20 09.36-09.57/21	09.51
	14.50	16.27	17.55	20.27	22.00	23.34	23.38	22.07	20.19	18.33	15.49	14.33
8	10.03	08.42 10.10-10.25/15	07.08	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23 09.36-09.57/21	09.53
	14.53	16.30	17.58	20.30	22.04	23.37	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39 10.11-10.23/12	07.04	06.15	04.31	03.03	03.17	04.51	06.24	07.50	08.26 09.36-09.57/21	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.26	15.43	14.31
10	09.59	08.35 10.13-10.20/7	07.01	06.11	04.27	03.01	03.20	04.54	06.27	07.53	08.29 09.36-09.57/21	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33 09.37-09.56/19	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.54	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36 09.38-09.57/19	10.01
	15.04	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.26	06.50	06.00	04.17	02.56	03.28	05.04	06.36	08.02	08.39 09.39-09.57/18	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.27
14	09.51	08.22	06.47	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42 09.39-09.56/17	10.05
	15.09	16.50	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.46 09.42-09.55/13	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49 09.46-09.53/7	10.08
	15.15	16.56	18.22	20.54	22.30	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.52	03.39	05.16	06.47	08.14	08.52 09.51-09.53/2	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.01	22.36	23.52	23.10	21.29	19.40	17.55	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.53	08.20	08.58	10.11
	15.24	17.06	18.31	21.04	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.54	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.18	19.29	17.44	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.38	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24 10.17-10.19/2	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.15
	15.44	17.24	18.49	21.22	22.58	23.54	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21 10.13-10.21/8	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.13	07.42	09.20	10.15
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.55	14.28
27	09.18 10.09-10.22/13	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.55	21.29	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15 10.06-10.23/17	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12 10.07-10.25/18		06.54	05.05	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.01	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.48	14.32
30	09.09 10.06-10.25/19		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06 10.06-10.26/20		06.46		03.23		04.23	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	97	172	0	0	0	0	0	0	0	0	271	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 10 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (94)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.26	20.40	18.54	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.39	06.12	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.18	18.32	15.49	14.34
8	10.02	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.15	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.38	23.33	22.00	20.11	18.26	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.16	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.25	06.50	06.00	04.17	02.56	03.28	05.04	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.09	16.49	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.46	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.12	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.03	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.52	03.48	05.25	06.55	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.55	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.53	05.05	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 11 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (95)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.26	20.40	18.53	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.18	18.32	15.49	14.33
8	10.03	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.14	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.25	15.42	14.31
10	09.59	08.35	07.00	06.11	04.27	03.01	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.03	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.26	06.50	06.00	04.17	02.56	03.28	05.04	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.55	03.30	05.07	06.38	08.05	08.42	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.46	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.58	10.11
	15.24	17.05	18.31	21.04	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.37	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.15
	15.47	17.27	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.55	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.53	17.34	18.57	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.53	05.04	03.29	02.58	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.23	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 12 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (96)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.11	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.18	23.48	22.26	20.40	18.53	16.08	14.44
2	10.10	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.37
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.09	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.35	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.16	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.06	20.18	18.32	15.49	14.34
8	10.02	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.03	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.14	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.38	23.33	22.00	20.11	18.25	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.40	23.31	21.56	20.08	18.22	15.39	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.32	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.16	23.44	23.26	21.49	20.01	18.15	15.33	14.27
13	09.53	08.25	06.50	06.00	04.17	02.56	03.28	05.04	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.09	16.49	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.46	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.07
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.12	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.53	08.20	08.58	10.11
	15.25	17.05	18.31	21.03	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.52	03.48	05.25	06.55	08.23	09.01	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.53	23.01	21.18	19.29	17.44	15.08	14.25
22	09.32	07.55	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.48	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.27	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.38	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.52	22.42	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.31	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.53	05.04	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.00	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	568	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906 WTG: 13 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (97)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
550	430	410	446	625	915	1089	1130	1007	772	633	663	8669

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.47	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.39	06.12	07.38	08.13	09.46
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.40	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.19	18.33	15.49	14.34
8	10.03	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.15	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.26	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.26	06.50	06.00	04.17	02.56	03.28	05.04	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.05
	15.09	16.50	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.46	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.55	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.04	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.52	03.48	05.25	06.55	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.13	07.42	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.55	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.54	05.05	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.24		04.23	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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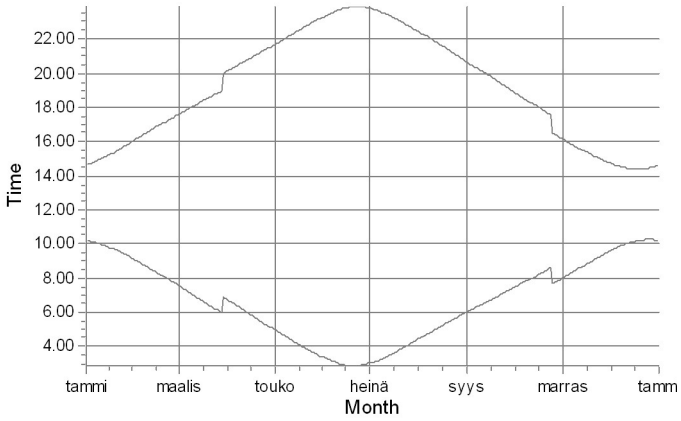
Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

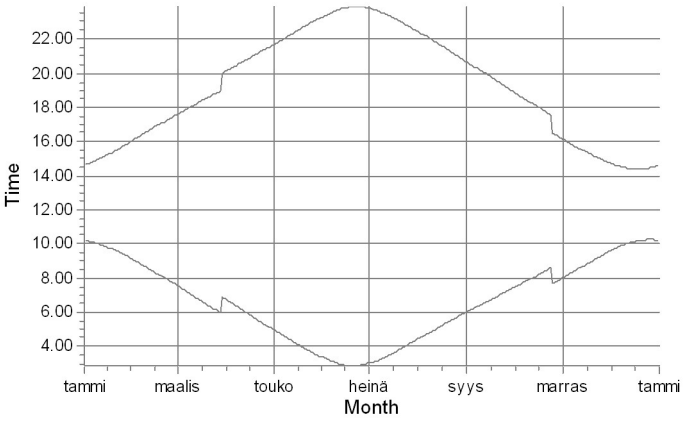
SHADOW - Calendar per WTG, graphical

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906

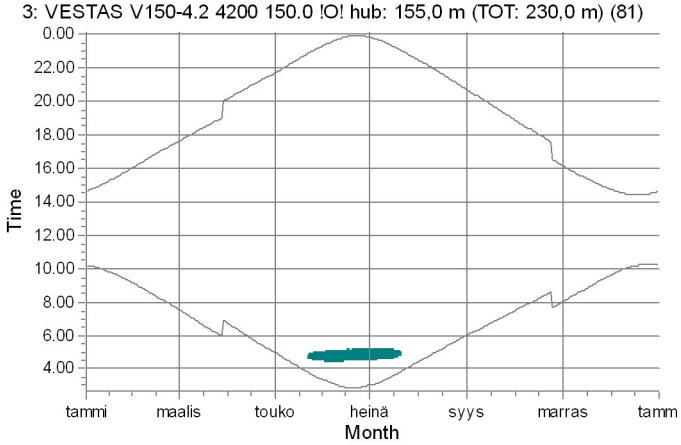
1: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (79)



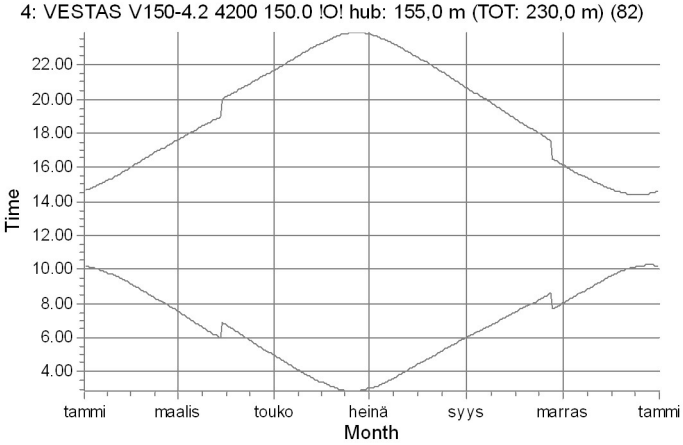
2: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (80)



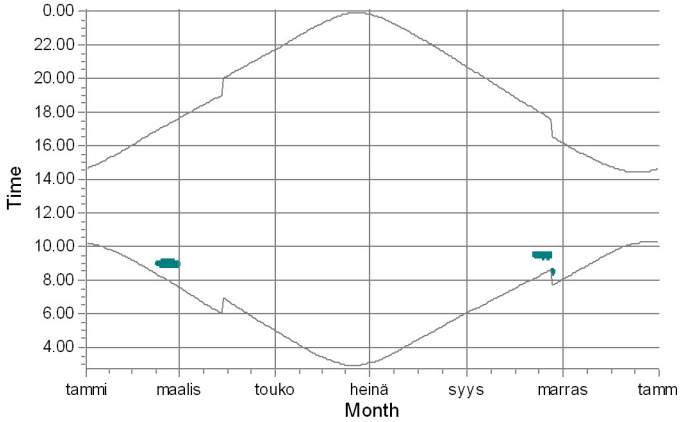
3: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (81)



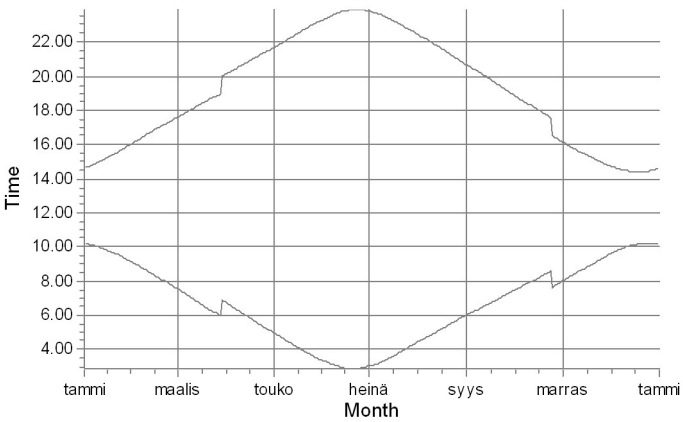
4: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (82)



5: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (89)



6: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (90)



Shadow receptors

F: Lomarakennus F (Hirvinevanhaara 147)

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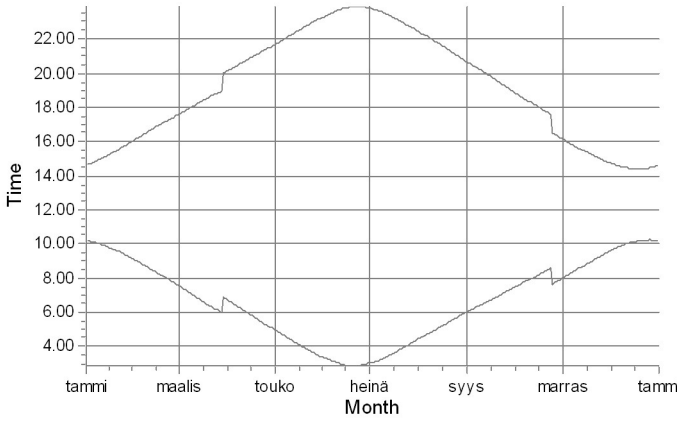
Calculated:
10.6.2020 15.54/3.3.247

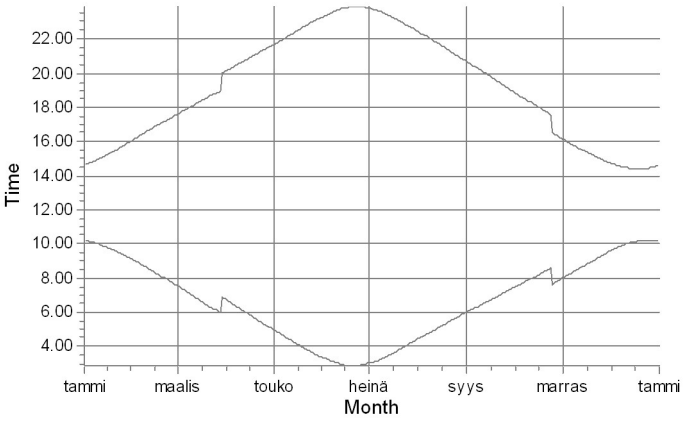
SHADOW - Calendar per WTG, graphical

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906

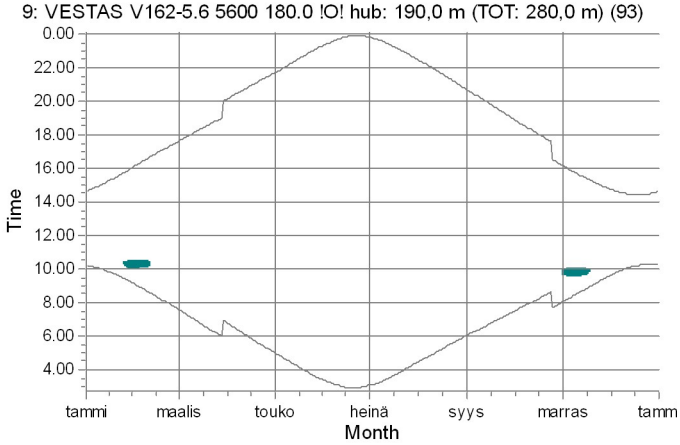
7: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (91)



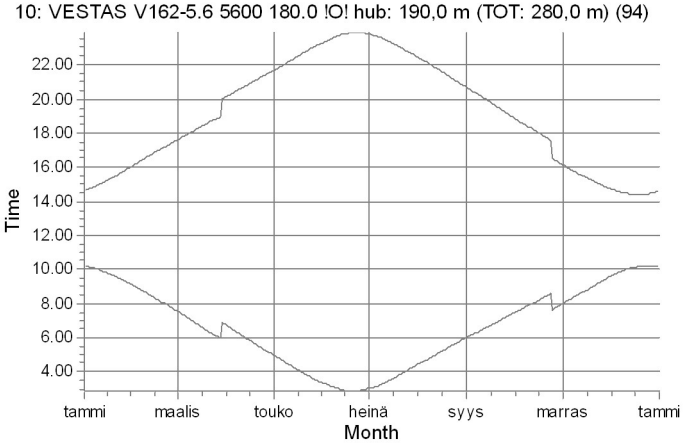
8: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (92)



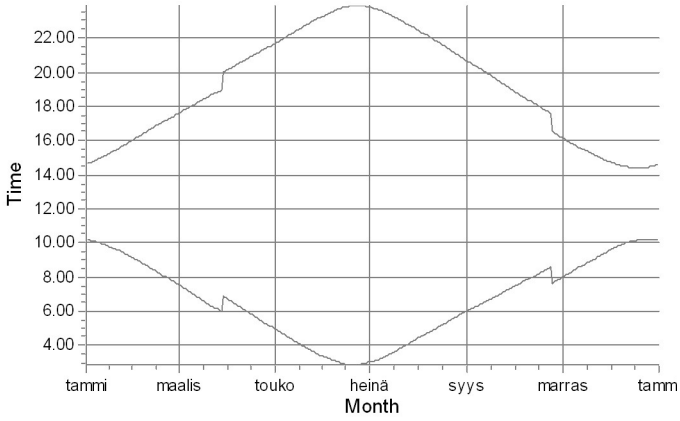
9: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (93)



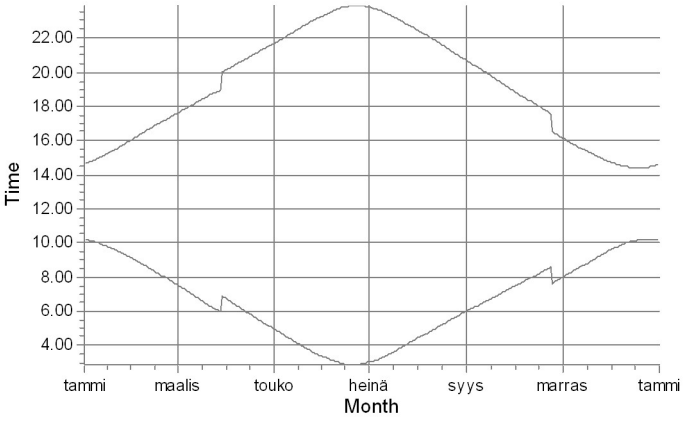
10: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (94)



11: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (95)



12: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (96)



Shadow receptors

F: Lomarakennus F (Hirvinevanhaara 147)

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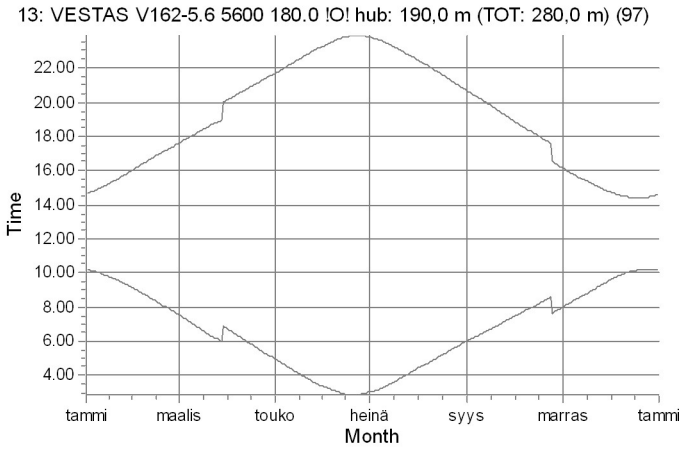
SHADOW - Calendar per WTG, graphical

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906



Shadow receptors

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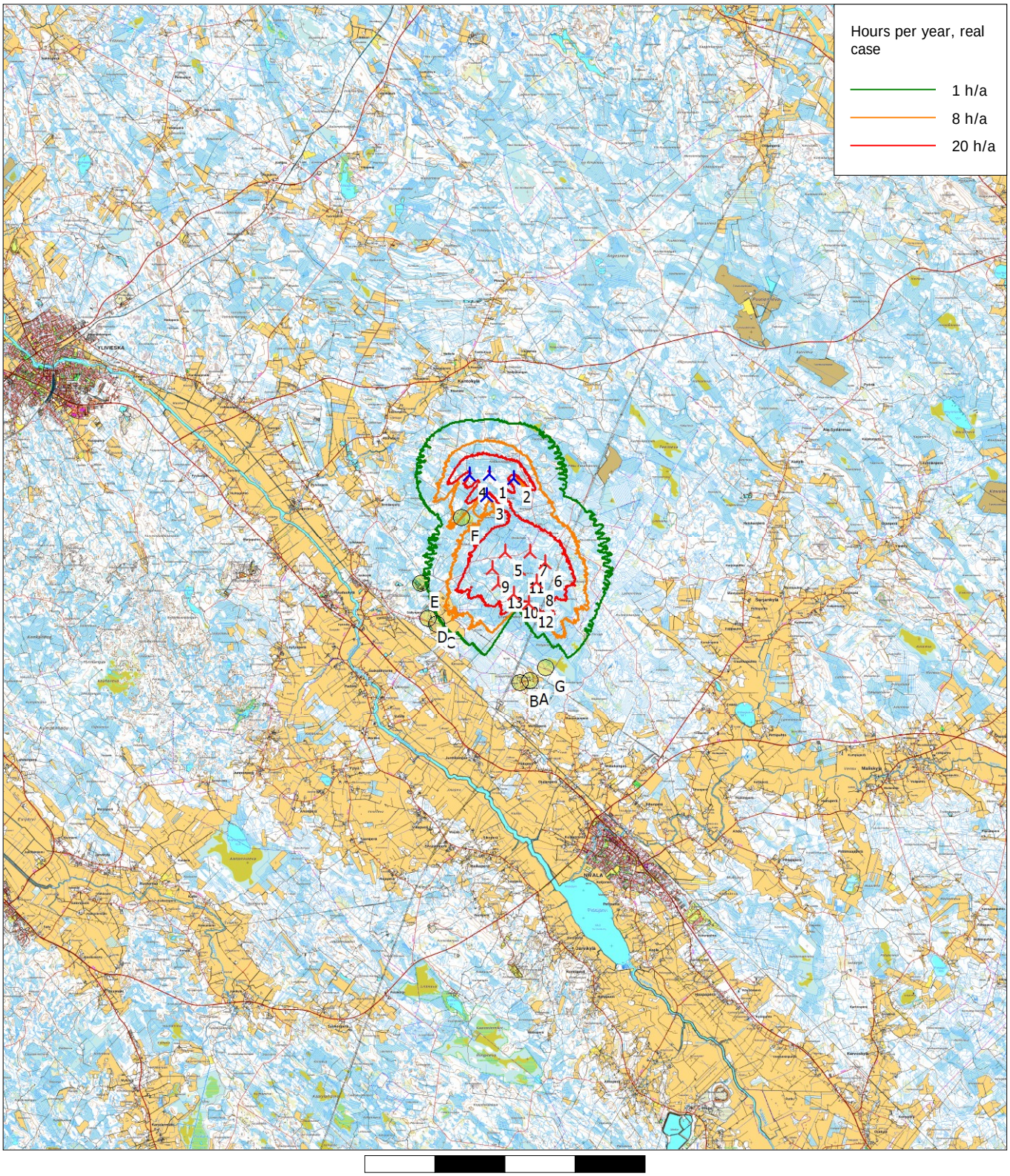
Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 15.54/3.3.247

SHADOW - Map

Calculation: Urakkaneva_RD180x9xHH190+Hirvineva_V150x4xHH155_no forest_20200906



0 2,5 5 7,5 10km

Map: Maastokartta 50k , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 396 150 North: 7 100 280

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Urakkaneva_20200521_0.wpo (4)

Urakkaneva_Generic RD180x9xHH190_20200514

Hirvineva_V150x4xHH155_2018

Urakkaneva laskentapisteet

Varjostus (real case, no forest)

1 h/a

8 h/a

20 h/a

MML, mtk rakennuskanta 2020/05

Asuinrakennus

Liike- tai julkinen rakennus

Lomarakennus

1 2 3 4 5 6 7 8 9

A B C D E F G

km 0 1 2 3 4

Liite 6: Varjostusmallinnusten tulokset ”real case, luke forest”

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Main Result

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906

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

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

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

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Urakkaneva_2020052
Area object(s) used in calculation:
Area object (Luke N): (9)
Area object (Luke keskiosa): (11)
Obstacles used in calculation
Eye height for map: 1,5 m
Grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89

Scale 1:100 000

New WTG Shadow receptor

WTGs

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	395638	7103907	90,4	VESTAS V150-4.2 4200 150.0 !O! h...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	1902	10,4
2	396514	7103767	95,0	VESTAS V150-4.2 4200 150.0 !O! h...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	1902	10,4
3	395550	7103150	89,6	VESTAS V150-4.2 4200 150.0 !O! h...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	1902	10,4
4	394929	7103873	86,8	VESTAS V150-4.2 4200 150.0 !O! h...	Yes	VESTAS	V150-4.2-4200	4200	150,0	155,0	1902	10,4
5	396213	7101101	93,0	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
6	397616	7100723	97,6	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
7	397086	7101114	95,0	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
8	397318	7100046	97,1	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
9	395742	7100512	93,3	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
10	396517	7099615	95,2	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
11	396717	7100499	95,4	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
12	397043	7099259	96,0	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4
13	395944	7099965	95,0	VESTAS V162-5.6 5600 180.0 !O! h...	Yes	VESTAS	V162-5.6-5600	5600	180,0	190,0	2449	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Asuinrakennus A (Hakuperäntie 202)	397098	7096526	95,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B (Hakuperäntie 169)	396724	7096452	92,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Asuinrakennus C (Säilyntie 285)	393762	7098532	81,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D (Säilyntie 264)	393460	7098729	84,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E (Raudaskallion metsatie)	393183	7099996	87,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Lomarakennus F (Hirvinevanhaara 147)	394644	7102345	90,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Lomarakennus G (Pohjanneva)	397651	7096966	97,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0

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10.6.2020 16.07/3.3.247

SHADOW - Main Result

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Asuinrakennus A (Hakuperäntie 202)	0:00
B	Asuinrakennus B (Hakuperäntie 169)	0:00
C	Asuinrakennus C (Säilyntie 285)	0:00
D	Asuinrakennus D (Säilyntie 264)	0:00
E	Lomarakennus E (Raudaskallion metsatie)	0:00
F	Lomarakennus F (Hirvinevanhaara 147)	0:00
G	Lomarakennus G (Pohjanneva)	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (79)	0:00	0:00
2	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (80)	0:00	0:00
3	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (81)	0:00	0:00
4	VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (82)	0:00	0:00
5	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (89)	0:00	0:00
6	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (90)	0:00	0:00
7	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (91)	0:00	0:00
8	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (92)	0:00	0:00
9	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (93)	0:00	0:00
10	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (94)	0:00	0:00
11	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (95)	0:00	0:00
12	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (96)	0:00	0:00
13	VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (97)	0:00	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

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SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906 Shadow receptor: A - Asuinrakennus A (Hakuperäntie 202)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.11	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.00	09.34
	14.38	16.07	17.37	20.09	21.41	23.18	23.47	22.26	20.40	18.53	16.08	14.45
2	10.10	09.00	07.28	06.39	04.54	03.19	03.02	04.29	06.04	07.30	08.03	09.37
	14.40	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.43
3	10.09	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.42	16.14	17.43	20.15	21.47	23.23	23.44	22.20	20.32	18.46	16.01	14.41
4	10.08	08.54	07.21	06.32	04.48	03.14	03.06	04.36	06.10	07.35	08.10	09.42
	14.44	16.17	17.46	20.18	21.50	23.26	23.42	22.16	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.12	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.25	18.39	15.55	14.37
6	10.05	08.48	07.14	06.25	04.41	03.10	03.11	04.42	06.15	07.41	08.16	09.47
	14.48	16.23	17.52	20.24	21.57	23.31	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.08	03.13	04.45	06.18	07.44	08.19	09.50
	14.51	16.27	17.55	20.27	22.00	23.33	23.37	22.06	20.18	18.32	15.49	14.34
8	10.02	08.41	07.07	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.52
	14.53	16.30	17.58	20.30	22.03	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.00	08.38	07.04	06.15	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.54
	14.56	16.33	18.01	20.33	22.06	23.38	23.32	21.59	20.11	18.26	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.40	23.30	21.56	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.23	04.58	06.30	07.56	08.32	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.37	14.29
12	09.55	08.29	06.53	06.04	04.21	02.58	03.25	05.01	06.33	07.59	08.36	10.00
	15.04	16.43	18.10	20.42	22.16	23.44	23.25	21.49	20.01	18.15	15.34	14.28
13	09.53	08.25	06.50	06.00	04.18	02.56	03.28	05.04	06.35	08.02	08.39	10.02
	15.07	16.46	18.13	20.45	22.19	23.45	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.10	16.50	18.16	20.48	22.23	23.47	23.20	21.42	19.54	18.08	15.28	14.26
15	09.48	08.19	06.43	05.53	04.11	02.54	03.34	05.10	06.41	08.08	08.45	10.06
	15.13	16.53	18.19	20.51	22.26	23.48	23.17	21.39	19.50	18.05	15.25	14.26
16	09.46	08.15	06.39	05.50	04.08	02.54	03.37	05.13	06.44	08.11	08.48	10.07
	15.16	16.56	18.22	20.54	22.29	23.49	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.08
	15.19	16.59	18.25	20.57	22.32	23.50	23.12	21.32	19.43	17.58	15.19	14.25
18	09.41	08.09	06.32	05.43	04.02	02.53	03.43	05.19	06.50	08.17	08.55	10.09
	15.22	17.02	18.28	21.00	22.35	23.51	23.09	21.29	19.39	17.55	15.16	14.25
19	09.39	08.05	06.29	05.39	03.59	02.52	03.46	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.03	22.39	23.52	23.06	21.25	19.36	17.51	15.14	14.25
20	09.36	08.02	06.25	05.36	03.55	02.52	03.49	05.25	06.55	08.23	09.01	10.11
	15.28	17.09	18.34	21.06	22.42	23.53	23.03	21.22	19.32	17.48	15.11	14.25
21	09.34	07.59	06.22	05.32	03.52	02.52	03.52	05.28	06.58	08.26	09.04	10.12
	15.31	17.12	18.37	21.09	22.45	23.53	23.01	21.18	19.29	17.44	15.08	14.25
22	09.31	07.55	06.18	05.29	03.49	02.53	03.55	05.31	07.01	08.29	09.07	10.13
	15.34	17.15	18.40	21.13	22.48	23.53	22.58	21.15	19.25	17.41	15.06	14.25
23	09.29	07.52	06.15	05.25	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.13
	15.37	17.18	18.43	21.16	22.51	23.53	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.21	18.46	21.19	22.54	23.53	22.51	21.08	19.18	17.34	15.00	14.27
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.57	23.53	22.48	21.04	19.15	16.31	14.58	14.27
26	09.20	07.42	06.04	05.15	03.38	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.28	18.51	21.25	23.01	23.52	22.45	21.01	19.11	16.28	14.56	14.28
27	09.18	07.38	06.01	05.12	03.35	02.57	04.10	05.46	07.15	07.44	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.51	22.42	20.57	19.08	16.24	14.53	14.30
28	09.15	07.35	05.57	05.08	03.32	02.58	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.31	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.53	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.13
	15.57		20.00	21.34	23.09	23.50	22.36	20.50	19.00	16.18	14.49	14.32
30	09.09		06.50	05.01	03.27	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.12	23.48	22.33	20.47	18.57	16.14	14.47	14.34
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.04		20.06		23.15		22.29	20.43		16.11		14.35
Potential sun hours	173	238	363	451	568	621	607	508	393	305	199	139
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906 Shadow receptor: B - Asuinrakennus B (Hakuperäntie 169)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.11	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.00	09.34
	14.38	16.07	17.37	20.09	21.41	23.18	23.47	22.26	20.40	18.54	16.08	14.45
2	10.10	09.00	07.28	06.39	04.54	03.19	03.03	04.29	06.04	07.30	08.03	09.37
	14.40	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.43
3	10.09	08.57	07.25	06.36	04.51	03.17	03.04	04.32	06.07	07.33	08.07	09.40
	14.42	16.14	17.43	20.15	21.47	23.23	23.44	22.20	20.33	18.46	16.02	14.41
4	10.08	08.54	07.21	06.32	04.48	03.14	03.06	04.36	06.10	07.35	08.10	09.42
	14.44	16.17	17.46	20.18	21.50	23.26	23.42	22.16	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.13	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.25	18.39	15.55	14.37
6	10.05	08.48	07.14	06.25	04.41	03.10	03.11	04.42	06.15	07.41	08.16	09.47
	14.48	16.23	17.52	20.24	21.57	23.31	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.08	03.13	04.45	06.18	07.44	08.19	09.50
	14.51	16.27	17.55	20.27	22.00	23.33	23.37	22.06	20.18	18.33	15.49	14.34
8	10.02	08.41	07.07	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.52
	14.53	16.30	17.58	20.30	22.03	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.00	08.38	07.04	06.15	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.54
	14.56	16.33	18.01	20.33	22.06	23.38	23.32	22.00	20.11	18.26	15.43	14.31
10	09.59	08.35	07.00	06.11	04.28	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.40	23.30	21.56	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.08	04.24	03.01	03.23	04.58	06.30	07.56	08.32	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.37	14.29
12	09.55	08.29	06.53	06.04	04.21	02.58	03.26	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.16	23.44	23.25	21.49	20.01	18.15	15.34	14.28
13	09.53	08.25	06.50	06.00	04.18	02.56	03.28	05.04	06.35	08.02	08.39	10.02
	15.07	16.46	18.13	20.45	22.19	23.45	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.10	16.50	18.16	20.48	22.23	23.47	23.20	21.42	19.54	18.08	15.28	14.26
15	09.48	08.19	06.43	05.53	04.11	02.54	03.34	05.10	06.41	08.08	08.45	10.06
	15.13	16.53	18.19	20.51	22.26	23.48	23.18	21.39	19.50	18.05	15.25	14.26
16	09.46	08.15	06.39	05.50	04.08	02.54	03.37	05.13	06.44	08.11	08.48	10.07
	15.16	16.56	18.22	20.54	22.29	23.49	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.08
	15.19	16.59	18.25	20.57	22.32	23.50	23.12	21.32	19.43	17.58	15.19	14.25
18	09.41	08.09	06.32	05.43	04.02	02.53	03.43	05.19	06.50	08.17	08.55	10.10
	15.22	17.02	18.28	21.00	22.35	23.51	23.09	21.29	19.39	17.55	15.16	14.25
19	09.39	08.05	06.29	05.39	03.59	02.52	03.46	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.03	22.39	23.52	23.06	21.25	19.36	17.51	15.14	14.25
20	09.36	08.02	06.25	05.36	03.55	02.52	03.49	05.25	06.55	08.23	09.01	10.11
	15.28	17.09	18.34	21.06	22.42	23.53	23.03	21.22	19.32	17.48	15.11	14.25
21	09.34	07.59	06.22	05.32	03.52	02.52	03.52	05.28	06.58	08.26	09.04	10.12
	15.31	17.12	18.37	21.09	22.45	23.53	23.01	21.18	19.29	17.44	15.08	14.25
22	09.31	07.55	06.18	05.29	03.49	02.53	03.55	05.31	07.01	08.29	09.07	10.13
	15.34	17.15	18.40	21.13	22.48	23.53	22.58	21.15	19.25	17.41	15.06	14.25
23	09.29	07.52	06.15	05.25	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.13
	15.37	17.18	18.43	21.16	22.51	23.53	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.21	18.46	21.19	22.54	23.53	22.51	21.08	19.18	17.34	15.00	14.27
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.57	23.53	22.48	21.04	19.15	16.31	14.58	14.28
26	09.20	07.42	06.04	05.15	03.38	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.52	22.45	21.01	19.11	16.28	14.56	14.28
27	09.18	07.38	06.01	05.12	03.35	02.57	04.10	05.46	07.15	07.44	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.51	22.42	20.57	19.08	16.24	14.53	14.30
28	09.15	07.35	05.57	05.08	03.32	02.58	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.31	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.53	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.13
	15.57		20.00	21.34	23.09	23.50	22.36	20.50	19.01	16.18	14.49	14.32
30	09.09		06.50	05.01	03.27	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.12	23.48	22.33	20.47	18.57	16.14	14.47	14.34
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.04		20.06		23.15		22.29	20.43		16.11		14.35
Potential sun hours	173	238	363	451	568	621	607	508	393	305	199	139
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906 Shadow receptor: C - Asuinrakennus C (Säilyntie 285)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.01	09.35
	14.38	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.45
2	10.11	09.00	07.28	06.40	04.55	03.19	03.02	04.29	06.04	07.30	08.04	09.38
	14.40	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.43
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.33	06.07	07.33	08.07	09.40
	14.42	16.14	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.47	16.02	14.41
4	10.08	08.54	07.22	06.32	04.48	03.14	03.06	04.36	06.10	07.36	08.10	09.43
	14.44	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.13	07.39	08.13	09.46
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.40	15.55	14.37
6	10.06	08.48	07.15	06.25	04.41	03.10	03.10	04.42	06.16	07.42	08.17	09.48
	14.48	16.24	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.38	03.08	03.13	04.45	06.18	07.44	08.20	09.50
	14.51	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.19	18.33	15.49	14.34
8	10.03	08.42	07.08	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39	07.04	06.15	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.55
	14.56	16.33	18.01	20.33	22.07	23.38	23.33	22.00	20.12	18.26	15.43	14.31
10	09.59	08.35	07.01	06.11	04.28	03.02	03.20	04.55	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.08	04.24	03.00	03.23	04.58	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.37	14.29
12	09.55	08.29	06.54	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.34	14.28
13	09.53	08.26	06.50	06.01	04.18	02.56	03.28	05.04	06.36	08.02	08.39	10.03
	15.07	16.47	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.47	05.57	04.14	02.55	03.31	05.07	06.39	08.05	08.42	10.05
	15.10	16.50	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.54	04.11	02.54	03.34	05.10	06.41	08.08	08.46	10.06
	15.13	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.26
16	09.47	08.16	06.40	05.50	04.08	02.53	03.37	05.13	06.44	08.11	08.49	10.08
	15.16	16.56	18.22	20.54	22.30	23.50	23.15	21.36	19.47	18.02	15.22	14.25
17	09.44	08.12	06.36	05.47	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.09
	15.19	16.59	18.25	20.58	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.25
18	09.42	08.09	06.33	05.43	04.02	02.52	03.43	05.19	06.50	08.17	08.55	10.10
	15.22	17.03	18.28	21.01	22.36	23.52	23.10	21.29	19.40	17.55	15.16	14.25
19	09.39	08.06	06.29	05.40	03.59	02.52	03.46	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.04	22.39	23.53	23.07	21.26	19.36	17.51	15.14	14.25
20	09.37	08.02	06.26	05.36	03.55	02.52	03.49	05.25	06.56	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.33	17.48	15.11	14.25
21	09.34	07.59	06.22	05.33	03.52	02.52	03.52	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.19	19.29	17.45	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.55	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.06	14.25
23	09.29	07.52	06.15	05.26	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.14
	15.38	17.18	18.43	21.16	22.52	23.54	22.55	21.12	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.22	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.01	14.27
25	09.24	07.46	06.08	05.19	03.40	02.54	04.04	05.40	07.10	07.39	09.17	10.14
	15.44	17.25	18.49	21.22	22.58	23.53	22.49	21.05	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.38	02.55	04.07	05.43	07.13	07.42	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.56	14.28
27	09.18	07.39	06.01	05.12	03.35	02.56	04.10	05.46	07.16	07.45	09.23	10.14
	15.51	17.31	18.55	21.29	23.04	23.52	22.43	20.58	19.08	16.24	14.53	14.30
28	09.15	07.35	05.57	05.08	03.32	02.58	04.14	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.54	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.14
	15.57		20.01	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.49	14.32
30	09.09		06.50	05.01	03.27	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.04	21.38	23.13	23.49	22.33	20.47	18.57	16.15	14.47	14.34
31	09.06		06.47		03.24		04.23	05.58		07.57		10.13
	16.04		20.07		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	568	622	607	508	393	305	199	138
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906 Shadow receptor: D - Asuinrakennus D (Säilyntie 264)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.01	09.35
	14.38	16.07	17.37	20.10	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.45
2	10.11	09.00	07.28	06.40	04.55	03.19	03.02	04.29	06.04	07.30	08.04	09.38
	14.40	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.43
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.33	06.07	07.33	08.07	09.40
	14.42	16.14	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.47	16.02	14.41
4	10.08	08.54	07.22	06.32	04.48	03.14	03.06	04.36	06.10	07.36	08.10	09.43
	14.44	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.13	07.39	08.13	09.46
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.40	15.55	14.37
6	10.06	08.48	07.15	06.25	04.41	03.10	03.10	04.42	06.16	07.42	08.17	09.48
	14.48	16.24	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.38	03.08	03.13	04.45	06.19	07.44	08.20	09.50
	14.51	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.19	18.33	15.49	14.34
8	10.03	08.42	07.08	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39	07.04	06.15	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.55
	14.56	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.12	18.26	15.43	14.31
10	09.59	08.35	07.01	06.11	04.28	03.02	03.20	04.55	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.08	04.24	03.00	03.23	04.58	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.05	18.19	15.37	14.29
12	09.55	08.29	06.54	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.34	14.28
13	09.53	08.26	06.50	06.01	04.18	02.56	03.28	05.04	06.36	08.02	08.39	10.03
	15.07	16.47	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.47	05.57	04.14	02.55	03.31	05.07	06.39	08.05	08.42	10.05
	15.10	16.50	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.54	04.11	02.54	03.34	05.10	06.41	08.08	08.46	10.06
	15.13	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.26
16	09.47	08.16	06.40	05.50	04.08	02.53	03.37	05.13	06.44	08.11	08.49	10.08
	15.16	16.56	18.22	20.55	22.30	23.50	23.15	21.36	19.47	18.02	15.22	14.25
17	09.44	08.13	06.36	05.47	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.09
	15.19	16.59	18.25	20.58	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.25
18	09.42	08.09	06.33	05.43	04.02	02.52	03.43	05.19	06.50	08.17	08.55	10.10
	15.22	17.03	18.28	21.01	22.36	23.52	23.10	21.29	19.40	17.55	15.16	14.25
19	09.39	08.06	06.29	05.40	03.59	02.52	03.46	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.04	22.39	23.53	23.07	21.26	19.36	17.51	15.14	14.25
20	09.37	08.02	06.26	05.36	03.55	02.52	03.49	05.25	06.56	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.33	17.48	15.11	14.25
21	09.34	07.59	06.22	05.33	03.52	02.52	03.52	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.19	19.29	17.45	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.55	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.26	17.41	15.06	14.25
23	09.29	07.52	06.15	05.26	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.14
	15.38	17.18	18.43	21.16	22.52	23.54	22.55	21.12	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.22	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.01	14.27
25	09.24	07.46	06.08	05.19	03.40	02.54	04.04	05.40	07.10	07.39	09.17	10.14
	15.44	17.25	18.49	21.22	22.58	23.53	22.49	21.05	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.38	02.55	04.07	05.43	07.13	07.42	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.56	14.28
27	09.18	07.39	06.01	05.12	03.35	02.56	04.10	05.46	07.16	07.45	09.23	10.14
	15.51	17.31	18.55	21.29	23.04	23.52	22.43	20.58	19.08	16.24	14.53	14.30
28	09.15	07.35	05.57	05.08	03.32	02.58	04.14	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.54	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.14
	15.57		20.01	21.35	23.10	23.50	22.36	20.51	19.01	16.18	14.49	14.32
30	09.09		06.50	05.01	03.27	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.04	21.38	23.13	23.49	22.33	20.47	18.57	16.15	14.47	14.34
31	09.06		06.47		03.24		04.23	05.58		07.57		10.13
	16.04		20.07		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	568	622	607	508	393	305	199	138
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906 Shadow receptor: E - Lomarakennus E (Raudaskallion metsatie)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.01	09.35
	14.38	16.07	17.37	20.10	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.44
2	10.11	09.01	07.29	06.40	04.54	03.19	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.13	21.45	23.22	23.47	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.41
	14.41	16.14	17.43	20.16	21.48	23.24	23.45	22.20	20.33	18.47	16.02	14.41
4	10.09	08.54	07.22	06.32	04.48	03.14	03.06	04.36	06.10	07.36	08.10	09.43
	14.44	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.13	07.39	08.13	09.46
	14.46	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.40	15.55	14.37
6	10.06	08.48	07.15	06.25	04.41	03.09	03.10	04.42	06.16	07.42	08.17	09.48
	14.48	16.24	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.38	03.07	03.13	04.45	06.19	07.45	08.20	09.51
	14.51	16.27	17.55	20.27	22.01	23.34	23.38	22.07	20.19	18.33	15.49	14.34
8	10.03	08.42	07.08	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.37	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39	07.04	06.15	04.31	03.04	03.17	04.51	06.24	07.50	08.26	09.55
	14.56	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.12	18.26	15.43	14.31
10	09.59	08.35	07.01	06.11	04.28	03.02	03.20	04.54	06.27	07.53	08.30	09.57
	14.58	16.37	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.08	04.24	03.00	03.23	04.58	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.05	18.19	15.37	14.29
12	09.55	08.29	06.54	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.34	14.28
13	09.53	08.26	06.50	06.01	04.18	02.56	03.28	05.04	06.36	08.02	08.39	10.03
	15.07	16.47	18.13	20.45	22.20	23.46	23.24	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.47	05.57	04.14	02.55	03.31	05.07	06.39	08.05	08.43	10.05
	15.10	16.50	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.54	04.11	02.54	03.34	05.10	06.41	08.08	08.46	10.06
	15.13	16.53	18.19	20.52	22.26	23.49	23.18	21.40	19.50	18.05	15.25	14.25
16	09.47	08.16	06.40	05.50	04.08	02.53	03.37	05.13	06.44	08.11	08.49	10.08
	15.16	16.56	18.22	20.55	22.30	23.50	23.16	21.36	19.47	18.02	15.22	14.25
17	09.44	08.13	06.36	05.47	04.05	02.53	03.39	05.16	06.47	08.14	08.52	10.09
	15.19	16.59	18.25	20.58	22.33	23.51	23.13	21.33	19.43	17.58	15.19	14.25
18	09.42	08.09	06.33	05.43	04.02	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.22	17.03	18.28	21.01	22.36	23.52	23.10	21.29	19.40	17.55	15.16	14.25
19	09.40	08.06	06.29	05.40	03.58	02.52	03.45	05.22	06.53	08.20	08.59	10.11
	15.25	17.06	18.31	21.04	22.39	23.53	23.07	21.26	19.36	17.51	15.14	14.24
20	09.37	08.03	06.26	05.36	03.55	02.52	03.48	05.25	06.56	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.43	23.54	23.04	21.22	19.33	17.48	15.11	14.25
21	09.35	07.59	06.22	05.33	03.52	02.52	03.52	05.28	06.59	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.19	19.29	17.45	15.08	14.25
22	09.32	07.56	06.19	05.29	03.49	02.52	03.55	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.26	17.41	15.06	14.25
23	09.29	07.52	06.15	05.26	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.12	19.22	17.38	15.03	14.26
24	09.27	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.36	09.14	10.14
	15.41	17.22	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.19	03.40	02.54	04.04	05.40	07.10	07.39	09.17	10.15
	15.44	17.25	18.49	21.22	22.58	23.54	22.49	21.05	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.13	07.42	09.20	10.15
	15.47	17.28	18.52	21.26	23.01	23.53	22.46	21.01	19.11	16.28	14.56	14.28
27	09.18	07.39	06.01	05.12	03.35	02.56	04.10	05.46	07.16	07.45	09.23	10.15
	15.51	17.31	18.55	21.29	23.04	23.52	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.52	22.40	20.54	19.04	16.21	14.51	14.31
29	09.12		06.54	05.05	03.29	02.59	04.17	05.52	07.21	07.51	09.29	10.14
	15.57		20.01	21.35	23.10	23.51	22.36	20.51	19.01	16.18	14.49	14.32
30	09.09		06.50	05.01	03.26	03.00	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.04	21.38	23.13	23.49	22.33	20.47	18.57	16.15	14.47	14.34
31	09.07		06.47		03.24		04.23	05.58		07.57		10.13
	16.04		20.07		23.16		22.30	20.44		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906 Shadow receptor: F - Lomarakennus F (Hirvinevanhaara 147)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.01	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.44
2	10.11	09.01	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.45	23.22	23.47	22.24	20.36	18.50	16.05	14.42
3	10.10	08.58	07.25	06.36	04.51	03.16	03.03	04.32	06.07	07.33	08.07	09.41
	14.41	16.13	17.43	20.15	21.48	23.25	23.45	22.20	20.33	18.47	16.01	14.40
4	10.09	08.54	07.22	06.32	04.47	03.13	03.05	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.44	22.17	20.29	18.43	15.58	14.38
5	10.08	08.51	07.18	06.29	04.44	03.11	03.07	04.38	06.13	07.39	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.40	15.55	14.37
6	10.06	08.48	07.15	06.25	04.41	03.09	03.10	04.42	06.15	07.42	08.17	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.05	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.27	17.55	20.27	22.01	23.35	23.38	22.07	20.19	18.33	15.49	14.33
8	10.03	08.42	07.08	06.18	04.34	03.05	03.14	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.37	23.36	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39	07.04	06.15	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.34	22.00	20.12	18.26	15.43	14.31
10	09.59	08.35	07.01	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.30	09.58
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.39	14.29
11	09.58	08.32	06.57	06.08	04.24	03.00	03.22	04.57	06.30	07.56	08.33	10.00
	15.01	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.04	18.19	15.36	14.28
12	09.56	08.29	06.54	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.02
	15.03	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.33	14.27
13	09.54	08.26	06.50	06.00	04.17	02.55	03.28	05.04	06.36	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.47	23.24	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.47	05.57	04.14	02.54	03.30	05.07	06.38	08.05	08.43	10.05
	15.09	16.50	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.07
	15.12	16.53	18.19	20.52	22.27	23.50	23.19	21.40	19.50	18.05	15.25	14.25
16	09.47	08.16	06.40	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.55	22.30	23.51	23.16	21.36	19.47	18.01	15.22	14.25
17	09.45	08.13	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.58	22.33	23.52	23.13	21.33	19.43	17.58	15.19	14.24
18	09.42	08.09	06.33	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.56	10.11
	15.21	17.02	18.28	21.01	22.36	23.53	23.10	21.29	19.40	17.55	15.16	14.24
19	09.40	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.59	10.12
	15.24	17.06	18.31	21.04	22.39	23.53	23.07	21.26	19.36	17.51	15.13	14.24
20	09.37	08.03	06.25	05.36	03.55	02.51	03.48	05.25	06.56	08.23	09.02	10.13
	15.28	17.09	18.34	21.07	22.43	23.54	23.04	21.22	19.33	17.48	15.11	14.24
21	09.35	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.19	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.55	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.55	22.55	21.12	19.22	17.38	15.03	14.25
24	09.27	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.36	09.14	10.15
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.18	03.40	02.53	04.04	05.40	07.10	07.39	09.18	10.15
	15.44	17.25	18.49	21.22	22.58	23.54	22.49	21.05	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.07	05.43	07.13	07.42	09.21	10.15
	15.47	17.28	18.52	21.26	23.01	23.54	22.46	21.01	19.11	16.28	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.16	07.45	09.24	10.15
	15.50	17.31	18.55	21.29	23.05	23.53	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.27	10.15
	15.54	17.34	18.58	21.32	23.08	23.52	22.40	20.54	19.04	16.21	14.51	14.30
29	09.12		06.54	05.05	03.29	02.58	04.16	05.52	07.21	07.51	09.30	10.14
	15.57		20.01	21.35	23.11	23.51	22.37	20.51	19.01	16.18	14.48	14.32
30	09.10		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.14
	16.00		20.04	21.38	23.13	23.50	22.33	20.47	18.57	16.14	14.46	14.33
31	09.07		06.46		03.23		04.23	05.58		07.57		10.13
	16.03		20.07		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906 Shadow receptor: G - Lomarakennus G (Pohjanneva)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.11	09.03	07.32	06.43	04.58	03.21	03.01	04.26	06.01	07.27	08.00	09.34
	14.38	16.07	17.37	20.09	21.41	23.18	23.47	22.26	20.40	18.53	16.08	14.44
2	10.10	09.00	07.28	06.39	04.54	03.19	03.02	04.29	06.04	07.30	08.03	09.37
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.09	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.32	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.23	23.44	22.20	20.32	18.46	16.01	14.41
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.35	08.10	09.42
	14.44	16.17	17.46	20.18	21.50	23.26	23.42	22.16	20.29	18.43	15.58	14.39
5	10.07	08.51	07.18	06.29	04.44	03.12	03.08	04.39	06.12	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.25	18.39	15.55	14.37
6	10.05	08.48	07.14	06.25	04.41	03.10	03.10	04.42	06.15	07.41	08.16	09.47
	14.48	16.23	17.52	20.24	21.57	23.31	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.44	07.11	06.22	04.37	03.08	03.13	04.45	06.18	07.44	08.19	09.50
	14.51	16.27	17.55	20.27	22.00	23.33	23.37	22.06	20.18	18.32	15.49	14.34
8	10.02	08.41	07.07	06.18	04.34	03.06	03.15	04.48	06.21	07.47	08.23	09.52
	14.53	16.30	17.58	20.30	22.03	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.00	08.38	07.04	06.14	04.31	03.04	03.18	04.51	06.24	07.50	08.26	09.54
	14.56	16.33	18.01	20.33	22.06	23.38	23.32	21.59	20.11	18.25	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.37	18.04	20.36	22.10	23.40	23.30	21.56	20.08	18.22	15.40	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.23	04.57	06.30	07.56	08.32	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.37	14.29
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.35	10.01
	15.04	16.43	18.10	20.42	22.16	23.44	23.25	21.49	20.01	18.15	15.34	14.28
13	09.53	08.25	06.50	06.00	04.18	02.56	03.28	05.04	06.35	08.02	08.39	10.02
	15.07	16.46	18.13	20.45	22.19	23.45	23.23	21.46	19.57	18.12	15.31	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.10	16.50	18.16	20.48	22.23	23.47	23.20	21.42	19.53	18.08	15.28	14.26
15	09.48	08.19	06.43	05.53	04.11	02.54	03.34	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.48	23.18	21.39	19.50	18.05	15.25	14.26
16	09.46	08.15	06.39	05.50	04.08	02.53	03.37	05.13	06.44	08.11	08.48	10.07
	15.15	16.56	18.22	20.54	22.29	23.49	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.53	03.40	05.16	06.47	08.14	08.52	10.08
	15.18	16.59	18.25	20.57	22.32	23.50	23.12	21.32	19.43	17.58	15.19	14.25
18	09.41	08.09	06.32	05.43	04.02	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.22	17.02	18.28	21.00	22.35	23.51	23.09	21.29	19.39	17.54	15.16	14.25
19	09.39	08.05	06.29	05.39	03.58	02.52	03.45	05.22	06.52	08.20	08.58	10.11
	15.25	17.06	18.31	21.03	22.39	23.52	23.06	21.25	19.36	17.51	15.13	14.25
20	09.36	08.02	06.25	05.36	03.55	02.52	03.48	05.25	06.55	08.23	09.01	10.11
	15.28	17.09	18.34	21.06	22.42	23.53	23.03	21.22	19.32	17.48	15.11	14.25
21	09.34	07.59	06.22	05.32	03.52	02.52	03.52	05.28	06.58	08.26	09.04	10.12
	15.31	17.12	18.37	21.09	22.45	23.53	23.01	21.18	19.29	17.44	15.08	14.25
22	09.31	07.55	06.18	05.29	03.49	02.52	03.55	05.31	07.01	08.29	09.07	10.13
	15.34	17.15	18.40	21.13	22.48	23.53	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.53	03.58	05.34	07.04	08.32	09.11	10.13
	15.37	17.18	18.43	21.16	22.51	23.53	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.54	04.01	05.37	07.07	08.35	09.14	10.14
	15.41	17.21	18.46	21.19	22.54	23.53	22.51	21.08	19.18	17.34	15.00	14.27
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.57	23.53	22.48	21.04	19.15	16.31	14.58	14.27
26	09.20	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.28	18.51	21.25	23.01	23.52	22.45	21.01	19.11	16.28	14.55	14.28
27	09.18	07.38	06.00	05.11	03.35	02.56	04.10	05.46	07.15	07.44	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.51	22.42	20.57	19.07	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.58	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.31	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.31
29	09.12		06.53	05.05	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.13
	15.57		20.00	21.34	23.09	23.50	22.36	20.50	19.00	16.18	14.49	14.32
30	09.09		06.50	05.01	03.26	03.01	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.12	23.48	22.33	20.47	18.57	16.14	14.46	14.34
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.04		20.06		23.15		22.29	20.43		16.11		14.35
Potential sun hours	172	238	363	451	568	621	607	508	393	305	199	139
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm) Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)

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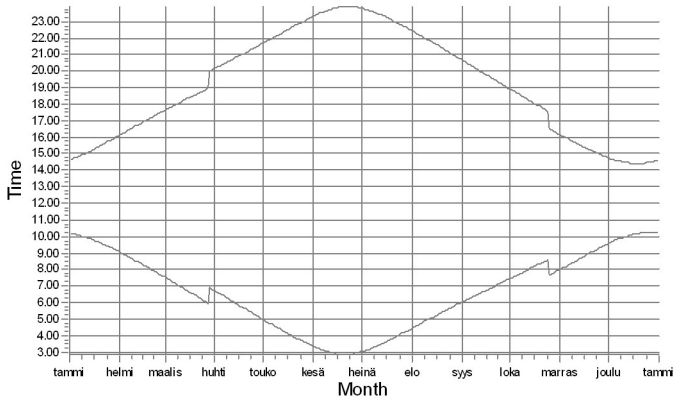
Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

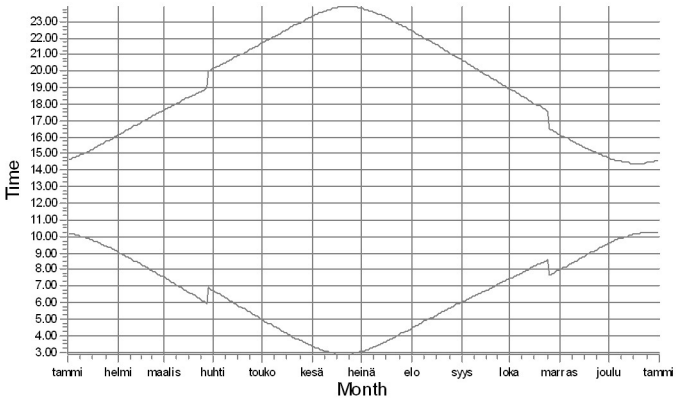
SHADOW - Calendar, graphical

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906

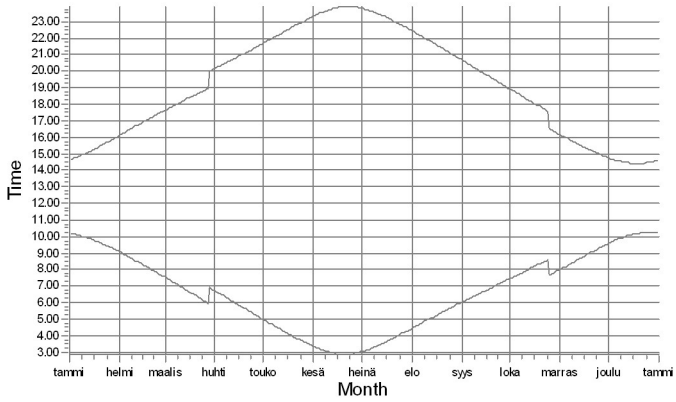
A: Asuinrakennus A (Hakuperäntie 202)



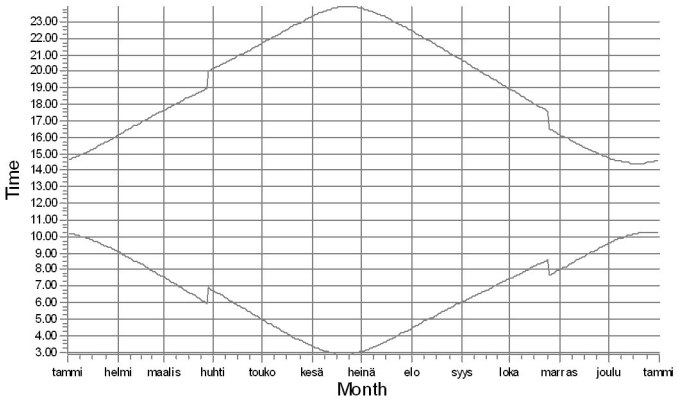
B: Asuinrakennus B (Hakuperäntie 169)



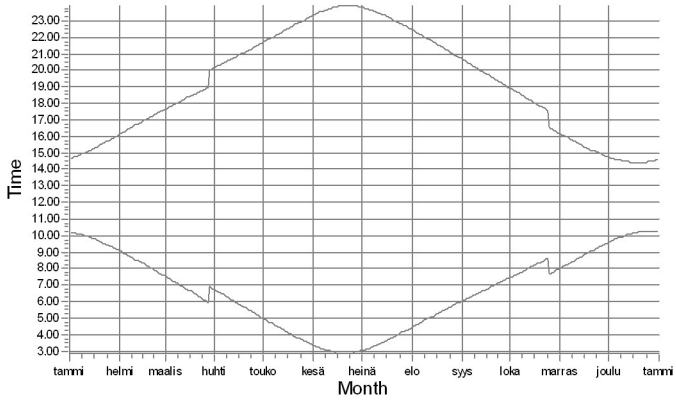
C: Asuinrakennus C (Säilyntie 285)



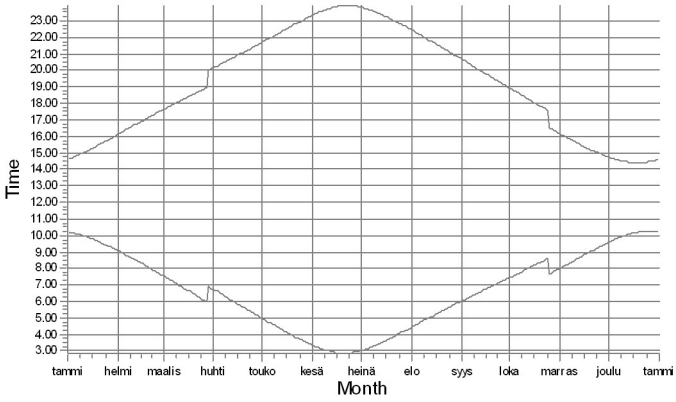
D: Asuinrakennus D (Säilyntie 264)



E: Lomarakennus E (Raudaskallion metsatie)



F: Lomarakennus F (Hirvinevanhaara 147)



WTGs

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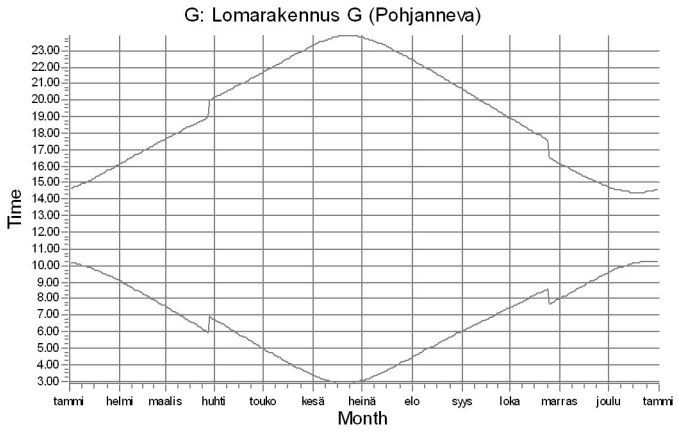
SHADOW - Calendar, graphical

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906



WTGs

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 1 - VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (79)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.57	03.20	03.01	04.26	06.01	07.27	08.01	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.49	22.27	20.40	18.54	16.08	14.44
2	10.11	09.01	07.28	06.39	04.54	03.18	03.01	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.45	23.22	23.47	22.24	20.36	18.50	16.04	14.42
3	10.10	08.58	07.25	06.36	04.51	03.15	03.03	04.32	06.07	07.33	08.07	09.41
	14.41	16.13	17.43	20.15	21.48	23.25	23.46	22.20	20.33	18.47	16.01	14.40
4	10.09	08.54	07.21	06.32	04.47	03.13	03.05	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.44	22.17	20.29	18.43	15.58	14.38
5	10.08	08.51	07.18	06.29	04.44	03.11	03.07	04.38	06.12	07.39	08.14	09.46
	14.45	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.40	15.55	14.36
6	10.06	08.48	07.15	06.25	04.40	03.09	03.09	04.41	06.15	07.41	08.17	09.49
	14.47	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.05	08.45	07.11	06.22	04.37	03.06	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.26	17.55	20.27	22.01	23.35	23.38	22.07	20.19	18.33	15.49	14.33
8	10.03	08.42	07.08	06.18	04.34	03.04	03.14	04.48	06.21	07.47	08.23	09.53
	14.52	16.30	17.58	20.30	22.04	23.37	23.36	22.04	20.15	18.29	15.45	14.32
9	10.01	08.39	07.04	06.14	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.56
	14.55	16.33	18.01	20.33	22.07	23.39	23.34	22.00	20.12	18.26	15.42	14.30
10	10.00	08.36	07.01	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.30	09.58
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.39	14.29
11	09.58	08.32	06.57	06.07	04.24	02.58	03.22	04.57	06.30	07.56	08.33	10.00
	15.00	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.04	18.19	15.36	14.28
12	09.56	08.29	06.54	06.04	04.20	02.56	03.24	05.00	06.33	07.59	08.36	10.02
	15.03	16.43	18.10	20.42	22.17	23.45	23.27	21.50	20.01	18.15	15.33	14.27
13	09.54	08.26	06.50	06.00	04.17	02.55	03.27	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.47	23.24	21.46	19.57	18.12	15.30	14.26
14	09.52	08.22	06.47	05.57	04.14	02.54	03.30	05.06	06.38	08.05	08.43	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.25
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.07
	15.12	16.53	18.19	20.51	22.27	23.50	23.19	21.40	19.50	18.05	15.24	14.25
16	09.47	08.16	06.40	05.50	04.07	02.52	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.55	22.30	23.51	23.16	21.36	19.47	18.01	15.21	14.24
17	09.45	08.13	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.10
	15.18	16.59	18.25	20.58	22.33	23.52	23.13	21.33	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.51	03.42	05.19	06.50	08.17	08.56	10.11
	15.21	17.02	18.28	21.01	22.36	23.53	23.10	21.29	19.40	17.54	15.16	14.24
19	09.40	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.59	10.12
	15.24	17.05	18.31	21.04	22.40	23.54	23.07	21.26	19.36	17.51	15.13	14.24
20	09.37	08.03	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.13
	15.27	17.09	18.34	21.07	22.43	23.54	23.05	21.22	19.32	17.48	15.10	14.24
21	09.35	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.55	23.02	21.19	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.51	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.55	22.59	21.15	19.25	17.41	15.05	14.24
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.15
	15.37	17.18	18.43	21.16	22.52	23.55	22.56	21.12	19.22	17.37	15.02	14.25
24	09.27	07.49	06.11	05.22	03.43	02.52	04.00	05.37	07.07	08.35	09.15	10.15
	15.40	17.21	18.46	21.19	22.55	23.55	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.18	03.40	02.53	04.03	05.40	07.10	07.39	09.18	10.15
	15.43	17.24	18.49	21.22	22.59	23.54	22.49	21.05	19.15	16.31	14.57	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.06	05.43	07.13	07.42	09.21	10.15
	15.47	17.27	18.52	21.26	23.02	23.54	22.46	21.01	19.11	16.27	14.55	14.27
27	09.18	07.39	06.01	05.11	03.34	02.55	04.10	05.46	07.15	07.45	09.24	10.15
	15.50	17.31	18.55	21.29	23.05	23.53	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.56	04.13	05.49	07.18	07.48	09.27	10.15
	15.53	17.34	18.58	21.32	23.08	23.52	22.40	20.54	19.04	16.21	14.50	14.30
29	09.13		06.53	05.04	03.28	02.58	04.16	05.52	07.21	07.51	09.30	10.14
	15.57		20.01	21.35	23.11	23.51	22.37	20.51	19.01	16.17	14.48	14.31
30	09.10		06.50	05.01	03.26	02.59	04.19	05.55	07.24	07.54	09.32	10.14
	16.00		20.04	21.38	23.14	23.50	22.33	20.47	18.57	16.14	14.46	14.33
31	09.07		06.46		03.23		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.34
Potential sun hours	172	238	363	451	569	623	608	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 2 - VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (80)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.57	03.20	03.01	04.25	06.01	07.27	08.01	09.35
	14.37	16.06	17.37	20.09	21.41	23.19	23.49	22.27	20.40	18.53	16.08	14.44
2	10.11	09.01	07.28	06.39	04.54	03.18	03.01	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.45	23.22	23.47	22.24	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.15	03.03	04.32	06.07	07.33	08.07	09.41
	14.41	16.13	17.43	20.15	21.48	23.25	23.46	22.20	20.33	18.46	16.01	14.40
4	10.09	08.54	07.21	06.32	04.47	03.13	03.05	04.35	06.09	07.36	08.10	09.43
	14.43	16.16	17.46	20.18	21.51	23.27	23.44	22.17	20.29	18.43	15.58	14.38
5	10.08	08.51	07.18	06.29	04.44	03.11	03.07	04.38	06.12	07.38	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.39	15.55	14.36
6	10.06	08.48	07.14	06.25	04.40	03.09	03.09	04.41	06.15	07.41	08.17	09.48
	14.47	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.05	08.45	07.11	06.21	04.37	03.06	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.26	17.55	20.27	22.01	23.35	23.38	22.07	20.19	18.32	15.48	14.33
8	10.03	08.42	07.07	06.18	04.34	03.04	03.14	04.48	06.21	07.47	08.23	09.53
	14.52	16.30	17.58	20.30	22.04	23.37	23.36	22.03	20.15	18.29	15.45	14.32
9	10.01	08.39	07.04	06.14	04.30	03.03	03.16	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.34	22.00	20.11	18.25	15.42	14.30
10	10.00	08.35	07.01	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.30	09.58
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.39	14.29
11	09.58	08.32	06.57	06.07	04.24	02.58	03.22	04.57	06.30	07.56	08.33	10.00
	15.00	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.04	18.18	15.36	14.28
12	09.56	08.29	06.53	06.04	04.20	02.56	03.24	05.00	06.33	07.59	08.36	10.02
	15.03	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.33	14.27
13	09.54	08.26	06.50	06.00	04.17	02.55	03.27	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.47	23.24	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.54	03.30	05.06	06.38	08.05	08.43	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.25
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.07
	15.12	16.53	18.19	20.51	22.27	23.50	23.19	21.39	19.50	18.05	15.24	14.25
16	09.47	08.16	06.39	05.50	04.07	02.52	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.30	23.51	23.16	21.36	19.47	18.01	15.21	14.24
17	09.45	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.58	22.33	23.52	23.13	21.33	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.51	03.42	05.19	06.50	08.17	08.55	10.11
	15.21	17.02	18.28	21.01	22.36	23.53	23.10	21.29	19.39	17.54	15.16	14.24
19	09.40	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.59	10.12
	15.24	17.05	18.31	21.04	22.40	23.54	23.07	21.26	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.13
	15.27	17.09	18.34	21.07	22.43	23.54	23.04	21.22	19.32	17.48	15.10	14.24
21	09.35	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.30	17.12	18.37	21.10	22.46	23.55	23.01	21.19	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.51	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.55	22.58	21.15	19.25	17.41	15.05	14.24
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.55	22.55	21.12	19.22	17.37	15.02	14.25
24	09.27	07.49	06.11	05.22	03.43	02.52	04.00	05.37	07.07	08.35	09.14	10.15
	15.40	17.21	18.46	21.19	22.55	23.55	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.18	03.40	02.53	04.03	05.40	07.10	07.39	09.18	10.15
	15.43	17.24	18.49	21.22	22.58	23.54	22.49	21.05	19.15	16.31	14.57	14.26
26	09.21	07.42	06.04	05.15	03.37	02.54	04.06	05.43	07.13	07.42	09.21	10.15
	15.47	17.27	18.52	21.25	23.02	23.54	22.46	21.01	19.11	16.27	14.55	14.27
27	09.18	07.39	06.01	05.11	03.34	02.55	04.10	05.46	07.15	07.45	09.24	10.15
	15.50	17.31	18.55	21.29	23.05	23.53	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.56	04.13	05.49	07.18	07.48	09.27	10.15
	15.53	17.34	18.58	21.32	23.08	23.52	22.40	20.54	19.04	16.21	14.50	14.30
29	09.12		06.53	05.04	03.28	02.58	04.16	05.52	07.21	07.51	09.30	10.14
	15.57		20.00	21.35	23.11	23.51	22.37	20.50	19.01	16.17	14.48	14.31
30	09.10		06.50	05.01	03.26	02.59	04.19	05.55	07.24	07.54	09.32	10.14
	16.00		20.03	21.38	23.14	23.50	22.33	20.47	18.57	16.14	14.46	14.33
31	09.07		06.46		03.23		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.34
Potential sun hours	172	238	363	451	569	623	608	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 3 - VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (81)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.01	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.49	22.27	20.40	18.54	16.08	14.44
2	10.11	09.01	07.28	06.39	04.54	03.18	03.01	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.45	23.22	23.47	22.24	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.03	04.32	06.07	07.33	08.07	09.41
	14.41	16.13	17.43	20.15	21.48	23.25	23.46	22.20	20.33	18.47	16.01	14.40
4	10.09	08.54	07.21	06.32	04.47	03.13	03.05	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.44	22.17	20.29	18.43	15.58	14.38
5	10.08	08.51	07.18	06.29	04.44	03.11	03.07	04.38	06.12	07.39	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.40	15.55	14.36
6	10.06	08.48	07.15	06.25	04.40	03.09	03.09	04.41	06.15	07.41	08.17	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.05	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.26	17.55	20.27	22.01	23.35	23.38	22.07	20.19	18.33	15.49	14.33
8	10.03	08.42	07.08	06.18	04.34	03.05	03.14	04.48	06.21	07.47	08.23	09.53
	14.52	16.30	17.58	20.30	22.04	23.37	23.36	22.03	20.15	18.29	15.45	14.32
9	10.01	08.39	07.04	06.15	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.34	22.00	20.12	18.26	15.42	14.30
10	10.00	08.35	07.01	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.30	09.58
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.57	20.08	18.22	15.39	14.29
11	09.58	08.32	06.57	06.07	04.24	02.58	03.22	04.57	06.30	07.56	08.33	10.00
	15.00	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.04	18.19	15.36	14.28
12	09.56	08.29	06.54	06.04	04.20	02.56	03.25	05.00	06.33	07.59	08.36	10.02
	15.03	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.33	14.27
13	09.54	08.26	06.50	06.00	04.17	02.55	03.27	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.47	23.24	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.47	05.57	04.14	02.54	03.30	05.07	06.38	08.05	08.43	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.25
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.07
	15.12	16.53	18.19	20.51	22.27	23.50	23.19	21.40	19.50	18.05	15.24	14.25
16	09.47	08.16	06.40	05.50	04.07	02.52	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.55	22.30	23.51	23.16	21.36	19.47	18.01	15.22	14.24
17	09.45	08.13	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.58	22.33	23.52	23.13	21.33	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.51	03.42	05.19	06.50	08.17	08.56	10.11
	15.21	17.02	18.28	21.01	22.36	23.53	23.10	21.29	19.40	17.54	15.16	14.24
19	09.40	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.59	10.12
	15.24	17.05	18.31	21.04	22.40	23.54	23.07	21.26	19.36	17.51	15.13	14.24
20	09.37	08.03	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.13
	15.27	17.09	18.34	21.07	22.43	23.54	23.04	21.22	19.32	17.48	15.10	14.24
21	09.35	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.19	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.51	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.55	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.55	22.55	21.12	19.22	17.37	15.02	14.25
24	09.27	07.49	06.11	05.22	03.43	02.52	04.00	05.37	07.07	08.35	09.14	10.15
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.18	03.40	02.53	04.03	05.40	07.10	07.39	09.18	10.15
	15.44	17.24	18.49	21.22	22.58	23.54	22.49	21.05	19.15	16.31	14.57	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.07	05.43	07.13	07.42	09.21	10.15
	15.47	17.28	18.52	21.26	23.02	23.54	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.55	04.10	05.46	07.15	07.45	09.24	10.15
	15.50	17.31	18.55	21.29	23.05	23.53	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.27	10.15
	15.53	17.34	18.58	21.32	23.08	23.52	22.40	20.54	19.04	16.21	14.50	14.30
29	09.12		06.54	05.04	03.28	02.58	04.16	05.52	07.21	07.51	09.30	10.14
	15.57		20.01	21.35	23.11	23.51	22.37	20.51	19.01	16.18	14.48	14.31
30	09.10		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.14
	16.00		20.04	21.38	23.13	23.50	22.33	20.47	18.57	16.14	14.46	14.33
31	09.07		06.46		03.23		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	623	608	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 4 - VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (82)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.04	07.32	06.43	04.58	03.20	03.01	04.26	06.01	07.27	08.01	09.35
	14.37	16.07	17.37	20.10	21.41	23.19	23.49	22.27	20.40	18.54	16.08	14.44
2	10.11	09.01	07.28	06.39	04.54	03.18	03.01	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.45	23.22	23.47	22.24	20.36	18.50	16.04	14.42
3	10.10	08.58	07.25	06.36	04.51	03.16	03.03	04.32	06.07	07.33	08.07	09.41
	14.41	16.13	17.43	20.15	21.48	23.25	23.46	22.20	20.33	18.47	16.01	14.40
4	10.09	08.55	07.22	06.32	04.47	03.13	03.05	04.35	06.10	07.36	08.10	09.44
	14.43	16.17	17.46	20.18	21.51	23.28	23.44	22.17	20.29	18.43	15.58	14.38
5	10.08	08.51	07.18	06.29	04.44	03.11	03.07	04.38	06.12	07.39	08.14	09.46
	14.45	16.20	17.49	20.21	21.54	23.30	23.42	22.14	20.26	18.40	15.55	14.36
6	10.06	08.48	07.15	06.25	04.40	03.09	03.09	04.41	06.15	07.42	08.17	09.49
	14.48	16.23	17.52	20.24	21.58	23.33	23.40	22.10	20.22	18.36	15.52	14.35
7	10.05	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.27	17.55	20.27	22.01	23.35	23.38	22.07	20.19	18.33	15.49	14.33
8	10.03	08.42	07.08	06.18	04.34	03.05	03.14	04.48	06.21	07.47	08.23	09.53
	14.52	16.30	17.58	20.30	22.04	23.37	23.36	22.04	20.15	18.29	15.45	14.32
9	10.01	08.39	07.04	06.15	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.56
	14.55	16.33	18.01	20.33	22.07	23.39	23.34	22.00	20.12	18.26	15.42	14.30
10	10.00	08.36	07.01	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.30	09.58
	14.58	16.36	18.04	20.36	22.11	23.41	23.31	21.57	20.08	18.22	15.39	14.29
11	09.58	08.32	06.57	06.07	04.24	02.58	03.22	04.57	06.30	07.56	08.33	10.00
	15.00	16.40	18.07	20.39	22.14	23.43	23.29	21.53	20.04	18.19	15.36	14.28
12	09.56	08.29	06.54	06.04	04.20	02.56	03.25	05.00	06.33	07.59	08.36	10.02
	15.03	16.43	18.10	20.42	22.17	23.45	23.27	21.50	20.01	18.15	15.33	14.27
13	09.54	08.26	06.50	06.00	04.17	02.55	03.27	05.03	06.36	08.02	08.39	10.04
	15.06	16.46	18.13	20.45	22.20	23.47	23.24	21.47	19.57	18.12	15.30	14.26
14	09.52	08.23	06.47	05.57	04.14	02.54	03.30	05.07	06.38	08.05	08.43	10.05
	15.09	16.49	18.16	20.49	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.25
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.07
	15.12	16.53	18.19	20.52	22.27	23.50	23.19	21.40	19.50	18.05	15.24	14.25
16	09.47	08.16	06.40	05.50	04.07	02.52	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.55	22.30	23.51	23.16	21.36	19.47	18.01	15.22	14.24
17	09.45	08.13	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.10
	15.18	16.59	18.25	20.58	22.33	23.52	23.13	21.33	19.43	17.58	15.19	14.24
18	09.42	08.09	06.33	05.43	04.01	02.51	03.42	05.19	06.50	08.17	08.56	10.11
	15.21	17.02	18.28	21.01	22.36	23.53	23.10	21.29	19.40	17.54	15.16	14.24
19	09.40	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.59	10.12
	15.24	17.06	18.31	21.04	22.40	23.54	23.07	21.26	19.36	17.51	15.13	14.24
20	09.37	08.03	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.13
	15.27	17.09	18.34	21.07	22.43	23.54	23.05	21.22	19.33	17.48	15.10	14.24
21	09.35	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.55	23.02	21.19	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.51	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.55	22.59	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.15
	15.37	17.18	18.43	21.16	22.52	23.55	22.56	21.12	19.22	17.38	15.02	14.25
24	09.27	07.49	06.11	05.22	03.43	02.52	04.00	05.37	07.07	08.36	09.15	10.15
	15.40	17.21	18.46	21.19	22.55	23.55	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.46	06.08	05.18	03.40	02.53	04.03	05.40	07.10	07.39	09.18	10.15
	15.44	17.24	18.49	21.22	22.59	23.54	22.49	21.05	19.15	16.31	14.57	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.07	05.43	07.13	07.42	09.21	10.15
	15.47	17.28	18.52	21.26	23.02	23.54	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.55	04.10	05.46	07.16	07.45	09.24	10.15
	15.50	17.31	18.55	21.29	23.05	23.53	22.43	20.58	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.56	04.13	05.49	07.18	07.48	09.27	10.15
	15.53	17.34	18.58	21.32	23.08	23.52	22.40	20.54	19.04	16.21	14.50	14.30
29	09.13		06.54	05.04	03.28	02.58	04.16	05.52	07.21	07.51	09.30	10.14
	15.57		20.01	21.35	23.11	23.51	22.37	20.51	19.01	16.18	14.48	14.31
30	09.10		06.50	05.01	03.26	02.59	04.19	05.55	07.24	07.54	09.33	10.14
	16.00		20.04	21.38	23.14	23.50	22.33	20.47	18.57	16.14	14.46	14.33
31	09.07		06.46		03.23		04.22	05.58		07.58		10.13
	16.03		20.07		23.17		22.30	20.44		16.11		14.35
Potential sun hours	172	238	363	451	569	623	608	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 5 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (89)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.22	23.47	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.09	08.54	07.21	06.32	04.47	03.13	03.06	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.29	23.42	22.13	20.26	18.39	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.17	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.27	17.55	20.27	22.00	23.34	23.38	22.07	20.19	18.32	15.49	14.33
8	10.03	08.42	07.07	06.18	04.34	03.05	03.14	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.37	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39	07.04	06.15	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.26	15.42	14.31
10	09.59	08.35	07.00	06.11	04.27	03.01	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.29	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.03	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.26	06.50	06.00	04.17	02.56	03.28	05.04	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.24	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.54	03.30	05.07	06.38	08.05	08.42	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.30	23.50	23.16	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.01	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.58	10.11
	15.24	17.05	18.31	21.04	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.54	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.18	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.38	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.15
	15.44	17.24	18.49	21.22	22.58	23.54	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.13	07.42	09.20	10.15
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.15
	15.50	17.31	18.55	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.53	17.34	18.58	21.32	23.07	23.52	22.40	20.54	19.04	16.21	14.51	14.30
29	09.12		06.53	05.04	03.29	02.58	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.51	22.36	20.50	19.01	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.23	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 6 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (90)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.57	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.26	20.40	18.53	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.03	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.13	03.05	04.35	06.09	07.35	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.45
	14.45	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.25	18.39	15.55	14.36
6	10.06	08.48	07.14	06.25	04.40	03.09	03.10	04.41	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.21	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.26	17.55	20.27	22.00	23.34	23.37	22.07	20.18	18.32	15.49	14.33
8	10.03	08.42	07.07	06.18	04.34	03.05	03.14	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.45	14.32
9	10.01	08.38	07.04	06.14	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.25	15.42	14.31
10	09.59	08.35	07.00	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.18	15.36	14.28
12	09.55	08.29	06.53	06.04	04.20	02.57	03.25	05.00	06.32	07.59	08.36	10.01
	15.03	16.43	18.10	20.42	22.16	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.25	06.50	06.00	04.17	02.55	03.28	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.54	03.30	05.07	06.38	08.05	08.42	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.24	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.52	08.20	08.58	10.11
	15.24	17.05	18.31	21.03	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.12
	15.27	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.10	14.24
21	09.34	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.37	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.53	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.27	18.51	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.38	06.00	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.53	17.34	18.57	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.50	14.30
29	09.12		06.53	05.04	03.29	02.58	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.00	16.17	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 7 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (91)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.57	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.53	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.22	23.47	22.23	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.03	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.13	03.05	04.35	06.09	07.35	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.36
6	10.06	08.48	07.14	06.25	04.40	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.26	17.55	20.27	22.00	23.34	23.38	22.07	20.18	18.32	15.49	14.33
8	10.03	08.42	07.07	06.18	04.34	03.05	03.14	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.37	23.35	22.03	20.15	18.29	15.45	14.32
9	10.01	08.38	07.04	06.14	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.25	15.42	14.31
10	09.59	08.35	07.00	06.11	04.27	03.01	03.19	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.18	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.03	16.43	18.10	20.42	22.17	23.45	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.26	06.50	06.00	04.17	02.55	03.27	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.54	03.30	05.07	06.38	08.05	08.42	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.53	03.33	05.10	06.41	08.08	08.46	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.24	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.30	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.52	08.20	08.58	10.11
	15.24	17.05	18.31	21.04	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.12
	15.27	17.09	18.34	21.07	22.42	23.54	23.04	21.22	19.32	17.48	15.10	14.24
21	09.34	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.18	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.37	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.53	04.04	05.40	07.10	07.38	09.17	10.15
	15.44	17.24	18.49	21.22	22.58	23.54	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.54	04.07	05.43	07.12	07.41	09.20	10.15
	15.47	17.27	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.39	06.00	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.53	17.34	18.57	21.32	23.07	23.52	22.39	20.54	19.04	16.21	14.50	14.30
29	09.12		06.53	05.04	03.29	02.58	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.51	22.36	20.50	19.00	16.17	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.22	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 8 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (92)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.26	20.40	18.53	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.04	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.09	07.35	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.45
	14.45	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.06	20.18	18.32	15.49	14.33
8	10.02	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.14	04.30	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.38	23.33	22.00	20.11	18.25	15.42	14.31
10	09.59	08.35	07.00	06.11	04.27	03.01	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.18	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.03	16.43	18.10	20.42	22.16	23.44	23.26	21.49	20.01	18.15	15.33	14.27
13	09.53	08.25	06.50	06.00	04.17	02.56	03.28	05.03	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.55	03.30	05.07	06.38	08.05	08.42	10.04
	15.09	16.49	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.46	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.12	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.52	08.20	08.58	10.11
	15.24	17.05	18.31	21.03	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.01	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.37	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.27	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.38	06.00	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.53	17.34	18.57	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.53	05.04	03.29	02.58	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.00	16.17	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.23	05.58		07.57		10.12
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 9 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (93)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.22	23.47	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.47	16.01	14.40
4	10.09	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.39	06.12	07.38	08.13	09.46
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.40	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.17	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.40	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.51
	14.50	16.27	17.55	20.27	22.00	23.34	23.38	22.07	20.19	18.33	15.49	14.33
8	10.03	08.42	07.08	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.37	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.39	07.04	06.15	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.26	15.43	14.31
10	09.59	08.35	07.01	06.11	04.27	03.01	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.54	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.26	06.50	06.00	04.17	02.56	03.28	05.04	06.36	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.27
14	09.51	08.22	06.47	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.05
	15.09	16.50	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.46	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.30	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.01	22.36	23.52	23.10	21.29	19.40	17.55	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.53	08.20	08.58	10.11
	15.24	17.06	18.31	21.04	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.54	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.46	23.54	23.01	21.18	19.29	17.44	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.14
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.38	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.15
	15.44	17.24	18.49	21.22	22.58	23.54	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.13	07.42	09.20	10.15
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.55	21.29	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.54	05.05	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.01	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.23	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 10 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (94)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.26	20.40	18.54	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.39	06.12	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.18	18.32	15.49	14.34
8	10.02	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.15	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.38	23.33	22.00	20.11	18.26	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.16	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.25	06.50	06.00	04.17	02.56	03.28	05.04	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.09	16.49	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.46	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.12	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.03	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.52	03.48	05.25	06.55	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.55	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.53	05.05	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 11 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (95)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.26	20.40	18.53	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.46
	14.45	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.18	18.32	15.49	14.33
8	10.03	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.14	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.25	15.42	14.31
10	09.59	08.35	07.00	06.11	04.27	03.01	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.29
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.03	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.26	06.50	06.00	04.17	02.56	03.28	05.04	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.26
14	09.51	08.22	06.46	05.57	04.14	02.55	03.30	05.07	06.38	08.05	08.42	10.05
	15.09	16.49	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.46	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.04	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.51	03.45	05.22	06.53	08.20	08.58	10.11
	15.24	17.05	18.31	21.04	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.51	03.48	05.25	06.55	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.51	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.24
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.37	15.03	14.25
24	09.26	07.49	06.11	05.22	03.43	02.53	04.00	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.15
	15.47	17.27	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.55	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.31	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.53	17.34	18.57	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.53	05.04	03.29	02.58	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.23		04.23	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 12 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (96)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.11	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.18	23.48	22.26	20.40	18.53	16.08	14.44
2	10.10	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.37
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.09	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.47	23.24	23.45	22.20	20.33	18.46	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.35	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.16	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.38	06.12	07.38	08.13	09.45
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.39	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.06	20.18	18.32	15.49	14.34
8	10.02	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.03	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.14	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.38	23.33	22.00	20.11	18.25	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.40	23.31	21.56	20.08	18.22	15.39	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.32	09.59
	15.01	16.40	18.07	20.39	22.13	23.42	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.00	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.16	23.44	23.26	21.49	20.01	18.15	15.33	14.27
13	09.53	08.25	06.50	06.00	04.17	02.56	03.28	05.04	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.04
	15.09	16.49	18.16	20.48	22.23	23.47	23.21	21.43	19.54	18.08	15.27	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.45	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.46	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.07
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.46	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.12	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.54	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.53	08.20	08.58	10.11
	15.25	17.05	18.31	21.03	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.52	03.48	05.25	06.55	08.23	09.01	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.53	23.01	21.18	19.29	17.44	15.08	14.25
22	09.32	07.55	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.48	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.23	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.12	07.41	09.20	10.14
	15.47	17.27	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.27	14.55	14.28
27	09.18	07.38	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.54	21.28	23.04	23.52	22.42	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.57	21.31	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.53	05.04	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.00	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.19	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.24		04.23	05.58		07.57		10.12
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	568	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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Liisa Karhu / liisa.karhu@fcg.fi
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Calendar per WTG

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906WTG: 13 - VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (97)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
552	432	411	447	627	919	1093	1134	1011	775	636	666	8701

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.12	09.03	07.32	06.43	04.58	03.21	03.00	04.26	06.01	07.27	08.00	09.35
	14.37	16.07	17.37	20.09	21.41	23.19	23.48	22.27	20.40	18.54	16.08	14.44
2	10.11	09.00	07.28	06.39	04.54	03.18	03.02	04.29	06.04	07.30	08.04	09.38
	14.39	16.10	17.40	20.12	21.44	23.21	23.46	22.23	20.36	18.50	16.05	14.42
3	10.10	08.57	07.25	06.36	04.51	03.16	03.04	04.32	06.07	07.33	08.07	09.40
	14.41	16.13	17.43	20.15	21.48	23.24	23.45	22.20	20.33	18.47	16.01	14.40
4	10.08	08.54	07.21	06.32	04.47	03.14	03.06	04.35	06.10	07.36	08.10	09.43
	14.43	16.17	17.46	20.18	21.51	23.27	23.43	22.17	20.29	18.43	15.58	14.38
5	10.07	08.51	07.18	06.29	04.44	03.11	03.08	04.39	06.12	07.38	08.13	09.46
	14.46	16.20	17.49	20.21	21.54	23.29	23.41	22.13	20.26	18.40	15.55	14.37
6	10.06	08.48	07.14	06.25	04.41	03.09	03.10	04.42	06.15	07.41	08.16	09.48
	14.48	16.23	17.52	20.24	21.57	23.32	23.39	22.10	20.22	18.36	15.52	14.35
7	10.04	08.45	07.11	06.22	04.37	03.07	03.12	04.45	06.18	07.44	08.20	09.50
	14.50	16.27	17.55	20.27	22.00	23.34	23.37	22.07	20.19	18.33	15.49	14.34
8	10.03	08.42	07.07	06.18	04.34	03.05	03.15	04.48	06.21	07.47	08.23	09.53
	14.53	16.30	17.58	20.30	22.04	23.36	23.35	22.03	20.15	18.29	15.46	14.32
9	10.01	08.38	07.04	06.15	04.31	03.03	03.17	04.51	06.24	07.50	08.26	09.55
	14.55	16.33	18.01	20.33	22.07	23.39	23.33	22.00	20.11	18.26	15.43	14.31
10	09.59	08.35	07.00	06.11	04.27	03.02	03.20	04.54	06.27	07.53	08.29	09.57
	14.58	16.36	18.04	20.36	22.10	23.41	23.31	21.56	20.08	18.22	15.39	14.30
11	09.57	08.32	06.57	06.07	04.24	03.00	03.22	04.57	06.30	07.56	08.33	09.59
	15.01	16.40	18.07	20.39	22.13	23.43	23.28	21.53	20.04	18.19	15.36	14.28
12	09.55	08.29	06.53	06.04	04.21	02.57	03.25	05.01	06.33	07.59	08.36	10.01
	15.04	16.43	18.10	20.42	22.17	23.44	23.26	21.50	20.01	18.15	15.33	14.27
13	09.53	08.26	06.50	06.00	04.17	02.56	03.28	05.04	06.35	08.02	08.39	10.03
	15.06	16.46	18.13	20.45	22.20	23.46	23.23	21.46	19.57	18.12	15.30	14.27
14	09.51	08.22	06.46	05.57	04.14	02.55	03.31	05.07	06.38	08.05	08.42	10.05
	15.09	16.50	18.16	20.48	22.23	23.48	23.21	21.43	19.54	18.08	15.28	14.26
15	09.49	08.19	06.43	05.53	04.11	02.54	03.33	05.10	06.41	08.08	08.46	10.06
	15.12	16.53	18.19	20.51	22.26	23.49	23.18	21.39	19.50	18.05	15.25	14.25
16	09.47	08.16	06.39	05.50	04.08	02.53	03.36	05.13	06.44	08.11	08.49	10.08
	15.15	16.56	18.22	20.54	22.29	23.50	23.15	21.36	19.47	18.01	15.22	14.25
17	09.44	08.12	06.36	05.46	04.05	02.52	03.39	05.16	06.47	08.14	08.52	10.09
	15.18	16.59	18.25	20.57	22.33	23.51	23.13	21.32	19.43	17.58	15.19	14.24
18	09.42	08.09	06.32	05.43	04.01	02.52	03.42	05.19	06.50	08.17	08.55	10.10
	15.21	17.02	18.28	21.00	22.36	23.52	23.10	21.29	19.39	17.55	15.16	14.24
19	09.39	08.06	06.29	05.39	03.58	02.52	03.45	05.22	06.53	08.20	08.58	10.11
	15.25	17.06	18.31	21.04	22.39	23.53	23.07	21.25	19.36	17.51	15.13	14.24
20	09.37	08.02	06.25	05.36	03.55	02.52	03.48	05.25	06.55	08.23	09.02	10.12
	15.28	17.09	18.34	21.07	22.42	23.53	23.04	21.22	19.32	17.48	15.11	14.24
21	09.34	07.59	06.22	05.32	03.52	02.52	03.51	05.28	06.58	08.26	09.05	10.13
	15.31	17.12	18.37	21.10	22.45	23.54	23.01	21.18	19.29	17.44	15.08	14.25
22	09.32	07.56	06.18	05.29	03.49	02.52	03.54	05.31	07.01	08.29	09.08	10.13
	15.34	17.15	18.40	21.13	22.49	23.54	22.58	21.15	19.25	17.41	15.05	14.25
23	09.29	07.52	06.15	05.25	03.46	02.52	03.57	05.34	07.04	08.32	09.11	10.14
	15.37	17.18	18.43	21.16	22.52	23.54	22.55	21.11	19.22	17.38	15.03	14.26
24	09.26	07.49	06.11	05.22	03.43	02.53	04.01	05.37	07.07	08.35	09.14	10.14
	15.40	17.21	18.46	21.19	22.55	23.54	22.52	21.08	19.18	17.34	15.00	14.26
25	09.24	07.45	06.08	05.18	03.40	02.54	04.04	05.40	07.10	07.38	09.17	10.14
	15.44	17.24	18.49	21.22	22.58	23.53	22.49	21.04	19.15	16.31	14.58	14.27
26	09.21	07.42	06.04	05.15	03.37	02.55	04.07	05.43	07.13	07.42	09.20	10.14
	15.47	17.28	18.52	21.25	23.01	23.53	22.46	21.01	19.11	16.28	14.55	14.28
27	09.18	07.39	06.01	05.11	03.34	02.56	04.10	05.46	07.15	07.45	09.23	10.14
	15.50	17.31	18.55	21.28	23.04	23.52	22.43	20.57	19.08	16.24	14.53	14.29
28	09.15	07.35	05.57	05.08	03.32	02.57	04.13	05.49	07.18	07.48	09.26	10.14
	15.54	17.34	18.58	21.32	23.07	23.51	22.39	20.54	19.04	16.21	14.51	14.30
29	09.12		06.54	05.05	03.29	02.59	04.16	05.52	07.21	07.51	09.29	10.14
	15.57		20.00	21.35	23.10	23.50	22.36	20.50	19.01	16.18	14.48	14.32
30	09.09		06.50	05.01	03.26	03.00	04.20	05.55	07.24	07.54	09.32	10.13
	16.00		20.03	21.38	23.13	23.49	22.33	20.47	18.57	16.14	14.46	14.33
31	09.06		06.46		03.24		04.23	05.58		07.57		10.13
	16.03		20.06		23.16		22.30	20.43		16.11		14.35
Potential sun hours	172	238	363	451	569	622	607	508	393	305	199	138
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

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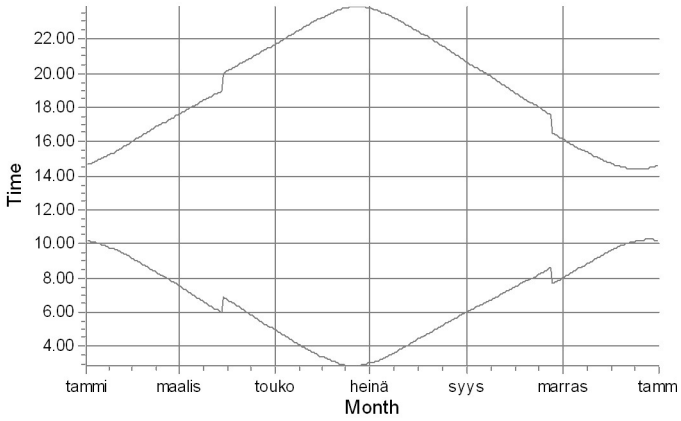
Calculated:
10.6.2020 16.07/3.3.247

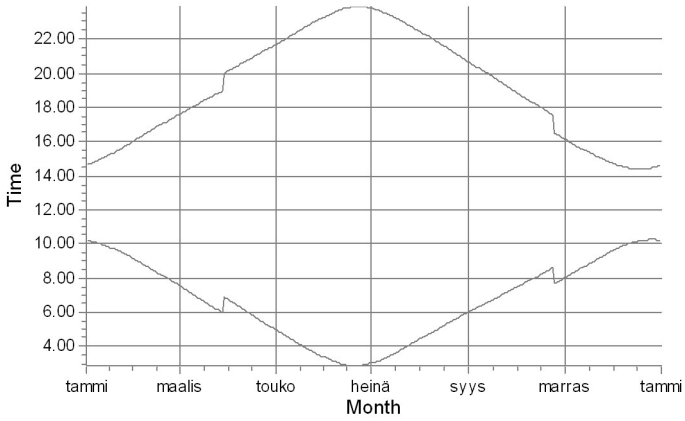
SHADOW - Calendar per WTG, graphical

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906

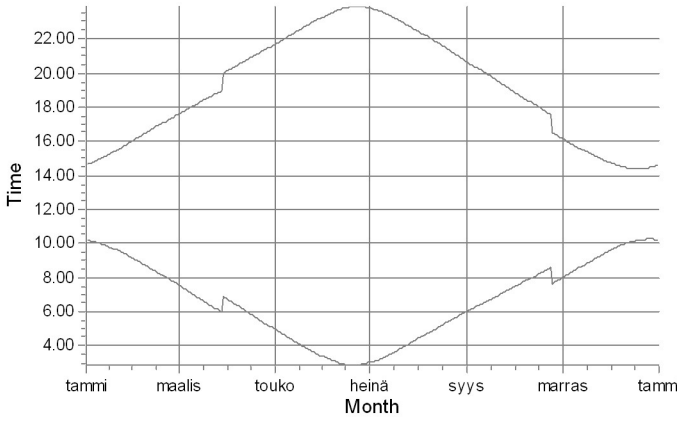
1: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (79)



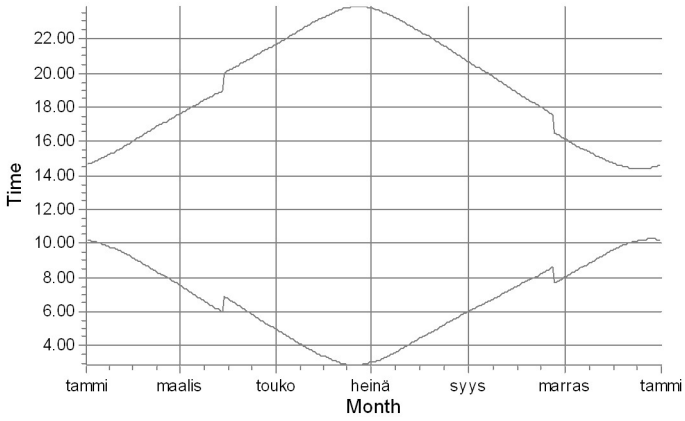
2: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (80)



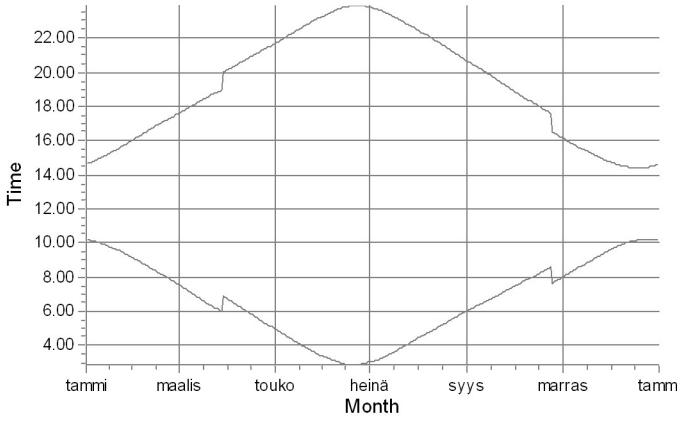
3: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (81)



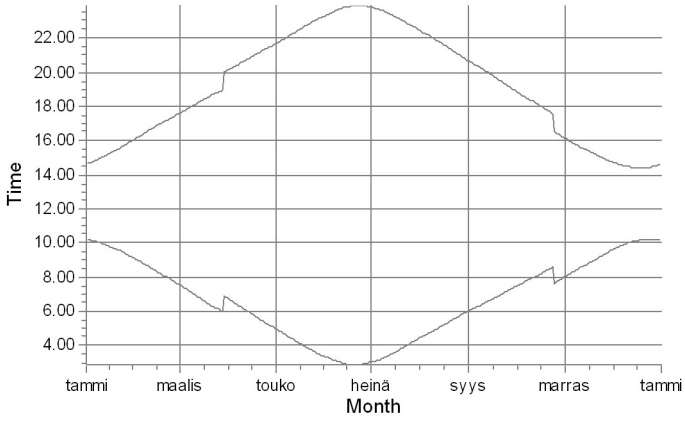
4: VESTAS V150-4.2 4200 150.0 !O! hub: 155,0 m (TOT: 230,0 m) (82)



5: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (89)



6: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (90)



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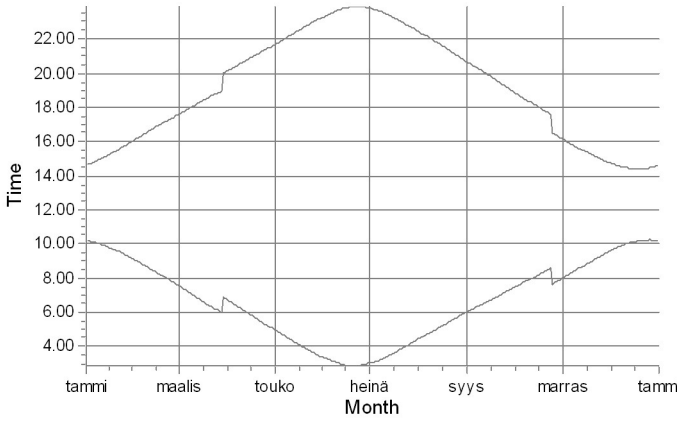
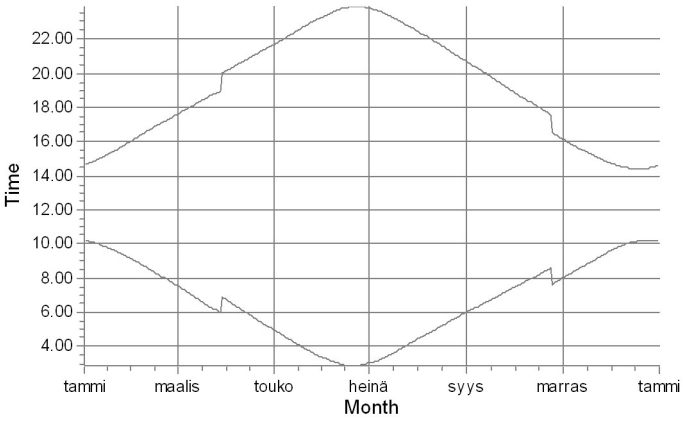
SHADOW - Calendar per WTG, graphical

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906

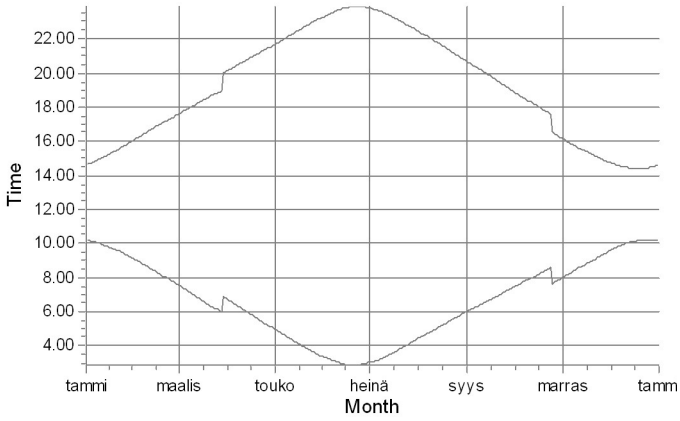
7: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (91)



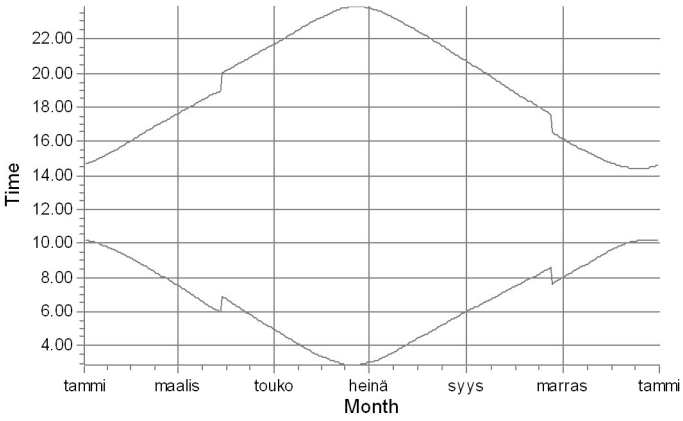
8: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (92)



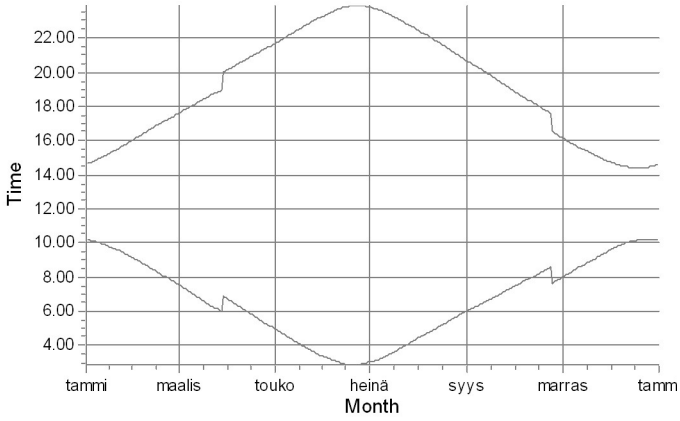
9: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (93)



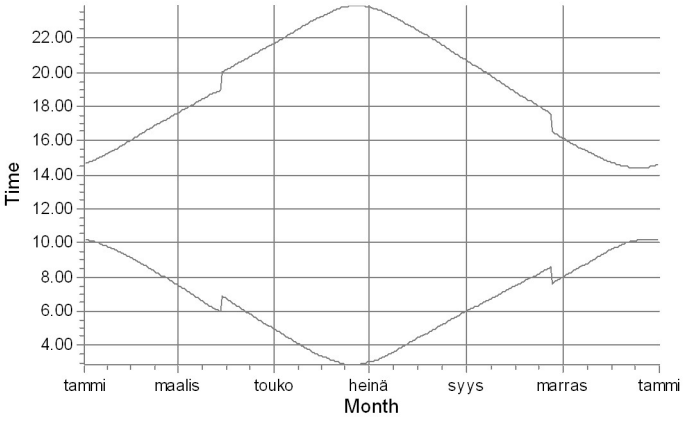
10: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (94)



11: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (95)



12: VESTAS V162-5.6 5600 180.0 !O! hub: 190,0 m (TOT: 280,0 m) (96)



Shadow receptors

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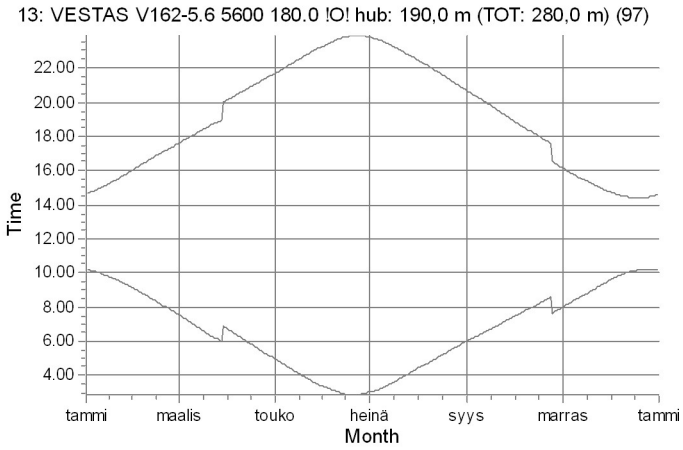
SHADOW - Calendar per WTG, graphical

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906



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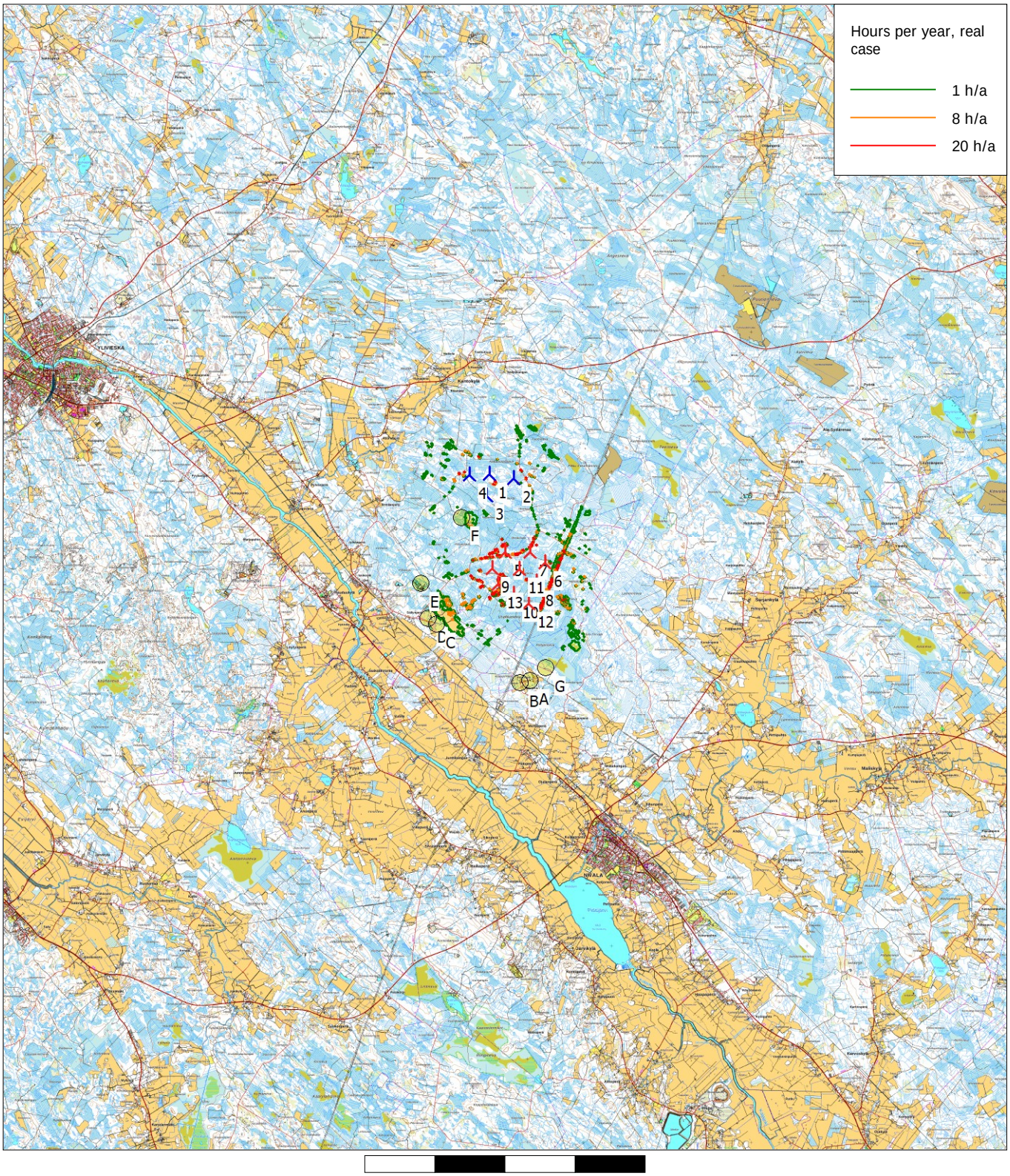
Calculated:
10.6.2020 16.07/3.3.247

SHADOW - Map

Calculation: Urakkaneva_RD180x9xHH190 +Hirvineva_V150x4xHH155_Luke forest_20200906



Map: Bitmap map: Q414.png , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 396 150 North: 7 100 280

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Urakkaneva_20200521_0.wpo (4)

Urakkaneva_Generic RD180x9xHH190_20200514

Hirvineva_V150x4xHH155_2018

Urakkaneva laskentapisteet

Varjostus (real case, Luke forest)

1 h/a

8 h/a

20 h/a

MML, mtk rakennuskanta 2020/05

Asuinrakennus

Liike- tai julkinen rakennus

Lomarakennus

1 2 3 4 5 6 7 8 9

A B C D E F G

0 1 2 3 4 km