

KOVASIN TUULIVOIMA OY

Kovasinkankaan tuulivoimahanke Ii

Melu- ja varjostusmallinnukset

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18.1.2021

Kovasinkankaan tuulivoimahanke Ii

1 MELU- JA VARJOSTUSMALLINNUKSEN TAVOITTEET

Iin kunnassa sijaitsevan Kovasinkankaan tuulivoimahankkeessa hankeomistaja Kovasin tuulivoima Oy suunnittelee 6 voimalan rakentamista. Voimaloiden Vestas 162-6.0MW melupäästö on 107,1 dB(A) ilman sahalaitoja. Voimaloiden roottorin halkaisija on 162 m (RD) ja voimalan napakorkeus 199 m (HH). Voimalan kokonaiskorkeus on 280 metriä.

Tuulivoimaloiden aiheuttamia melu ja varjostuksia on arvioitu laskentamallien avulla. Voimaloiden sijoittelu on hankekehittäjän mukainen (Kovasin tuulivoima Oy 7.12.2020). Yhteisvaikutuksia on mallinnettu hankealueen läheisyydessä sijaitsevan Ketunmaankankaan tuulivoimahankkeen kanssa. Ketunmaankankaan voimalaitokset ovat Vestaksen V126 -3.45MW voimaloita. Suunnitteilla on 5 voimalaa, joiden napakorkeus on 137 metriä.

Melu- ja varjostusmallinnukset on laatinut ins. Henna-Riikka Rintamäki FCG Suunnittelu ja tekniikka Oy:stä ja laaduntarkistuksen on tehnyt FM Liisa Karhu FCG Suunnittelu ja tekniikka Oy:stä.

2 LÄHTÖTIEDOT JA MENETELMÄT

2.1 Melu

2.1.1 Melumallinnus

Tuulivoimaloiden aiheuttamat äänenpainetasot on mallinnettu WindPRO-laskentaohjelmalla ISO 9613-2 standardin mukaisesti. Ympäristöhallinnon tuulivoimaloiden melun mallintamista koskevan ohjeen 2/2014 mukaisesti tuulen nopeutena käytettiin 8 m/s, ilman lämpötilana 15 °C, ilmanpaineena 101,325 kPa, ilman suhteellisenä kosteutena 70 %, maanpinnan kovuutena arvoa 0,4 ja järvien vesipinnan kovuutena arvoa 0,0. Laskenta on tehty 4,0 m maan pinnan tasosta. Laskennan pystysuora resoluutio on 1,0 m ja vaakasuora resoluutio on 1,0 m.

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

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Taulukko 1. Käytetyt mallinnusparametrit ISO 9613-2 laskelmissa sekä melulle altistuvat kohteet.

MALLINNUSOHJELMA JA VERSIO:			
WindPRO version 3.4.388		Mallinnusmenetelmä: ISO 9613-2	
AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT			
Laskenta korkeus		Laskentaruudun koko [m·m]	
4,0 m		25x25 m	
Suhteellinen kosteus		Lämpötila	
70 %	Muu, mikä ja miksi:	15 C°	
Maastomallin lähde ja tarkkuus			
Maastomallin lähde: MML maastotietokanta		Vaakaresoluutio:1,0	Pystyresoluutio:1,0
Maan- ja vedenpinnan absorption ja heijastuksen huomioiminen, käytetyt kertoimet			
Maa		0,4	HUOM
Vesistöt		0,0	
Ilmakehän stabiilius laskennassa/meteorologinen korjaus			
Neutraali, (0): Neutraali		Muu, mikä ja miksi:	
Sääolosuhteiden huomiointi; laskennassa käytetty tuulen suunnat ja nopeus			
Tuulen suunta: 0-360°		Tuulenoisuus: 8 m/s	
Voimalan äänen suuntaavuus ja vaimentuminen			
Vapaa avaruus: kyllä	Muu, mikä, miksi:		

2.1.2 Matalataajuinen melu

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, 2018) julkistamien Anojanssi projektin tulosten mukaisten ääneneristävyysarvoin ja tuloksia verrattiin toimenpiderajoihin.

Taulukko 2. Suomalaisen pientalon julkisivun äänitasoeron alalikiarvo Anojanssi projektin tulosten mukaisesti.

f [Hz]	20	25	31.5	40	50	63	80	100	125	160	200
DLo [dB]	7.6	8.3	9.2	10.3	11.5	13.0	14.8	16.8	18.8	21.1	22.8

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Tulokset on esitetty taajuuskohtaisena taulukkona hankealueen ympäröidyille asuin- ja lomarakennuksille.

2.2 Varjostusmallinnus

Tuulivoimaloiden varjostusvaikutuksia mallinnettiin WindPRO-ohjelman Shadow-moduulilla. Laskennoissa varjot huomioidaan, jos aurinko on yli 3 astetta horisontin yläpuolella ja varjoksi lasketaan, kun siipi peittää vähintään 20 % auringosta.

Varjostusmallin laskennassa on huomioitu hankealueen korkeustiedot, tuulivoimaloiden sijainnit, tuulivoimalan napakorkeudet ja roottorin halkaisija ja hankealueen aikavyöhyke. Mallinnuksessa otettiin huomioon auringon asema horisontissa eri kellon- ja vuodenaikoina, pilvisuus 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 Luulajan sääaseman pitkäaikaisiin mitattuihin säätietoihin 1981-2010, (Ilmatieteenlaitos raportti 2012:1). Laskentojen tuulen suunta ja nopeusjakaumana käytettiin NASA:n MERRA-dataa (Modern Era Retrospective-analysis for Research and Applications) hankealueen läheisyydeltä.

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

2.3 Paikkatietoaineisto

Korkeustiedot perustuvat Maanmittauslaitoksen (MML) maastotietokannan korkeuskäyrä aineistoon. Korkeusaseman intrapoloitimenetelmänä kohteille on käytetty WindPro TIN menetelmä.

Rakennusten käyttötarkoitus on arvoitu MML maastotietokannan asuin-, liike- tai julkisen-, loma-, teollisen-, kirkollisen, tai muun rakennuksen mukaisesti.

2.4 Voimalat

Tuulivoimaloiden melumallinnuksen lähtöarvoina on käytetty valmistajan ilmoittamia tuulivoimaloiden melupäästön arvoja.

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Taulukko 3. Kavasinkankaan hankkeen tuulivoimaloiden tyyppitiedot ja äänitehotasot sekä melun erityispiirteet.

TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)							
Tuulivoimalan valmistaja: Vestas				Tyyppi: V162 – 6.0 MW		Sarjanumero/t:-	
Nimellisteho: 6.0 MW		Napakorkeus: 199 m		Roottorin halkaisija: 162 m		Tornin tyyppi: teräs	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä			
Kyllä	- dB	Kyllä	- dB	Noise mode säätö:		Mode 0 no STE	
Ei		Ei		Noise mode, lähtömelutaso		107,1 dB(A)	
AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT							
Melupäästötiedot perustuvat dokumenttiin: " DMS no.: 0095-3732_00 Third octave noise emission, EnVentusTM V162-6.0 MW 50/60Hz							
Mallinuksissa on lisätty voimalan äänitehotasoihin 2 dB ympäristöministeriön ohjeen 2/2014 mukaisesti.							
Oktaaveittain [Hz], dB(A)		1/3-oktaaveittain [Hz], dB(A)					
31,5	-	20	58,3	200	93,8	2000	92,4
63	86,2	25	63,3	250	95,3	2500	90,3
125	94,7	31,5	68,2	315	96,5	3150	87,8
250	100,1	40	72,9	400	97,3	4000	84,8
500	102,3	50	76,8	500	97,7	5000	81,6
1000	101,4	63	80,6	630	97,7	6300	78,0
2000	97,4	80	84,1	800	97,4	8000	73,8
4000	90,2	100	87,0	1000	96,7	10000	69,6
8000	79,8	125	89,5	1250	95,7		
107,1 dB(A)		160	92,0	1600	94,2		
Melun erityispiirteiden mittausta ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudimodulaatio)		Muu, Mikä:	
kyllä	Ei	kyllä	ei	kyllä	ei	kyllä	ei

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Taulukko 3. Ketunmaankankaan tuulivoimaloiden äänitehotasot sekä melun erityispiirteet.

TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)							
Tuulivoimalan valmistaja: Vestas				Tyyppi: V126-3.45 MW		Sarjanumero/t:-	
Nimellisteho:3,45 MW		Napakorkeus: 137 m		Roottorin halkaisija:126		Tornin tyyppi: teräs/hybridi	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä			
Kyllä		Kyllä		- dB		Noise mode säätö: Mode 0 STE	
Ei		Ei				Noise mode, lähtömelutaso 106.2 dB(A)	
AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT							
Melupäästötiedot perustuvat dokumenttiin DMS no.: 0049-9517_01, V126-3.45MW-(IEC3A)-50/60Hz Third octave noise emission. Date 2015-02-23							
Oktaaveittain [Hz],dB(A)		1/3-oktaaveittain [Hz] LWA dB					
		20	65,1	200	90,1	1600	94,6
63	88,2	25	70,1	250	91,3	2000	94,3
125	94,3	31,5	70,7	315	92,3	2500	91,8
250	96,1	40	75,1	400	92,6	3150	88,7
500	99,5	50	80,3	500	93,8	4000	87,2
1000	102,3	63	83,8	630	96,8	5000	80,5
2000	98,5	80	85,0	800	97,3	6300	76,6
4000	91,4	100	87,6	1000	97,8	8000	74,9
8000	80,2	125	91,2	1250	97,5		
106,2 dB(A)		160	89,1				
Melun erityispiirteiden mittaustulos ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudimodulaatio)		Muu, Mikä:	
kyllä	ei	kyllä	ei	kyllä	ei	kyllä	ei

2.5 Raja- ja ohjearvot

2.5.1 Melu

Valtioneuvoston asetuksessa (1107/2015) tuulivoimaloille on määritelty ohjearvot 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.

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Taulukko 4. Valtioneuvoston asetuksen mukaiset tuulivoimaloiden melutason ohjearvot (Valtioneuvoston asetus 1107/2015).

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 5. 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.

2.5.2 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.

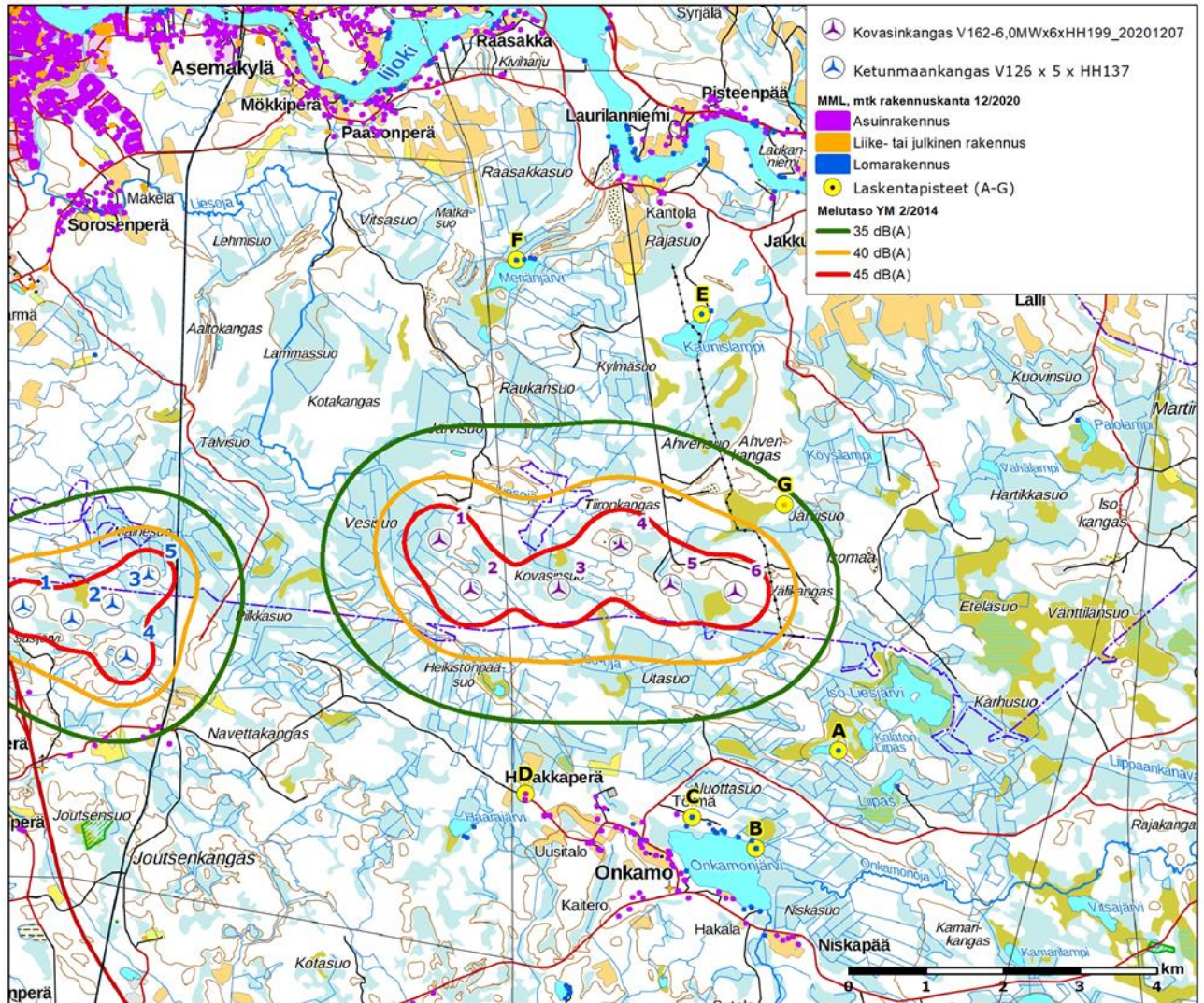
Arvioinnissa on tarkasteltu vaikutuksia alueella, jossa varjoja tai välkettä mallinnuksen mukaisessa todellisessa tilanteessa ("real case") esiintyy vähintään kahdeksan tuntia vuodessa.

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3 MELU- JA VARJOSTUSMALLINNUSTEN TULOKSET

3.1 Melun laskentatulokset ISO 9613-2

Tuulivoimapuista lähimpien asuin- ja lomarakennusten pihapiirissä melutasot jäävät laskelmien mukaan alle 40 dB(A) (Liite 1).



Kuva 1. Laskennalliset melutasot standardin ISO 9613-2 mukaisesti.

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Taulukko 6. Laskennalliset melutasot lähtömelutason olleessa 104,0 dB(A).

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Kohteen korkeus- asema (m)	Laskenta- korkeus (m)	Melutaso dB(A)
Lomarakennus A (Kantolantie 285)	435 168	7 235 667	40	4,0	29,3
Lomarakennus B (Kantolantie 142)	434 099	7 234 395	35	4,0	27,0
Lomarakennus C (Kantolantie 42)	433 269	7 234 801	35	4,0	29,2
Asuinrakennus D (Onkamonkyläntie 280)	431 108	7 235 103	32,5	4,0	30,7
Lomarakennus E (Kaunislammentie 153)	433 395	7 241 348	37,5	4,0	28,9
Lomarakennus F (Meriänjärvi)	430 991	7 242 055	30	4,0	27,5
Liikerakennus G (Impivaarantie kämpmä)	434 473	7 238 869	37,8	4,0	36,1

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 voimalaitostyyppillä Vestas V162 6,0MW, matalataajuinen melu ei ylitä Sosiaali- ja terveysministeriön asumisterveysohjearvoa. Taulukoissa näkyy toimenpiderajan alitus (negatiivinen arvo) tai ylitys (positiivinen arvo).

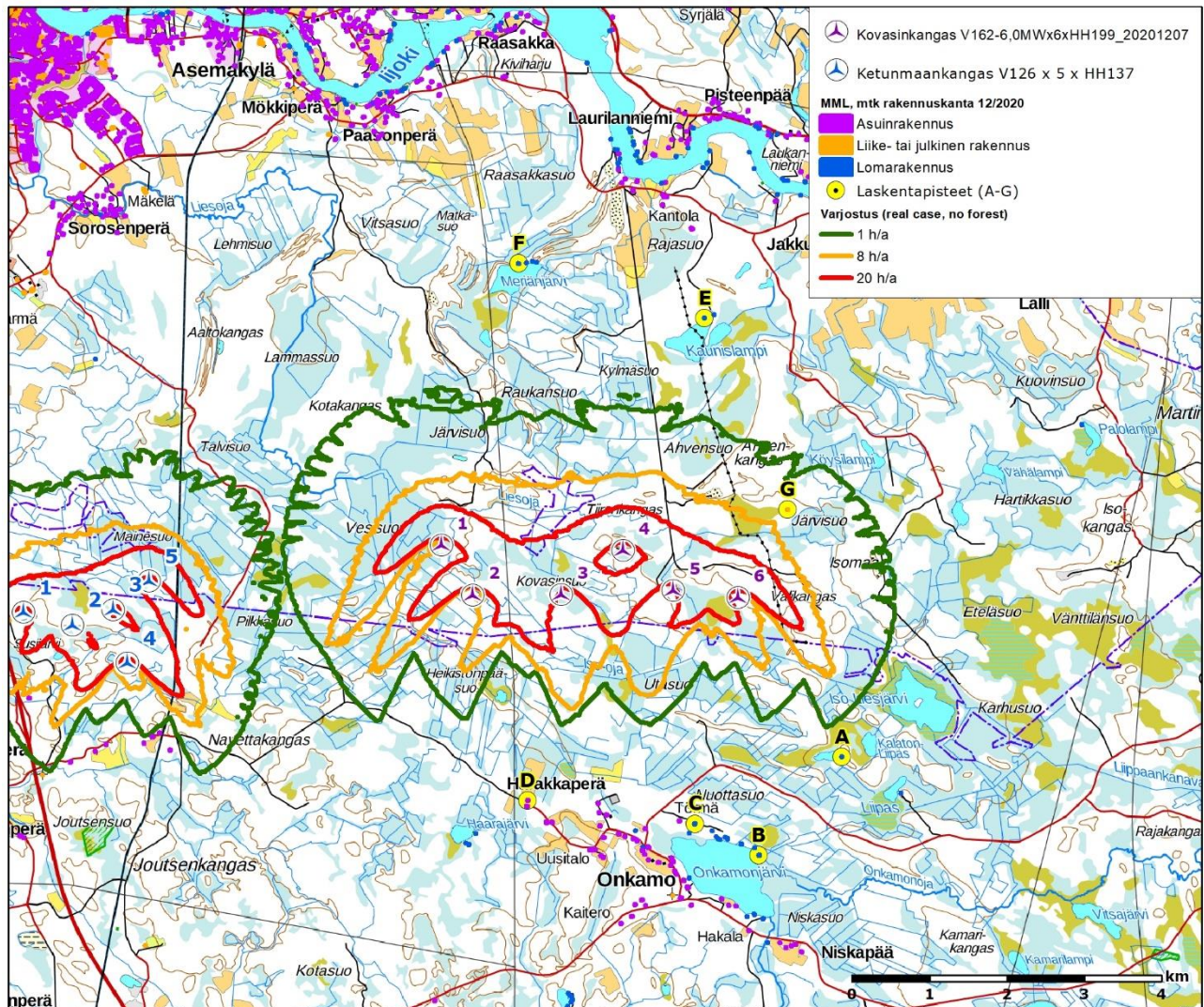
Taulukko 7. Matalataajuisen melun mallinnustulokset sekä vertailu verrattuna Sosiaali- ja terveysministeriön toimenpiderajaan. Myös suunnitteilla olevat Ketunmaankankaan tuulivoimalat on huomioitu.

Rakennus	Äänitaso ulkona		Äänitaso sisällä	
	L eq,1h - Asumisterveys- ohje sisällä	Hz	L eq,1h - Asumisterveys- ohje sisällä	Hz
Lomarakennus A (Kantolantie 285)	-1,9	100	-15,8	50
Lomarakennus B (Kantolantie 142)	-3,1	100	-16,8	50
Lomarakennus C (Kantolantie 42)	-1,6	100	-15,4	50
Asuinrakennus D (Onkamonkyläntie 280)	-0,4	100	-14,1	50
Lomarakennus E (Kaunislammentie 153)	-2,4	100	-16,1	50
Lomarakennus F (Meriänjärvi)	-3,1	100	-16,5	50
Liikerakennus G (Impivaarantie kämpmä)	3,2	200	-11,6	50

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3.3 Varjostusmallinnuksen tulokset

Tuulivoimapuistoa lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on mallinnuksen mukaan kaikissa laskentapisteissä alle 8 h/a, kun puuston suojaavaa vaikutusta ei ole huomioitu (Liite 3).



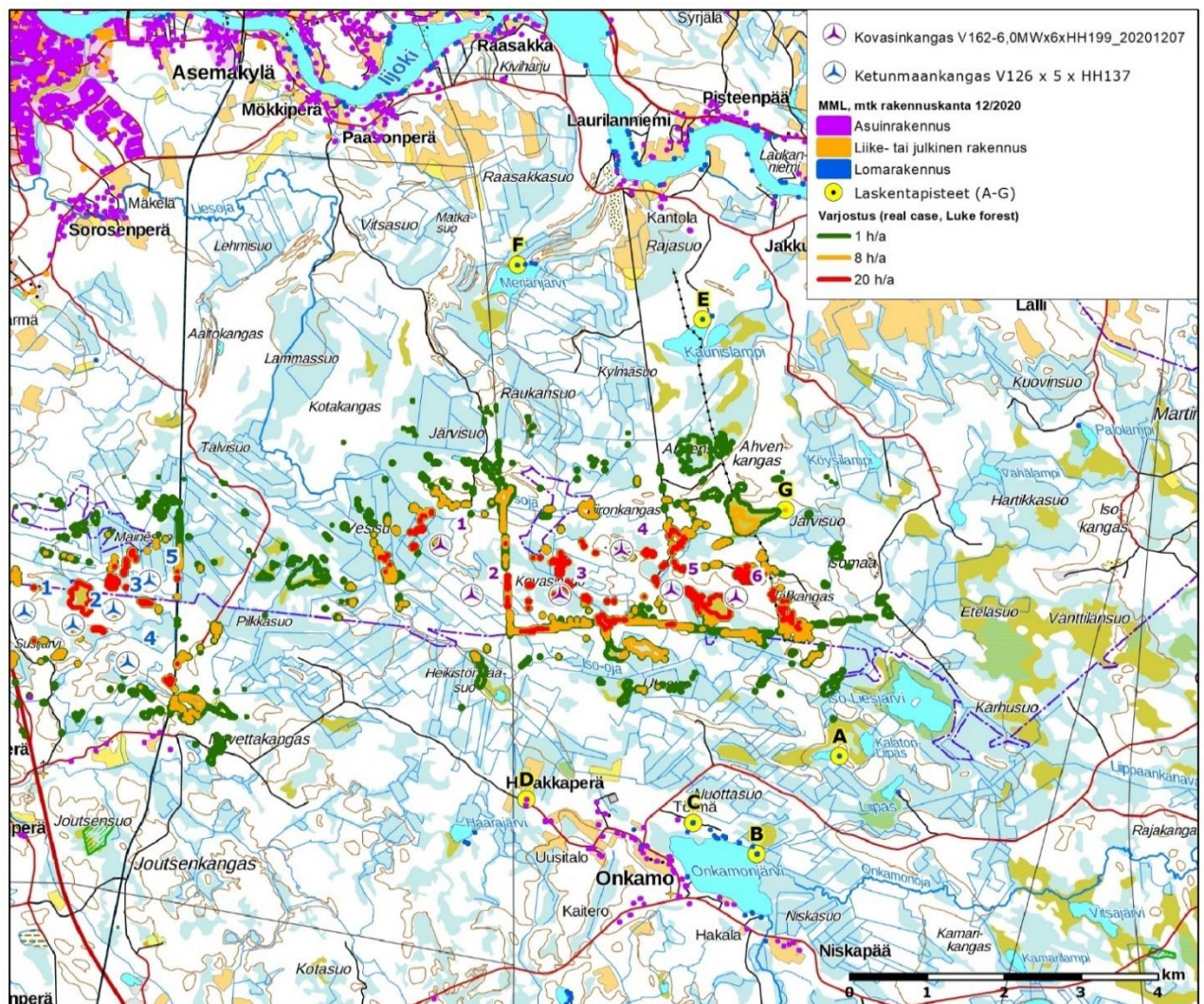
Kuva 2. Laskennalliset varjostusmallinnuksen tulokset "real case, no forest".

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Taulukko 8. Laskennalliset varjostustunnit vuodessa lähialueen laskentapisteissä, kun puuston suojaava vaikutusta ei ole huomioitu "real case, no forest".

Laskentapiste	ETRS89 -TM35 Itä	ETRS89 -TM35 Pohjoinen	Kohteen korkeus- asema (m)	Varjostus (h/a)
Lomarakennus A (Kantolantie 285)	435 168	7 235 667	40,0	0:00
Lomarakennus B (Kantolantie 142)	434 099	7 234 395	35,0	0:00
Lomarakennus C (Kantolantie 42)	433 269	7 234 801	35,0	0:00
Asuinrakennus D (Onkamonseläntie 280)	431 108	7 235 103	32,5	0:00
Lomarakennus E (Kaunislammentie 153)	433 395	7 241 348	37,5	0:00
Lomarakennus F (Meriänjärvi)	430 991	7 242 055	30,0	0:00
Liikerakennus G (Impivaarantie kämpä)	434 473	7 238 869	37,8	4:41

Tuulivoimapuistoa lähimpien rakennusten pihapiirissä varjostusvaikutus on mallinnuksen mukaan kaikissa laskentapisteissä alle 8 h/a, kun huomioidaan puuston suojaava vaikutus (Luonnonvarakeskuksen aineisto 2017) (liite 4).



Kuva 3. Laskennalliset varjostusmallinnuksen tulokset "real case, Luke forest".

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Taulukko 9. Laskennalliset varjostustunnit vuodessa lähialueen laskentapisteissä, kun puuston suojaavaa vaikutus on huomioitu "real case, Luke forest".

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Kohteen korkeus-asema (m)	Varjostus (h/a)
Lomarakennus A (Kantolantie 285)	435 168	7 235 667	40,0	0:00
Lomarakennus B (Kantolantie 142)	434 099	7 234 395	35,0	0:00
Lomarakennus C (Kantolantie 42)	433 269	7 234 801	35,0	0:00
Asuinrakennus D (Onkamonsyläntie 280)	431 108	7 235 103	32,5	0:00
Lomarakennus E (Kaunislammentie 153)	433 395	7 241 348	37,5	0:00
Lomarakennus F (Meriänjärvi)	430 991	7 242 055	30,0	0:00
Liikerakennus G (Impivaarantie kämppä)	434 473	7 238 869	37,8	3:09

Laatija

Tarkastaja

18.1.2021

Liite 1

**Liite 1: Kavasinkankaan tuulivoimahanke - Melun leviämismallinnuksen tulokset ISO 9613-2,
YM 2/2014**

DECIBEL - Main Result

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_20201207

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Kovasinka

Area type with hard ground: Veistöalueet_Kovasinkangas

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

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

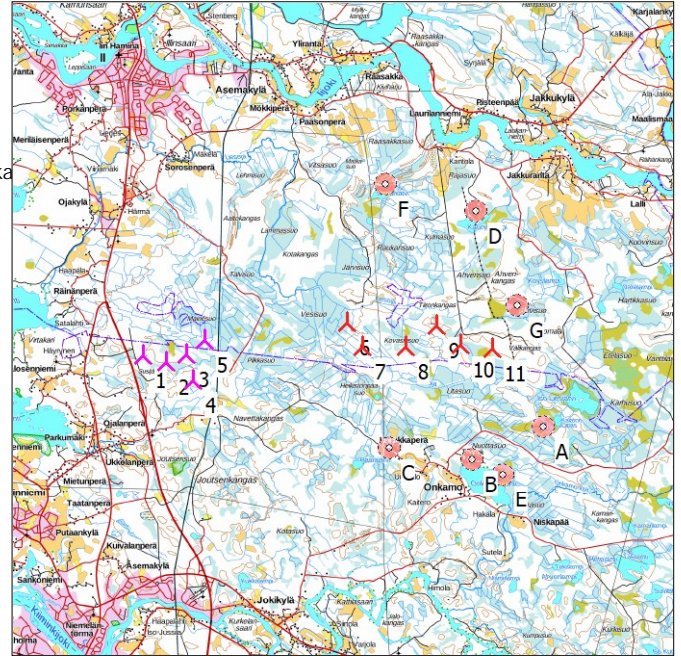
Deviation from "official" noise demands. Negative is more

restrictive, positive is less restrictive.:

0,0 dB(A)

All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89



New WTG

Scale 1:200 000

Noise sensitive area

WTGs

	East	North	Z	Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data		Wind speed [m/s]	LwA,ref [dB(A)]
					Valid	Manufact.	Type-generator				Creator	Name		
				[m]										
1	424 583	7 237 533	16,1	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	USER	Level 0 - Calculated - Mode 0-0S - 2016-01	8,0	106,2
2	425 215	7 237 368	20,0	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	USER	Level 0 - Calculated - Mode 0-0S - 2016-01	8,0	106,2
3	425 739	7 237 570	22,5	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	USER	Level 0 - Calculated - Mode 0-0S - 2016-01	8,0	106,2
4	425 926	7 236 878	21,5	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	USER	Level 0 - Calculated - Mode 0-0S - 2016-01	8,0	106,2
5	426 209	7 237 939	25,0	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	USER	Level 0 - Calculated - Mode 0-0S - 2016-01	8,0	106,2
6	429 984	7 238 403	28,3	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	USER	V162 - 6.0 MW Mode 0 noSTE - 10-2020	8,0	107,1
7	430 394	7 237 760	31,7	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	USER	V162 - 6.0 MW Mode 0 noSTE - 10-2020	8,0	107,1
8	431 537	7 237 767	35,0	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	USER	V162 - 6.0 MW Mode 0 noSTE - 10-2020	8,0	107,1
9	432 336	7 238 334	42,4	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	USER	V162 - 6.0 MW Mode 0 noSTE - 10-2020	8,0	107,1
10	432 986	7 237 817	40,0	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	USER	V162 - 6.0 MW Mode 0 noSTE - 10-2020	8,0	107,1
11	433 822	7 237 725	38,7	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	USER	V162 - 6.0 MW Mode 0 noSTE - 10-2020	8,0	107,1

Calculation Results

Sound level

Noise sensitive area

No.	Name	East	North	Z	Immission height [m]	Demands Noise [dB(A)]	Sound level From WTGs [dB(A)]	Distance to noise demand [m]	Demands fulfilled ? Noise
A	Lomarakennus A (Kantolantie 285)	435 168	7 235 667	40,0	4,0	40,0	29,3	1 644	Yes
B	Lomarakennus C (Kantolantie 42)	433 269	7 234 801	35,0	4,0	40,0	29,2	2 008	Yes
C	Asuinrakennus D (Onkamonylantie 280)	431 108	7 235 103	32,5	4,0	40,0	30,7	1 734	Yes
D	Lomarakennus E (Kaunislammentie 153)	433 395	7 241 348	37,5	4,0	40,0	28,9	2 279	Yes
E	Lomarakennus B (Kantolantie 142)	434 099	7 234 395	35,0	4,0	40,0	27,0	2 467	Yes
F	Lomarakennus F (Merijärvi)	430 991	7 242 055	30,0	4,0	40,0	27,5	2 929	Yes
G	Liikerakennus G (Impivaarantie kämppä)	434 473	7 238 869	37,8	4,0	40,0	36,1	467	Yes

Distances (m)

WTG	A	B	C	D	E	F	G
1	10748	9106	6962	9602	10020	7843	9980
2	10097	8453	6313	9097	9368	7439	9379
3	9619	8023	5908	8537	8943	6907	8830
4	9321	7631	5477	8704	8542	7243	8776
5	9243	7726	5660	7953	8650	6310	8316

To be continued on next page...

Project:
Kovasinkangas_20191009

Description:
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Calculated:
30.12.2020 16.32/3.4.388

DECIBEL - Main Result

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_20201207

...continued from previous page

WTG	A	B	C	D	E	F	G
6	5862	4875	3486	4506	5744	3788	4513
7	5212	4126	2751	4677	5005	4336	4227
8	4194	3435	2698	4034	4235	4323	3136
9	3890	3654	3457	3194	4315	3957	2203
10	3063	3030	3301	3554	3598	4684	1822
11	2459	2976	3774	3648	3341	5173	1316

DECIBEL - Detailed results

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_20201207 Noise 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 Lomarakennus A (Kantolantie 285)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	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	10 748	10 749	4,01	106,2		0,00	91,63	-	-	0,00	0,00	-
10	3 063	3 069	23,04	107,1	2	0,00	80,74	-	-	0,00	0,00	-
11	2 459	2 466	25,95	107,1	2	0,00	78,84	-	-	0,00	0,00	-
2	10 097	10 098	4,76	106,2		0,00	91,08	-	-	0,00	0,00	-
3	9 619	9 620	5,31	106,2		0,00	90,66	-	-	0,00	0,00	-
4	9 321	9 322	5,72	106,2		0,00	90,39	-	-	0,00	0,00	-
5	9 243	9 243	5,75	106,2		0,00	90,32	-	-	0,00	0,00	-
6	5 862	5 864	14,17	107,1	2	0,00	86,36	-	-	0,00	0,00	-
7	5 212	5 216	15,86	107,1	2	0,00	85,35	-	-	0,00	0,00	-
8	4 194	4 199	19,00	107,1	2	0,00	83,46	-	-	0,00	0,00	-
9	3 890	3 895	19,75	107,1	2	0,00	82,81	-	-	0,00	0,00	-
Sum			29,30									

- Data undefined due to calculation with octave data

Noise sensitive area: B Lomarakennus C (Kantolantie 42)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	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	9 106	9 106	5,70	106,2		0,00	90,19	-	-	0,00	0,00	-
10	3 030	3 036	23,19	107,1	2	0,00	80,65	-	-	0,00	0,00	-
11	2 976	2 983	23,43	107,1	2	0,00	80,49	-	-	0,00	0,00	-
2	8 453	8 454	6,57	106,2		0,00	89,54	-	-	0,00	0,00	-
3	8 023	8 024	7,19	106,2		0,00	89,09	-	-	0,00	0,00	-
4	7 631	7 632	7,78	106,2		0,00	88,65	-	-	0,00	0,00	-
5	7 726	7 727	7,63	106,2		0,00	88,76	-	-	0,00	0,00	-
6	4 875	4 879	16,52	107,1	2	0,00	84,77	-	-	0,00	0,00	-
7	4 126	4 130	18,91	107,1	2	0,00	83,32	-	-	0,00	0,00	-
8	3 435	3 440	21,48	107,1	2	0,00	81,73	-	-	0,00	0,00	-
9	3 654	3 660	20,62	107,1	2	0,00	82,27	-	-	0,00	0,00	-
Sum			29,20									

- Data undefined due to calculation with octave data

Noise sensitive area: C Asuinrakennus D (Onkamonsyläntie 280)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	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	6 962	6 963	8,86	106,2		0,00	87,86	-	-	0,00	0,00	-
10	3 301	3 307	22,03	107,1	2	0,00	81,39	-	-	0,00	0,00	-
11	3 774	3 779	20,17	107,1	2	0,00	82,55	-	-	0,00	0,00	-
2	6 313	6 314	10,02	106,2		0,00	87,01	-	-	0,00	0,00	-
3	5 908	5 910	10,80	106,2		0,00	86,43	-	-	0,00	0,00	-

To be continued on next page...

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, Ii

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Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 16.32/3.4.388

DECIBEL - Detailed results

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_20201207 Noise calculation model: ISO 9613-2 General 8,0 m/s
...continued from previous page

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Pure tones [dB]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]
4	5 477	5 479	11,70	106,2		0,00	85,77	-	-	0,00	0,00	-
5	5 660	5 662	11,31	106,2		0,00	86,06	-	-	0,00	0,00	-
6	3 486	3 491	21,28	107,1	2	0,00	81,86	-	-	0,00	0,00	-
7	2 751	2 758	24,50	107,1	2	0,00	79,81	-	-	0,00	0,00	-
8	2 698	2 705	24,74	107,1	2	0,00	79,64	-	-	0,00	0,00	-
9	3 457	3 463	21,39	107,1	2	0,00	81,79	-	-	0,00	0,00	-
Sum			30,69									

- Data undefined due to calculation with octave data

Noise sensitive area: D Lomarakennus E (Kaunislammentie 153)

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	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	9 602	9 603	5,08	106,2		0,00	90,65	-	-	0,00	0,00	-
10	3 554	3 560	22,15	107,1	2	0,00	82,03	-	-	0,00	0,00	-
11	3 648	3 653	21,81	107,1	2	0,00	82,25	-	-	0,00	0,00	-
2	9 097	9 097	5,71	106,2		0,00	90,18	-	-	0,00	0,00	-
3	8 537	8 538	6,46	106,2		0,00	89,63	-	-	0,00	0,00	-
4	8 704	8 705	6,23	106,2		0,00	89,80	-	-	0,00	0,00	-
5	7 953	7 954	7,29	106,2		0,00	89,01	-	-	0,00	0,00	-
6	4 506	4 510	17,66	107,1	2	0,00	84,08	-	-	0,00	0,00	-
7	4 677	4 681	17,79	107,1	2	0,00	84,41	-	-	0,00	0,00	-
8	4 034	4 039	20,03	107,1	2	0,00	83,12	-	-	0,00	0,00	-
9	3 194	3 201	23,35	107,1	2	0,00	81,10	-	-	0,00	0,00	-
Sum			28,88									

- Data undefined due to calculation with octave data

Noise sensitive area: E Lomarakennus B (Kantolantie 142)

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	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	10 020	10 021	5,47	106,2		0,00	91,02	-	-	0,00	0,00	-
10	3 598	3 604	20,83	107,1	2	0,00	82,14	-	-	0,00	0,00	-
11	3 341	3 347	21,86	107,1	2	0,00	81,49	-	-	0,00	0,00	-
2	9 368	9 369	6,28	106,2		0,00	90,43	-	-	0,00	0,00	-
3	8 943	8 944	6,81	106,2		0,00	90,03	-	-	0,00	0,00	-
4	8 542	8 543	7,40	106,2		0,00	89,63	-	-	0,00	0,00	-
5	8 650	8 650	7,18	106,2		0,00	89,74	-	-	0,00	0,00	-
6	5 744	5 747	14,12	107,1	2	0,00	86,19	-	-	0,00	0,00	-
7	5 005	5 009	16,19	107,1	2	0,00	84,99	-	-	0,00	0,00	-
8	4 235	4 239	18,54	107,1	2	0,00	83,55	-	-	0,00	0,00	-
9	4 315	4 320	18,27	107,1	2	0,00	83,71	-	-	0,00	0,00	-
Sum			27,02									

- Data undefined due to calculation with octave data

Noise sensitive area: F Lomarakennus F (Merijärvi)

Wind speed: 8,0 m/s

No.	Distance [m]	Sound distance [m]	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	7 843	7 844	8,17	106,2		0,00	88,89	-	-	0,00	0,00	-
10	4 684	4 689	18,11	107,1	2	0,00	84,42	-	-	0,00	0,00	-
11	5 173	5 177	16,67	107,1	2	0,00	85,28	-	-	0,00	0,00	-
2	7 439	7 440	8,88	106,2		0,00	88,43	-	-	0,00	0,00	-
3	6 907	6 908	9,78	106,2		0,00	87,79	-	-	0,00	0,00	-
4	7 243	7 244	9,28	106,2		0,00	88,20	-	-	0,00	0,00	-
5	6 310	6 311	10,86	106,2		0,00	87,00	-	-	0,00	0,00	-
6	3 788	3 793	21,11	107,1	2	0,00	82,58	-	-	0,00	0,00	-
7	4 336	4 341	19,23	107,1	2	0,00	83,75	-	-	0,00	0,00	-
8	4 323	4 327	19,28	107,1	2	0,00	83,72	-	-	0,00	0,00	-
9	3 957	3 962	20,49	107,1	2	0,00	82,96	-	-	0,00	0,00	-
Sum			27,52									

- Data undefined due to calculation with octave data

Project:
Kovasinkangas_20191009

Description:
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Calculated:
30.12.2020 16.32/3.4.388

DECIBEL - Detailed results

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_20201207 Noise calculation model: ISO 9613-2 General 8,0 m/s

Noise sensitive area: G Liikerakennus G (Impivaarantie kämppä)

Wind speed: 8,0 m/s

WTG

No.	Distance [m]	Sound distance [m]	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	9 980	9 981	4,62	106,2		0,00	90,98	-	-	0,00	0,00	-
10	1 822	1 832	29,72	107,1	2	0,00	76,26	-	-	0,00	0,00	-
11	1 316	1 331	33,55	107,1	2	0,00	73,48	-	-	0,00	0,00	-
2	9 379	9 380	5,35	106,2		0,00	90,44	-	-	0,00	0,00	-
3	8 830	8 831	6,06	106,2		0,00	89,92	-	-	0,00	0,00	-
4	8 776	8 777	6,13	106,2		0,00	89,87	-	-	0,00	0,00	-
5	8 316	8 317	6,77	106,2		0,00	89,40	-	-	0,00	0,00	-
6	4 513	4 517	17,63	107,1	2	0,00	84,10	-	-	0,00	0,00	-
7	4 227	4 231	18,57	107,1	2	0,00	83,53	-	-	0,00	0,00	-
8	3 136	3 142	22,72	107,1	2	0,00	80,94	-	-	0,00	0,00	-
9	2 203	2 212	27,36	107,1	2	0,00	77,90	-	-	0,00	0,00	-
Sum			36,11									

- Data undefined due to calculation with octave data

Project:
Kovasinkangas_20191009

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Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 16.32/3.4.388

DECIBEL - Assumptions for noise calculation

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_20201207

Noise calculation model:

ISO 9613-2 General

Wind speed (in 10 m height):

8,0 m/s

Ground attenuation:

General, terrain specific

Ground factor for porous ground: 0,4

Area object with hard ground: Area object (Roughness): REGIONS_Kovasinkangas_20191009_1.w2r (1)

Area type with hard ground: Veistöalueet_Kovasinkangas

Ground factor for hard ground: 0,0

Meteorological coefficient, CO:

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

All coordinates are in

Finish TM ETRS-TM35FIN-ETRS89

WTG: VESTAS V126-3.45 LTq 3450 126.0 !O!

Noise: Level 0 - Calculated - Mode 0-0S - 2016-01

Source	Source/Date	Creator	Edited
HH: Vestas; 10 m: calculated by EMD	8.1.2016	USER	11.9.2019 8.52

Document DMS 0053-3712.03.

Blades without serrated trailing edge.

Hub height wind speed noise data from Vestas. Wind speed at hub height is converted to 10 m height using the IEC 61400-11 wind profile (5 cm roughness). Noise levels are interpolated at integer wind speeds.

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data							
					63	125	250	500	1000	2000	4000	8000
From Windcat	137,0	8,0	106,2	No	88,2	94,3	96,1	99,5	102,3	98,5	91,4	80,2

WTG: VESTAS V162-6.0 HH199 6000 162.0 !O!

Noise: V162 - 6.0 MW Mode 0 noSTE - 10-2020

Source	Source/Date	Creator	Edited
FCG	26.10.2019	USER	30.12.2020 16.02

DMS no.: 0095-3732_00

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Penalty [dB]	Octave data							
						63	125	250	500	1000	2000	4000	8000
From Windcat	199,0	8,0	107,1	Yes	2,0	86,2	94,7	100,1	102,3	101,4	97,4	90,2	79,8

Noise sensitive area: A Lomarakennus A (Kantolantie 285)

Predefined calculation standard:

Immission height(a.g.l.): 4,0 m

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, II

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 16.32/3.4.388

DECIBEL - Assumptions for noise calculation

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_20201207

Noise sensitive area: B Lomarakennus C (Kantolantie 42)

Predefined calculation standard:

Immission height(a.g.l.): 4,0 m

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: C Asuinrakennus D (Onkamonkyläntie 280)

Predefined calculation standard:

Immission height(a.g.l.): 4,0 m

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: D Lomarakennus E (Kaunislammentie 153)

Predefined calculation standard:

Immission height(a.g.l.): 4,0 m

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: E Lomarakennus B (Kantolantie 142)

Predefined calculation standard:

Immission height(a.g.l.): 4,0 m

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: F Lomarakennus F (Meriänjärvi)

Predefined calculation standard:

Immission height(a.g.l.): 4,0 m

Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Noise sensitive area: G Liikerakennus G (Impivaarantie kämppä)

Predefined calculation standard:

Immission height(a.g.l.): 4,0 m

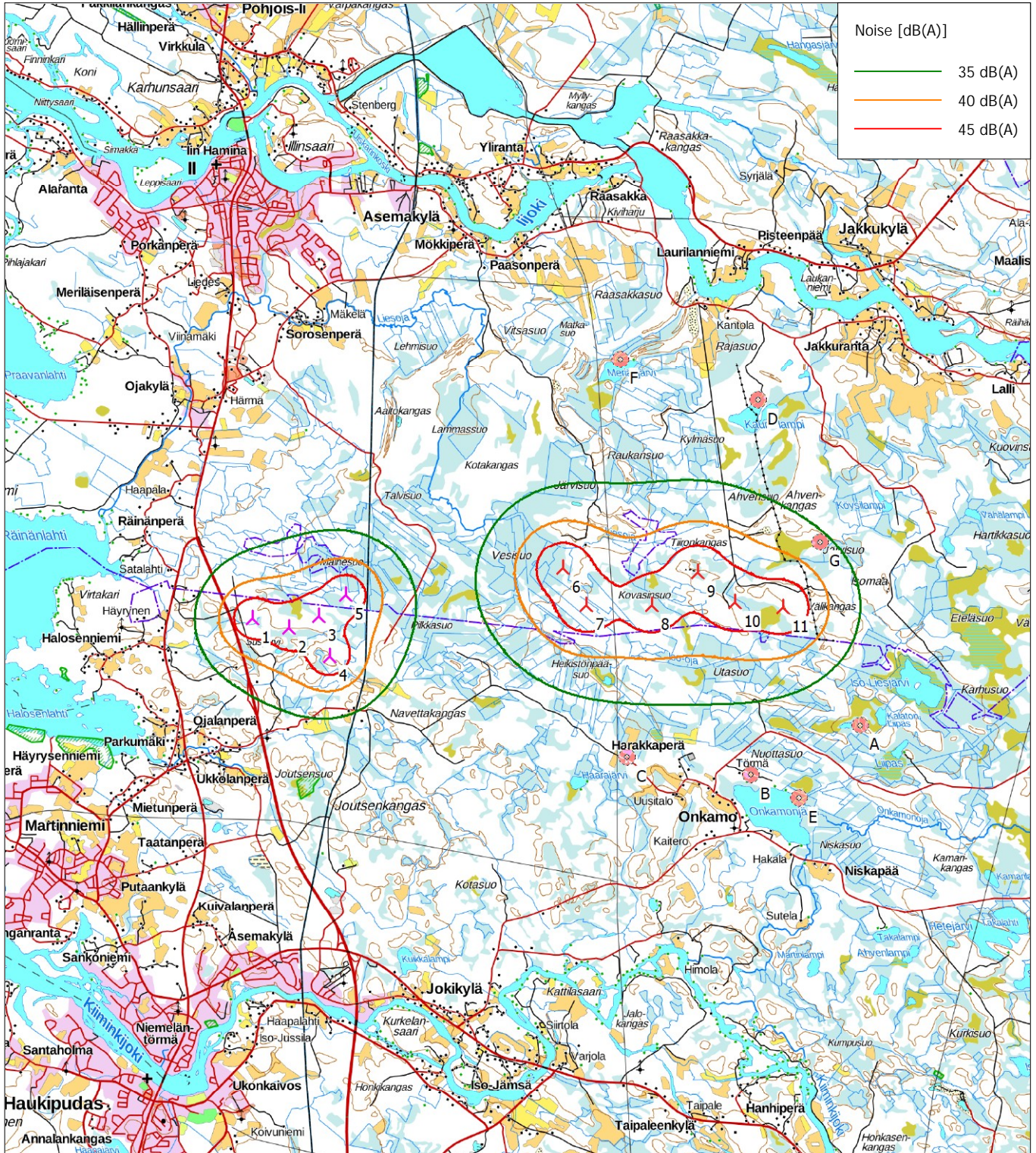
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

DECIBEL - Map 8,0 m/s

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_20201207



Map: Maastokarttarasteri100K, Print scale 1:100 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 429 203 North: 7 238 217

▲ New WTG

■ Noise sensitive area

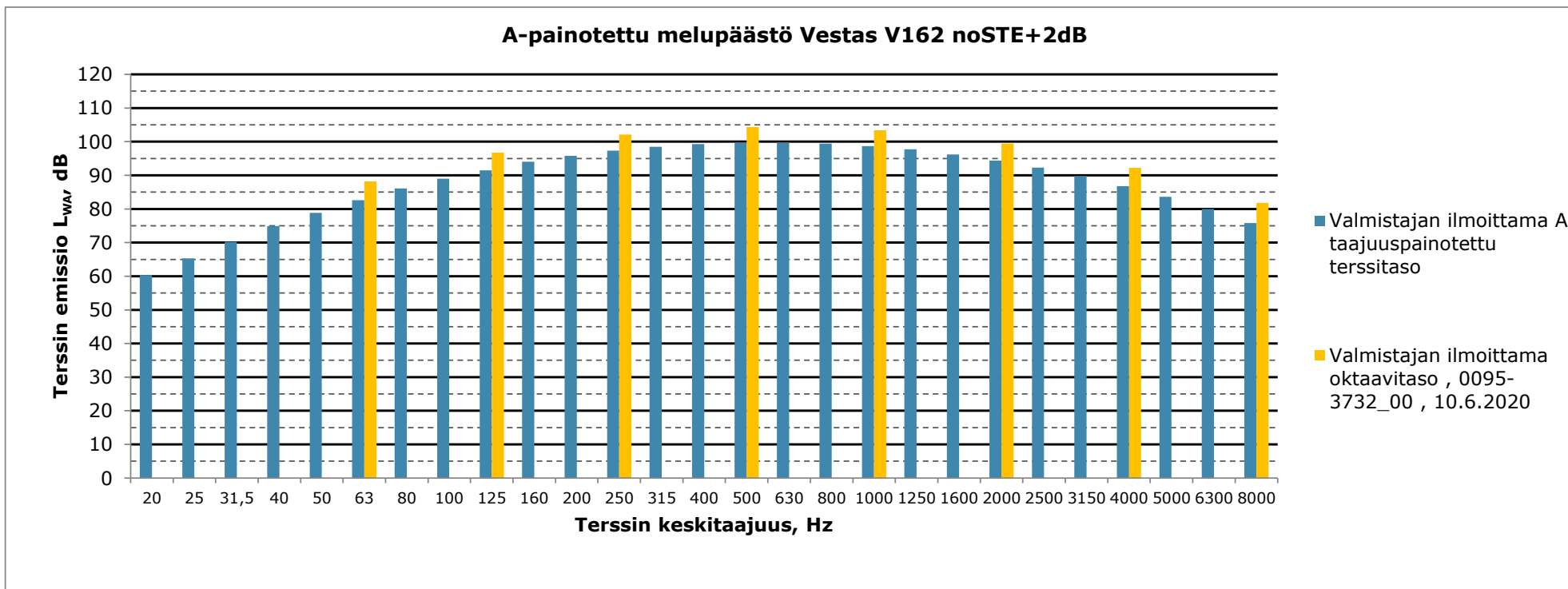
Noise calculation model: ISO 9613-2 General. Wind speed: 8,0 m/s

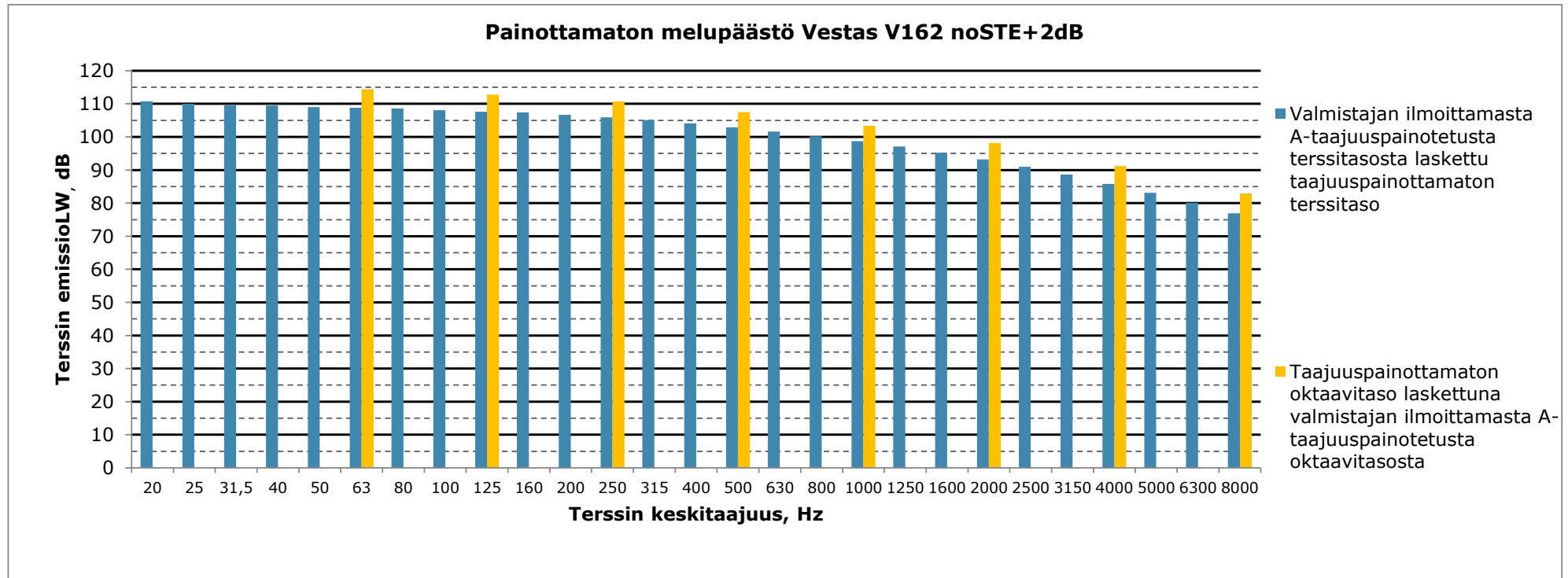
Height above sea level from active line object

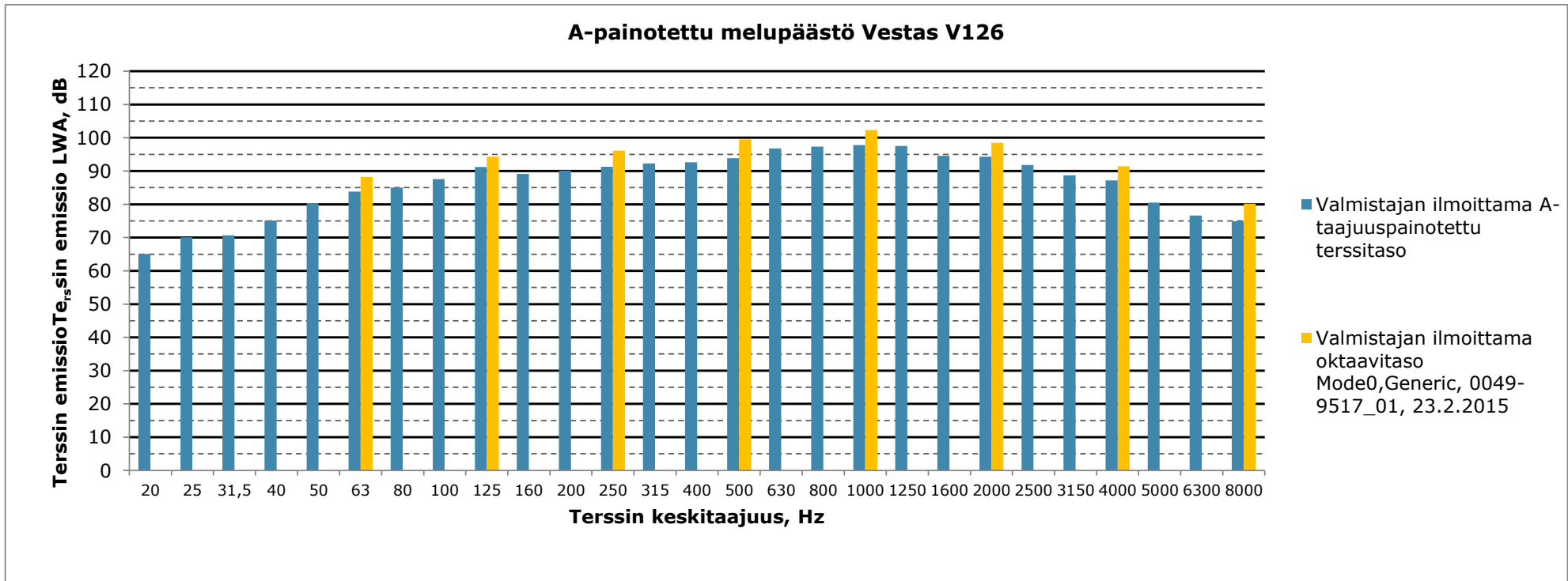
18.1.2021

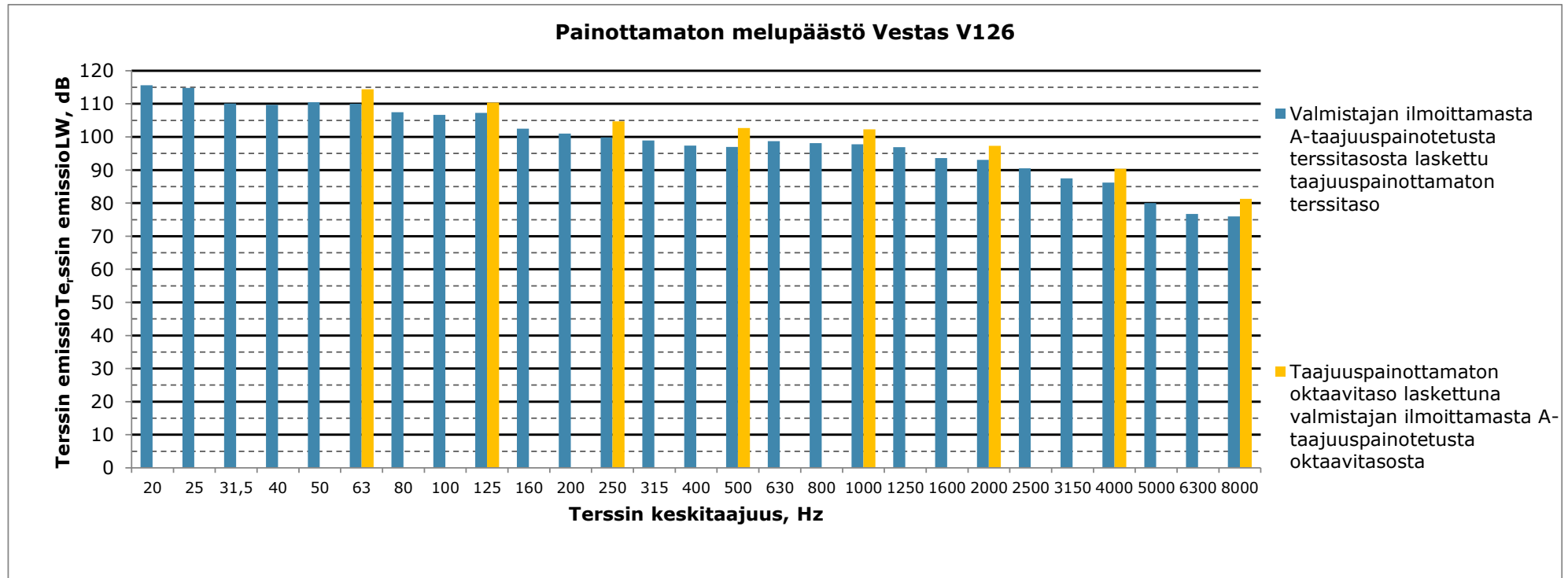
Liite 2

Liite 2: Kivasinkankaan tuulivoimahanke - Matalataajuisen melun rakennuskohtaiset arvot

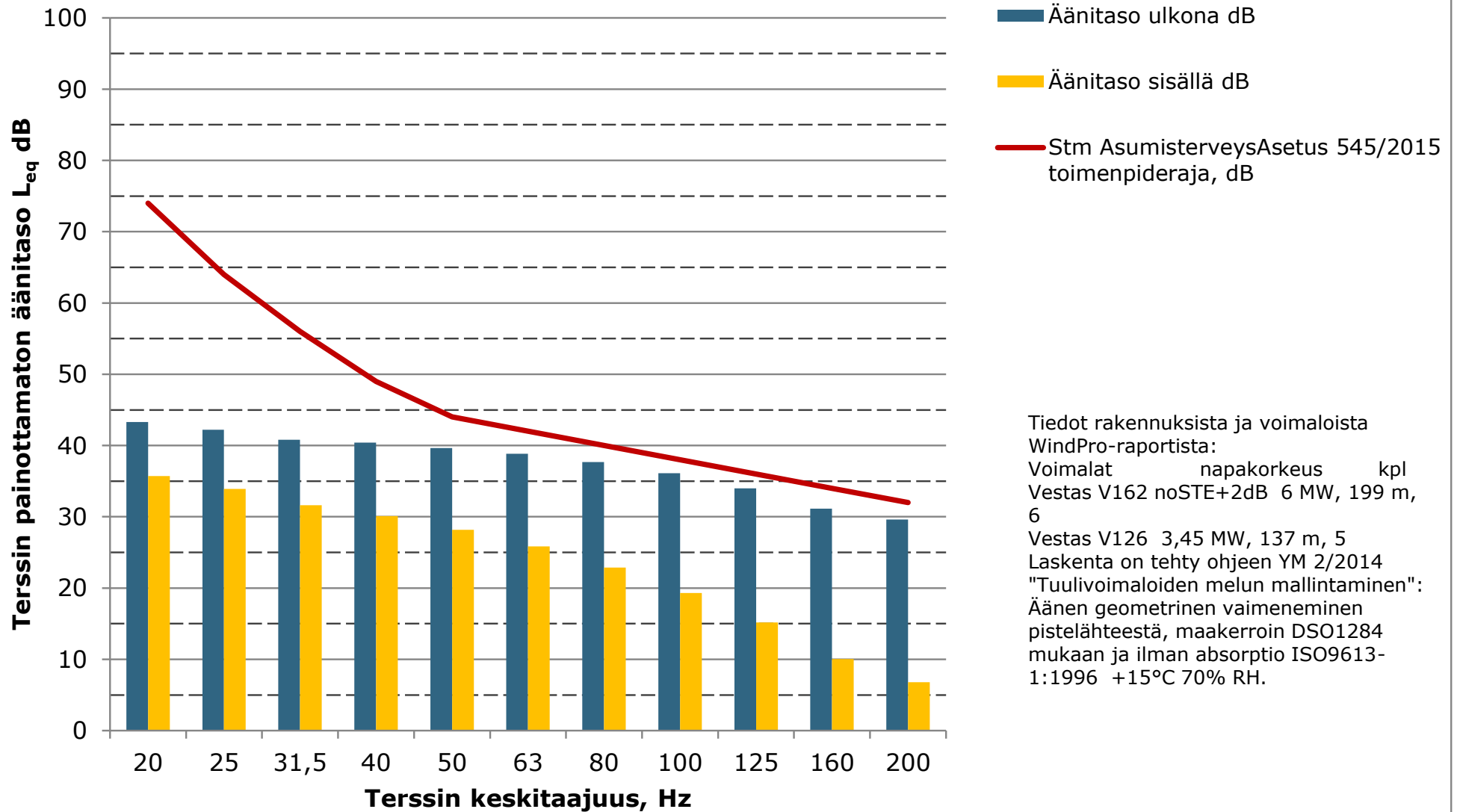




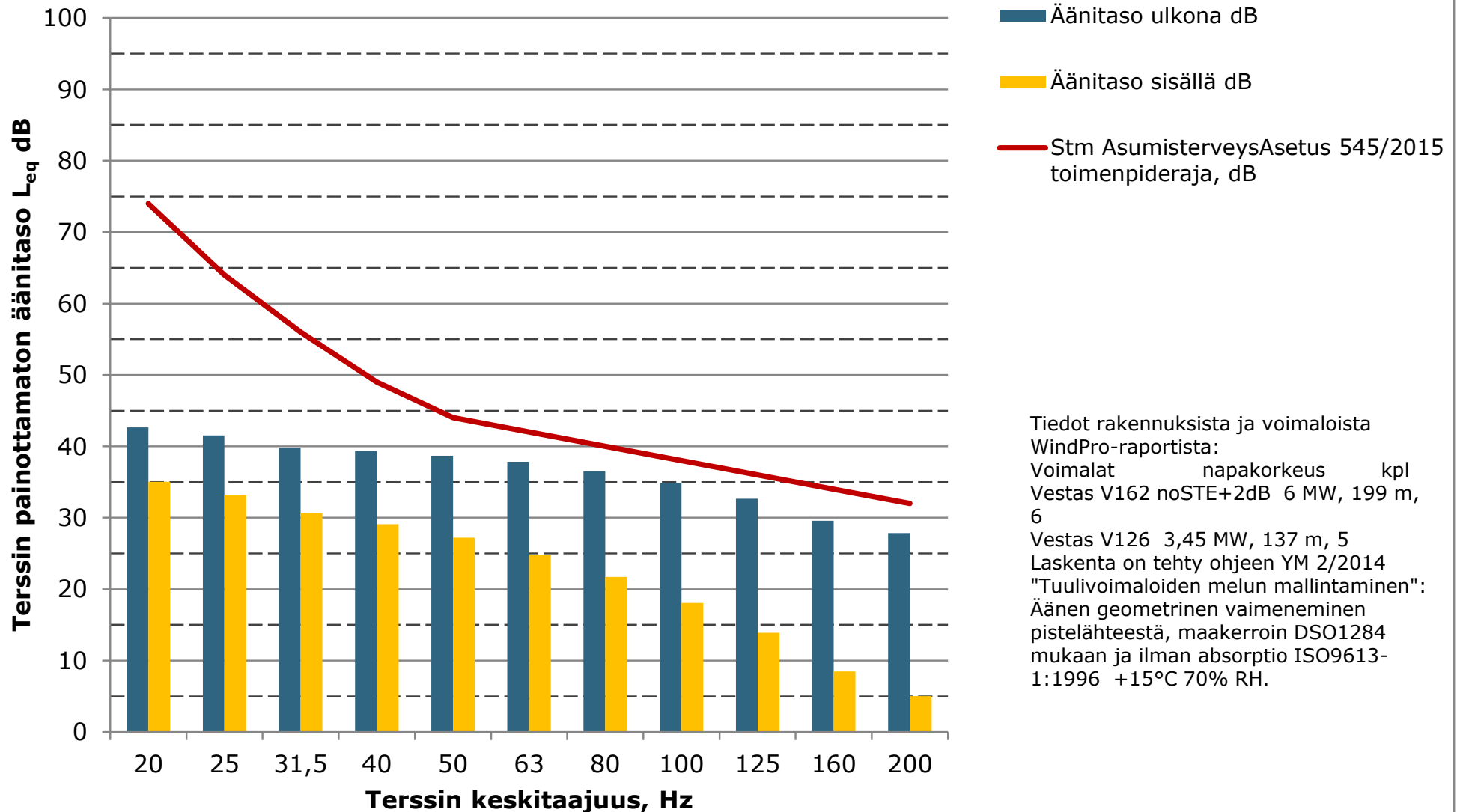


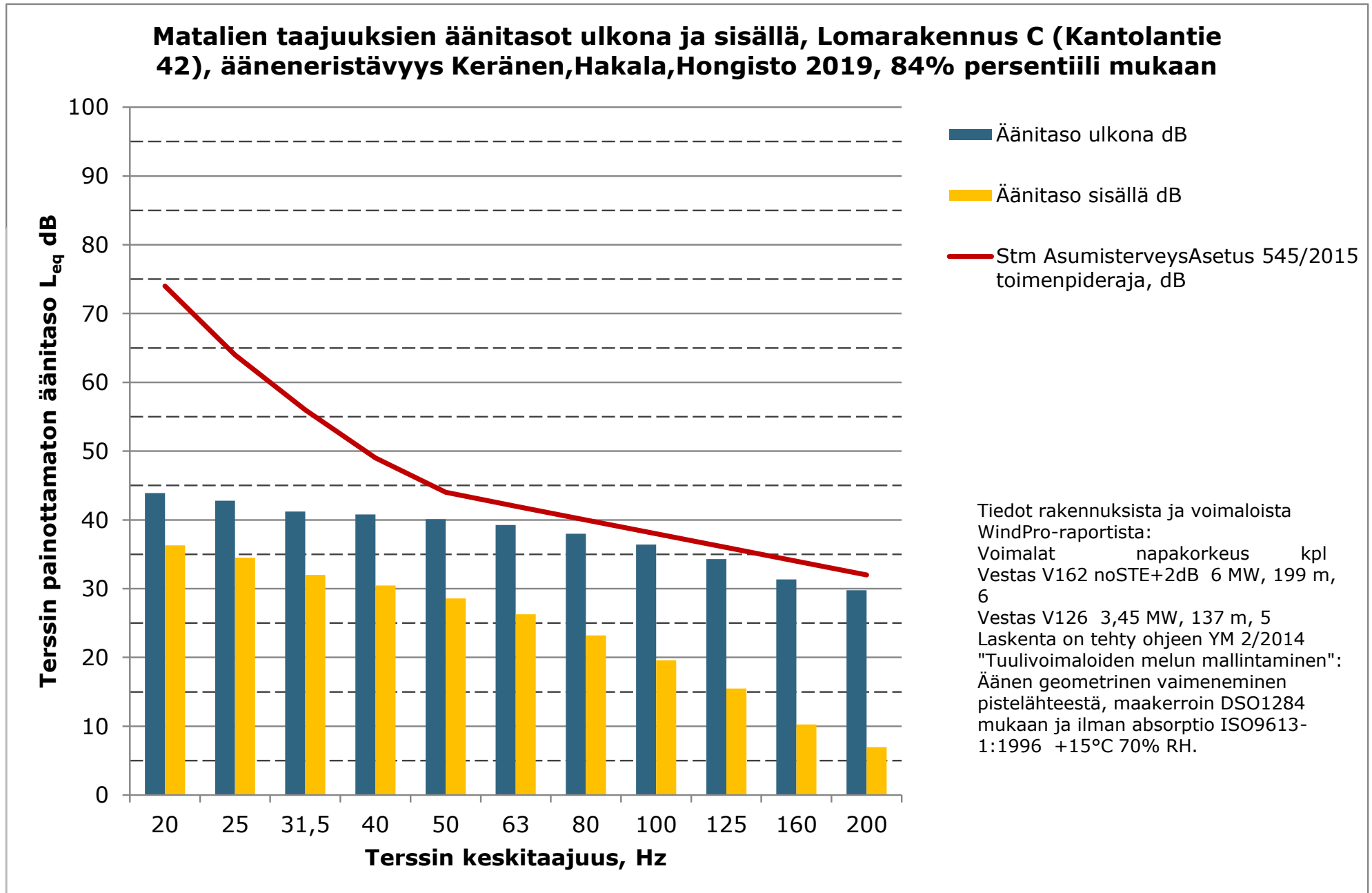


Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus A (Kantolantie 285), ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persenttiili mukaan

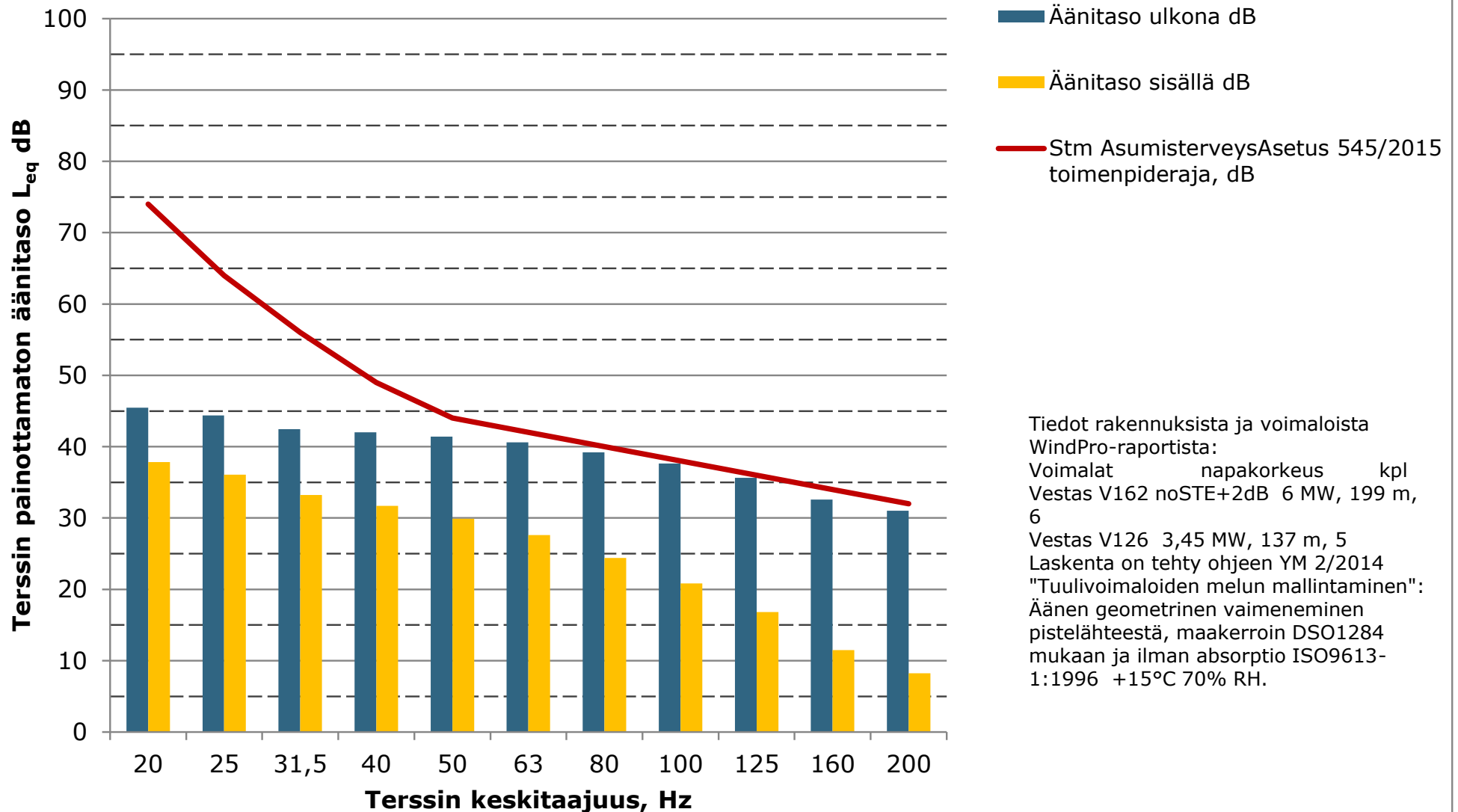


Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus B (Kantolantie 142), ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persenttiili mukaan

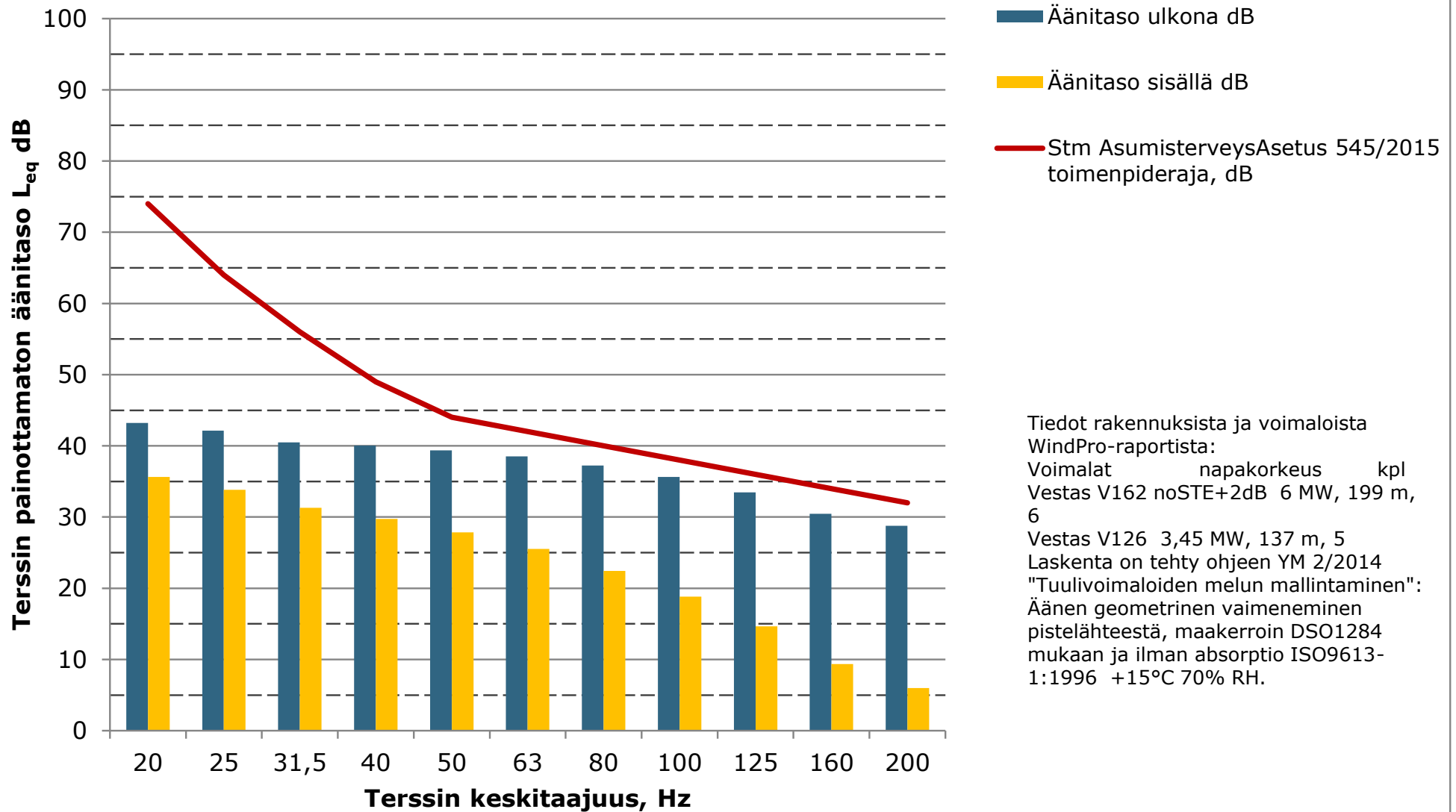




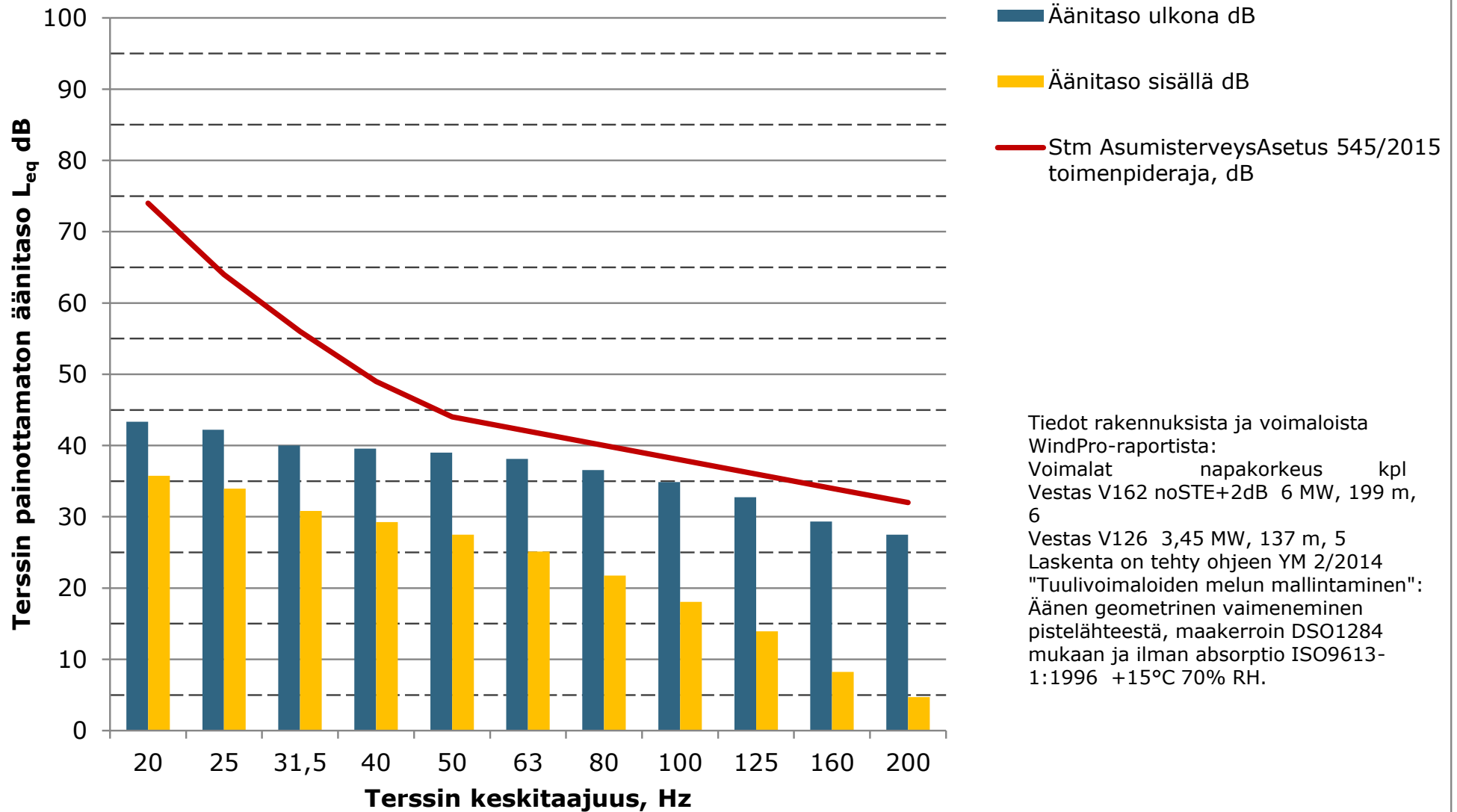
**Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus D
(Onkamonylänitie 280), ääneneristävyys Keränen, Hakala, Hongisto 2019,
84% persentiili mukaan**



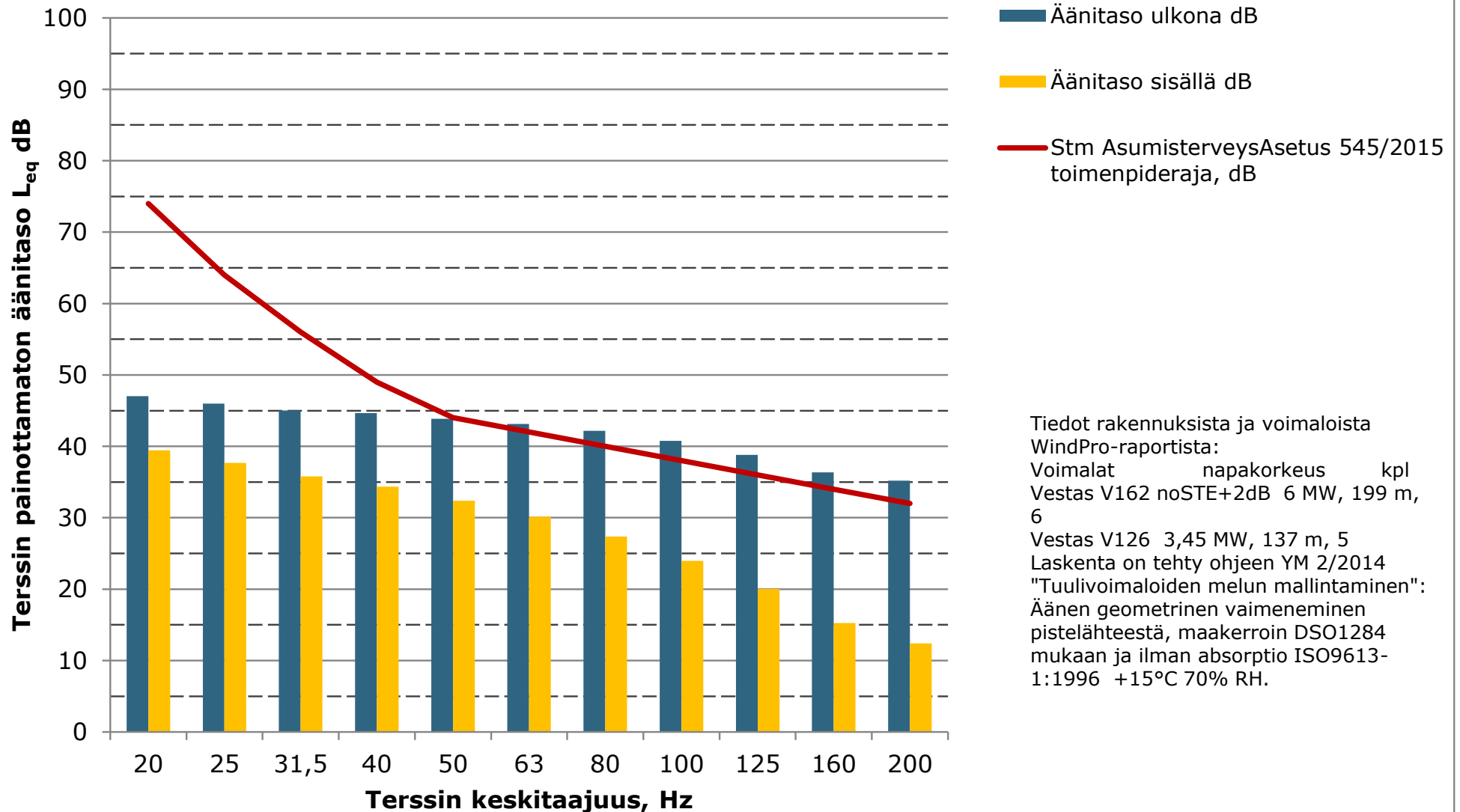
**Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus E
(Kaunislammentie 153), ääneneristävyys Keränen, Hakala, Hongisto 2019, 84%
persentiili mukaan**



**Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus F
(Meriänjärvi), ääneneristävyys Keränen, Hakala, Hongisto 2019, 84%
persentiili mukaan**



**Matalien taajuuksien äänitasot ulkona ja sisällä, Liikerakennus G
(Impivaarantie kämppä), ääneneristävyys Keränen, Hakala, Hongisto 2019,
84% persentiili mukaan**



Tiedot rakennuksista ja voimaloista
WindPro-raportista:
Voimalat napakorkeus kpl
Vestas V162 noSTE+2dB 6 MW, 199 m,
6
Vestas V126 3,45 MW, 137 m, 5
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.

18.1.2021

Liite 3

Liite 3: Kovasinkankaan tuulivoimahanke - Varjostusmallinnusten tulokset "real case, no forest"

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, II

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Main Result

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207
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

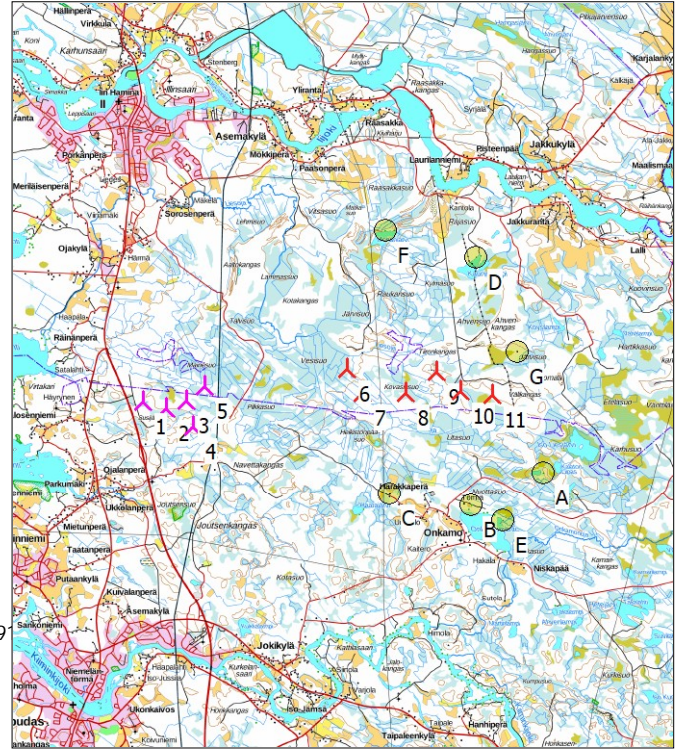
Sunshine probability S (Average daily sunshine hours) [LULEA]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational hours are calculated from WTGs in calculation and wind distribution:
Default Meteo data description (2)

Operational time
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
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_Kovasinkangas_2019
Obstacles used in calculation
Eye height for map: 2,0 m
Grid resolution: 10,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:200 000
New WTG
Shadow receptor

WTGs

	East	North	Z	Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.	Type-generator				Calculation distance [m]	RPM [RPM]
			[m]									
1	424 583	7 237 533	16,1	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
2	425 215	7 237 368	20,0	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
3	425 739	7 237 570	22,5	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
4	425 926	7 236 878	21,5	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
5	426 209	7 237 939	25,0	VESTAS V126-3.45 LTq 345...	Yes	VESTAS	V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
6	429 984	7 238 403	28,3	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
7	430 394	7 237 760	31,7	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
8	431 537	7 237 767	35,0	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
9	432 336	7 238 334	42,4	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
10	432 986	7 237 817	40,0	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
11	433 822	7 237 725	38,7	VESTAS V162-6.0 HH199 60...	Yes	VESTAS	V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	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	Lomarakennus A (Kantolantie 285)	435 168	7 235 667	40,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Lomarakennus C (Kantolantie 42)	433 269	7 234 801	35,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Asuinrakennus D (Onkamonkyläntie 280)	431 108	7 235 103	32,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Lomarakennus E (Kaunislammentie 153)	433 395	7 241 348	37,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus B (Kantolantie 142)	434 099	7 234 395	35,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Lomarakennus F (Merijärvi)	430 991	7 242 055	30,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Liikerakennus G (Impivaarantie kämppä)	434 473	7 238 869	37,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, li

Licensed user:
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Osmontie 34, PO Box 950
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+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Main Result

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours per year	[h/year]
A	Lomarakennus A (Kantolantie 285)	0:00	
B	Lomarakennus C (Kantolantie 42)	0:00	
C	Asuinrakennus D (Onkamonkyläntie 280)	0:00	
D	Lomarakennus E (Kaunislammentie 153)	0:00	
E	Lomarakennus B (Kantolantie 142)	0:00	
F	Lomarakennus F (Merijärvi)	0:00	
G	Liikerakennus G (Impivaarantie kämppä)	4:41	

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

No.	Name						Worst case	Expected
							[h/year]	[h/year]
1	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(13)	0:00	0:00			
2	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(14)	0:00	0:00			
3	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(15)	0:00	0:00			
4	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(16)	0:00	0:00			
5	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(17)	0:00	0:00			
6	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(29)	0:00	0:00			
7	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(30)	0:00	0:00			
8	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(31)	0:00	0:00			
9	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(32)	0:00	0:00			
10	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(33)	7:52	1:31			
11	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(34)	16:55	3:09			

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.

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_2021020Shadow receptor: A - Lomarakennus A (Kantolantie 285)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.30	09.11	07.32	06.38	04.46	02.51	02.24	04.09	05.53	07.25	08.05	09.49
	14.13	15.54	17.30	20.09	21.48	23.40	00.20	22.37	20.41	18.50	15.57	14.24
2	10.29	09.07	07.29	06.34	04.42	02.47	02.27	04.13	05.56	07.28	08.08	09.52
	14.15	15.57	17.34	20.12	21.51	23.44	00.17	22.33	20.38	18.46	15.54	14.22
3	10.28	09.04	07.25	06.30	04.38	02.44	02.30	04.16	05.59	07.31	08.12	09.55
	14.17	16.01	17.37	20.15	21.55	23.48	00.15	22.29	20.34	18.42	15.50	14.19
4	10.26	09.00	07.21	06.26	04.34	02.41	02.33	04.20	06.03	07.34	08.15	09.58
	14.20	16.05	17.40	20.18	21.58	23.51	00.12	22.26	20.30	18.38	15.47	14.17
5	10.24	08.57	07.18	06.23	04.31	02.38	02.36	04.24	06.06	07.37	08.19	10.01
	14.22	16.08	17.44	20.22	22.02	23.55	00.09	22.22	20.26	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.40	04.27	06.09	07.40	08.22	10.04
	14.25	16.12	17.47	20.25	22.05	23.58	00.06	22.18	20.23	18.31	15.40	14.13
7	10.21	08.50	07.10	06.15	04.23	02.32	02.43	04.31	06.12	07.43	08.26	10.07
	14.28	16.15	17.50	20.28	22.09	00.01	00.03	22.15	20.19	18.27	15.37	14.11
8	10.19	08.47	07.07	06.11	04.20	02.29	02.46	04.34	06.15	07.47	08.29	10.10
	14.31	16.19	17.53	20.31	22.12	00.05	00.00	22.11	20.15	18.24	15.33	14.09
9	10.17	08.43	07.03	06.08	04.16	02.26	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.22	17.56	20.34	22.16	00.08	23.57	22.07	20.11	18.20	15.30	14.07
10	10.14	08.40	06.59	06.04	04.12	02.24	02.53	04.41	06.21	07.53	08.36	10.15
	14.37	16.26	18.00	20.37	22.20	00.11	23.54	22.04	20.08	18.16	15.27	14.06
11	10.12	08.37	06.56	06.00	04.09	02.21	02.57	04.44	06.24	07.56	08.40	10.17
	14.40	16.29	18.03	20.41	22.23	00.14	23.51	22.00	20.04	18.13	15.23	14.04
12	10.10	08.33	06.52	05.56	04.05	02.19	03.00	04.48	06.27	07.59	08.43	10.20
	14.43	16.33	18.06	20.44	22.27	00.16	23.47	21.56	20.00	18.09	15.20	14.03
13	10.07	08.30	06.48	05.53	04.01	02.17	03.00	04.51	06.30	08.02	08.47	10.22
	14.47	16.36	18.09	20.47	22.30	00.19	23.44	21.52	19.56	18.05	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.15	03.04	04.55	06.33	08.05	08.50	10.24
	14.50	16.40	18.12	20.50	22.34	00.22	23.41	21.49	19.53	18.02	15.14	14.01
15	10.02	08.22	06.41	05.45	03.54	02.13	03.08	04.58	06.36	08.09	08.54	10.26
	14.53	16.43	18.15	20.54	22.38	00.24	23.37	21.45	19.49	17.58	15.10	14.00
16	09.59	08.19	06.37	05.41	03.50	02.11	03.11	05.01	06.39	08.12	08.57	10.27
	14.57	16.47	18.19	20.57	22.41	00.26	23.34	21.41	19.45	17.54	15.07	13.59
17	09.57	08.15	06.33	05.38	03.47	02.10	03.15	05.05	06.42	08.15	09.01	10.29
	15.00	16.50	18.22	21.00	22.45	00.28	23.30	21.37	19.42	17.51	15.04	13.59
18	09.54	08.12	06.30	05.34	03.43	02.09	03.18	05.08	06.45	08.18	09.05	10.30
	15.04	16.54	18.25	21.04	22.49	00.29	23.27	21.34	19.38	17.47	15.01	13.58
19	09.51	08.08	06.26	05.30	03.39	02.08	03.22	05.11	06.48	08.21	09.08	10.31
	15.07	16.57	18.28	21.07	22.53	00.30	23.24	21.30	19.34	17.44	14.58	13.58
20	09.48	08.05	06.22	05.27	03.36	02.08	03.26	05.15	06.51	08.25	09.12	10.33
	15.11	17.00	18.31	21.10	22.56	00.31	23.20	21.26	19.30	17.40	14.55	13.58
21	09.45	08.01	06.19	05.23	03.32	02.08	03.29	05.18	06.54	08.28	09.15	10.33
	15.14	17.04	18.34	21.13	23.00	00.31	23.16	21.23	19.27	17.36	14.52	13.58
22	09.42	07.58	06.15	05.19	03.29	02.08	03.33	05.21	06.57	08.31	09.19	10.34
	15.18	17.07	18.37	21.17	23.04	00.32	23.13	21.19	19.23	17.33	14.49	13.59
23	09.39	07.54	06.11	05.15	03.25	02.09	03.37	05.24	07.01	08.35	09.22	10.34
	15.21	17.11	18.41	21.20	23.07	00.31	23.09	21.15	19.19	17.29	14.46	13.59
24	09.36	07.50	06.07	05.12	03.22	02.10	03.40	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.11	00.31	23.06	21.11	19.15	17.26	14.43	14.00
25	09.33	07.47	06.04	05.08	03.18	02.11	03.44	05.31	07.07	07.41	09.29	10.35
	15.28	17.17	18.47	21.27	23.15	00.30	23.02	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.04	03.14	02.13	03.48	05.34	07.10	07.45	09.33	10.35
	15.32	17.21	18.50	21.30	23.19	00.29	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.39	05.56	05.00	03.11	02.15	03.51	05.37	07.13	07.48	09.36	10.34
	15.36	17.24	18.53	21.34	23.22	00.27	22.55	21.00	19.04	16.15	14.34	14.03
28	09.24	07.36	05.52	04.57	03.08	02.17	03.55	05.41	07.16	07.51	09.39	10.34
	15.39	17.27	18.56	21.37	23.26	00.26	22.51	20.56	19.01	16.11	14.32	14.05
29	09.20		06.49	04.53	03.04	02.19	03.59	05.44	07.19	07.55	09.43	10.33
	15.43		19.59	21.41	23.30	00.24	22.48	20.53	18.57	16.08	14.29	14.06
30	09.17		06.45	04.49	03.01	02.22	04.02	05.47	07.22	07.58	09.46	10.33
	15.46		20.03	21.44	23.33	00.22	22.44	20.49	18.53	16.04	14.26	14.08
31	09.14		06.41		02.54		04.06	05.50		08.01		10.32
	15.50		20.06		23.37		22.40	20.45		16.01		14.10
Potential sun hours	156	232	362	456	584	657	630	517	395	301	187	116
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)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_2021020Shadow receptor: B - Lomarakennus C (Kantolantie 42)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.30	09.11	07.32	06.38	04.46	02.51	02.25	04.10	05.53	07.25	08.05	09.49
	14.13	15.54	17.31	20.09	21.48	23.40	00.19	22.37	20.42	18.50	15.58	14.24
2	10.29	09.07	07.29	06.34	04.42	02.48	02.28	04.13	05.56	07.28	08.08	09.52
	14.15	15.58	17.34	20.12	21.51	23.44	00.17	22.33	20.38	18.46	15.54	14.22
3	10.28	09.04	07.25	06.30	04.38	02.45	02.31	04.17	06.00	07.31	08.12	09.55
	14.18	16.01	17.37	20.15	21.55	23.48	00.14	22.29	20.34	18.42	15.51	14.20
4	10.26	09.01	07.21	06.27	04.35	02.41	02.34	04.20	06.03	07.34	08.15	09.58
	14.20	16.05	17.40	20.18	21.58	23.51	00.12	22.26	20.30	18.39	15.47	14.17
5	10.24	08.57	07.18	06.23	04.31	02.38	02.37	04.24	06.06	07.37	08.19	10.01
	14.23	16.08	17.44	20.22	22.02	23.55	00.09	22.22	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.40	04.27	06.09	07.40	08.22	10.04
	14.25	16.12	17.47	20.25	22.05	23.58	00.06	22.18	20.23	18.31	15.40	14.13
7	10.21	08.50	07.10	06.15	04.24	02.32	02.43	04.31	06.12	07.44	08.26	10.07
	14.28	16.15	17.50	20.28	22.09	00.01	00.03	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.30	02.47	04.34	06.15	07.47	08.29	10.10
	14.31	16.19	17.53	20.31	22.12	00.04	00.00	22.11	20.15	18.24	15.34	14.09
9	10.17	08.44	07.03	06.08	04.16	02.27	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.23	17.57	20.34	22.16	00.08	23.57	22.07	20.12	18.20	15.30	14.08
10	10.14	08.40	06.59	06.04	04.12	02.24	02.54	04.41	06.21	07.53	08.36	10.15
	14.37	16.26	18.00	20.38	22.20	00.11	23.54	22.04	20.08	18.17	15.27	14.06
11	10.12	08.37	06.56	06.00	04.09	02.22	02.57	04.45	06.24	07.56	08.40	10.17
	14.40	16.30	18.03	20.41	22.23	00.14	23.51	22.00	20.04	18.13	15.24	14.05
12	10.10	08.33	06.52	05.57	04.05	02.19	03.01	04.48	06.27	07.59	08.43	10.20
	14.44	16.33	18.06	20.44	22.27	00.16	23.47	21.56	20.00	18.09	15.20	14.03
13	10.07	08.30	06.48	05.53	04.01	02.17	03.01	04.51	06.30	08.02	08.47	10.22
	14.47	16.37	18.09	20.47	22.31	00.19	23.44	21.52	19.57	18.06	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.15	03.04	04.55	06.33	08.06	08.50	10.24
	14.50	16.40	18.12	20.51	22.34	00.21	23.41	21.49	19.53	18.02	15.14	14.01
15	10.02	08.23	06.41	05.45	03.54	02.13	03.08	04.58	06.36	08.09	08.54	10.26
	14.53	16.44	18.16	20.54	22.38	00.24	23.37	21.45	19.49	17.58	15.11	14.00
16	09.59	08.19	06.37	05.42	03.51	02.12	03.11	05.02	06.39	08.12	08.58	10.27
	14.57	16.47	18.19	20.57	22.42	00.26	23.34	21.41	19.45	17.55	15.07	13.59
17	09.57	08.16	06.34	05.38	03.47	02.11	03.15	05.05	06.43	08.15	09.01	10.29
	15.00	16.50	18.22	21.00	22.45	00.27	23.30	21.38	19.42	17.51	15.04	13.59
18	09.54	08.12	06.30	05.34	03.43	02.10	03.19	05.08	06.46	08.18	09.05	10.30
	15.04	16.54	18.25	21.04	22.49	00.29	23.27	21.34	19.38	17.47	15.01	13.58
19	09.51	08.08	06.26	05.30	03.40	02.09	03.22	05.12	06.49	08.22	09.08	10.31
	15.07	16.57	18.28	21.07	22.53	00.30	23.24	21.30	19.34	17.44	14.58	13.58
20	09.48	08.05	06.22	05.27	03.36	02.09	03.26	05.15	06.52	08.25	09.12	10.32
	15.11	17.01	18.31	21.10	22.56	00.31	23.20	21.26	19.31	17.40	14.55	13.58
21	09.45	08.01	06.19	05.23	03.32	02.09	03.30	05.18	06.55	08.28	09.15	10.33
	15.14	17.04	18.34	21.14	23.00	00.31	23.16	21.23	19.27	17.37	14.52	13.58
22	09.42	07.58	06.15	05.19	03.29	02.09	03.33	05.21	06.58	08.31	09.19	10.34
	15.18	17.07	18.38	21.17	23.04	00.31	23.13	21.19	19.23	17.33	14.49	13.59
23	09.39	07.54	06.11	05.16	03.25	02.10	03.37	05.25	07.01	08.35	09.22	10.34
	15.21	17.11	18.41	21.20	23.07	00.31	23.09	21.15	19.19	17.29	14.46	13.59
24	09.36	07.50	06.08	05.12	03.22	02.11	03.41	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.11	00.31	23.06	21.11	19.16	17.26	14.43	14.00
25	09.33	07.47	06.04	05.08	03.18	02.12	03.44	05.31	07.07	07.41	09.29	10.35
	15.29	17.17	18.47	21.27	23.15	00.30	23.02	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.04	03.15	02.13	03.48	05.34	07.10	07.45	09.33	10.35
	15.32	17.21	18.50	21.30	23.19	00.29	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.56	05.01	03.11	02.15	03.52	05.38	07.13	07.48	09.36	10.34
	15.36	17.24	18.53	21.34	23.22	00.27	22.55	21.00	19.05	16.15	14.35	14.03
28	09.24	07.36	05.53	04.57	03.08	02.17	03.55	05.41	07.16	07.51	09.39	10.34
	15.39	17.27	18.56	21.37	23.26	00.26	22.51	20.56	19.01	16.12	14.32	14.05
29	09.20		06.49	04.53	03.04	02.20	03.59	05.44	07.19	07.55	09.43	10.33
	15.43		20.00	21.41	23.30	00.24	22.48	20.53	18.57	16.08	14.29	14.07
30	09.17		06.45	04.49	03.01	02.22	04.02	05.47	07.22	07.58	09.46	10.33
	15.47		20.03	21.44	23.33	00.22	22.44	20.49	18.53	16.05	14.27	14.08
31	09.14		06.41		02.54		04.06	05.50		08.02		10.32
	15.50		20.06		23.37		22.40	20.45		16.01		14.10
Potential sun hours	156	232	362	456	584	657	630	517	395	301	187	116
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)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_2021207Shadow receptor: C - Asuinrakennus D (Onkamonylantie 280)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.25	04.10	05.54	07.25	08.05	09.49
	14.13	15.54	17.31	20.09	21.48	23.41	00.20	22.37	20.42	18.50	15.58	14.24
2	10.29	09.07	07.29	06.34	04.42	02.48	02.28	04.13	05.57	07.28	08.09	09.53
	14.15	15.58	17.34	20.12	21.51	23.44	00.17	22.33	20.38	18.46	15.54	14.22
3	10.28	09.04	07.25	06.30	04.38	02.45	02.31	04.17	06.00	07.31	08.12	09.56
	14.18	16.01	17.37	20.15	21.55	23.48	00.15	22.30	20.34	18.42	15.51	14.20
4	10.26	09.01	07.22	06.27	04.35	02.42	02.34	04.20	06.03	07.34	08.16	09.59
	14.20	16.05	17.41	20.19	21.58	23.51	00.12	22.26	20.30	18.39	15.47	14.17
5	10.25	08.57	07.18	06.23	04.31	02.39	02.37	04.24	06.06	07.38	08.19	10.02
	14.23	16.09	17.44	20.22	22.02	23.55	00.09	22.22	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.36	02.40	04.27	06.09	07.41	08.22	10.05
	14.26	16.12	17.47	20.25	22.06	23.58	00.06	22.19	20.23	18.31	15.41	14.13
7	10.21	08.51	07.11	06.16	04.24	02.33	02.43	04.31	06.12	07.44	08.26	10.07
	14.28	16.16	17.50	20.28	22.09	00.01	00.03	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.30	02.47	04.34	06.15	07.47	08.29	10.10
	14.31	16.19	17.54	20.31	22.13	00.05	00.00	22.11	20.16	18.24	15.34	14.09
9	10.17	08.44	07.03	06.08	04.16	02.27	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.23	17.57	20.35	22.16	00.08	23.57	22.08	20.12	18.20	15.30	14.08
10	10.15	08.40	07.00	06.04	04.13	02.24	02.54	04.41	06.21	07.53	08.37	10.15
	14.37	16.26	18.00	20.38	22.20	00.11	23.54	22.04	20.08	18.17	15.27	14.06
11	10.12	08.37	06.56	06.01	04.09	02.22	02.57	04.45	06.24	07.56	08.40	10.18
	14.41	16.30	18.03	20.41	22.23	00.14	23.51	22.00	20.04	18.13	15.24	14.05
12	10.10	08.33	06.52	05.57	04.05	02.20	03.01	04.48	06.28	07.59	08.44	10.20
	14.44	16.33	18.06	20.44	22.27	00.17	23.48	21.56	20.01	18.09	15.20	14.03
13	10.07	08.30	06.49	05.53	04.02	02.17	03.01	04.52	06.31	08.03	08.47	10.22
	14.47	16.37	18.09	20.48	22.31	00.19	23.44	21.53	19.57	18.06	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.15	03.04	04.55	06.34	08.06	08.51	10.24
	14.50	16.40	18.13	20.51	22.34	00.22	23.41	21.49	19.53	18.02	15.14	14.01
15	10.02	08.23	06.41	05.46	03.54	02.14	03.08	04.58	06.37	08.09	08.54	10.26
	14.54	16.44	18.16	20.54	22.38	00.24	23.38	21.45	19.49	17.58	15.11	14.00
16	10.00	08.19	06.37	05.42	03.51	02.12	03.12	05.02	06.40	08.12	08.58	10.28
	14.57	16.47	18.19	20.57	22.42	00.26	23.34	21.41	19.46	17.55	15.08	14.00
17	09.57	08.16	06.34	05.38	03.47	02.11	03.15	05.05	06.43	08.15	09.01	10.29
	15.00	16.51	18.22	21.01	22.45	00.28	23.31	21.38	19.42	17.51	15.04	13.59
18	09.54	08.12	06.30	05.34	03.43	02.10	03.19	05.08	06.46	08.19	09.05	10.31
	15.04	16.54	18.25	21.04	22.49	00.29	23.27	21.34	19.38	17.48	15.01	13.59
19	09.51	08.09	06.26	05.31	03.40	02.09	03.23	05.12	06.49	08.22	09.08	10.32
	15.07	16.57	18.28	21.07	22.53	00.30	23.24	21.30	19.34	17.44	14.58	13.58
20	09.48	08.05	06.23	05.27	03.36	02.09	03.26	05.15	06.52	08.25	09.12	10.33
	15.11	17.01	18.32	21.10	22.56	00.31	23.20	21.27	19.31	17.40	14.55	13.58
21	09.45	08.01	06.19	05.23	03.33	02.09	03.30	05.18	06.55	08.28	09.15	10.34
	15.15	17.04	18.35	21.14	23.00	00.31	23.17	21.23	19.27	17.37	14.52	13.59
22	09.42	07.58	06.15	05.19	03.29	02.09	03.34	05.22	06.58	08.32	09.19	10.34
	15.18	17.08	18.38	21.17	23.04	00.32	23.13	21.19	19.23	17.33	14.49	13.59
23	09.39	07.54	06.11	05.16	03.26	02.10	03.37	05.25	07.01	08.35	09.22	10.35
	15.22	17.11	18.41	21.21	23.08	00.31	23.10	21.15	19.20	17.30	14.46	14.00
24	09.36	07.51	06.08	05.12	03.22	02.11	03.41	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.11	00.31	23.06	21.12	19.16	17.26	14.43	14.00
25	09.33	07.47	06.04	05.08	03.18	02.12	03.44	05.31	07.07	07.41	09.29	10.35
	15.29	17.18	18.47	21.27	23.15	00.30	23.02	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.05	03.15	02.13	03.48	05.34	07.10	07.45	09.33	10.35
	15.32	17.21	18.50	21.31	23.19	00.29	22.59	21.04	19.08	16.19	14.38	14.02
27	09.27	07.40	05.57	05.01	03.11	02.15	03.52	05.38	07.13	07.48	09.36	10.35
	15.36	17.24	18.53	21.34	23.22	00.28	22.55	21.00	19.05	16.15	14.35	14.04
28	09.24	07.36	05.53	04.57	03.08	02.17	03.55	05.41	07.16	07.52	09.40	10.34
	15.40	17.28	18.57	21.38	23.26	00.26	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		06.49	04.53	03.05	02.20	03.59	05.44	07.19	07.55	09.43	10.34
	15.43		20.00	21.41	23.30	00.24	22.48	20.53	18.57	16.08	14.29	14.07
30	09.17		06.45	04.50	03.01	02.22	04.03	05.47	07.22	07.58	09.46	10.33
	15.47		20.03	21.44	23.33	00.22	22.44	20.49	18.54	16.05	14.27	14.08
31	09.14		06.42		02.54		04.06	05.50		08.02		10.32
	15.51		20.06		23.37		22.41	20.45		16.01		14.10
Potential sun hours	156	232	362	456	584	657	630	517	395	301	187	116
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)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20210207Shadow receptor: D - Lomarakennus E (Kaunislammentie 153)
Sunshine probability S (Average daily sunshine hours) [LULEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.32	09.11	07.33	06.38	04.45	02.50	02.23	04.09	05.53	07.25	08.05	09.50
	14.12	15.53	17.31	20.09	21.48	23.42	00.22	22.37	20.42	18.50	15.57	14.23
2	10.30	09.08	07.29	06.34	04.42	02.46	02.25	04.12	05.56	07.28	08.09	09.53
	14.14	15.57	17.34	20.12	21.52	23.46	00.19	22.34	20.38	18.46	15.54	14.21
3	10.29	09.04	07.25	06.30	04.38	02.43	02.28	04.16	05.59	07.31	08.12	09.56
	14.16	16.01	17.37	20.15	21.55	23.49	00.17	22.30	20.34	18.42	15.50	14.19
4	10.27	09.01	07.22	06.26	04.34	02.40	02.32	04.20	06.03	07.34	08.16	09.59
	14.19	16.04	17.40	20.19	21.59	23.53	00.14	22.26	20.30	18.39	15.47	14.16
5	10.25	08.58	07.18	06.23	04.30	02.37	02.35	04.23	06.06	07.37	08.19	10.02
	14.22	16.08	17.44	20.22	22.02	23.56	00.11	22.23	20.27	18.35	15.43	14.14
6	10.24	08.54	07.14	06.19	04.27	02.34	02.38	04.27	06.09	07.41	08.23	10.05
	14.24	16.11	17.47	20.25	22.06	00.00	00.08	22.19	20.23	18.31	15.40	14.12
7	10.22	08.51	07.11	06.15	04.23	02.31	02.42	04.30	06.12	07.44	08.26	10.08
	14.27	16.15	17.50	20.28	22.09	00.03	00.05	22.15	20.19	18.27	15.37	14.10
8	10.20	08.47	07.07	06.11	04.19	02.28	02.45	04.34	06.15	07.47	08.30	10.11
	14.30	16.19	17.53	20.31	22.13	00.06	00.02	22.12	20.15	18.24	15.33	14.08
9	10.18	08.44	07.03	06.08	04.16	02.25	02.49	04.37	06.18	07.50	08.33	10.14
	14.33	16.22	17.56	20.35	22.17	00.10	23.59	22.08	20.12	18.20	15.30	14.06
10	10.15	08.40	07.00	06.04	04.12	02.22	02.52	04.41	06.21	07.53	08.37	10.16
	14.36	16.26	18.00	20.38	22.20	00.13	23.55	22.04	20.08	18.16	15.26	14.05
11	10.13	08.37	06.56	06.00	04.08	02.20	02.56	04.44	06.24	07.56	08.40	10.19
	14.39	16.29	18.03	20.41	22.24	00.16	23.52	22.00	20.04	18.13	15.23	14.03
12	10.11	08.33	06.52	05.56	04.04	02.17	02.59	04.48	06.27	07.59	08.44	10.21
	14.43	16.33	18.06	20.44	22.28	00.19	23.49	21.57	20.00	18.09	15.20	14.02
13	10.08	08.30	06.48	05.53	04.01	02.15	03.03	04.51	06.30	08.03	08.47	10.23
	14.46	16.36	18.09	20.48	22.31	00.21	23.45	21.53	19.57	18.05	15.16	14.01
14	10.06	08.26	06.45	05.49	03.57	02.13	03.03	04.54	06.33	08.06	08.51	10.25
	14.49	16.40	18.12	20.51	22.35	00.24	23.42	21.49	19.53	18.02	15.13	14.00
15	10.03	08.23	06.41	05.45	03.53	02.11	03.07	04.58	06.36	08.09	08.55	10.27
	14.53	16.43	18.16	20.54	22.39	00.26	23.39	21.45	19.49	17.58	15.10	13.59
16	10.00	08.19	06.37	05.41	03.50	02.09	03.10	05.01	06.39	08.12	08.58	10.29
	14.56	16.47	18.19	20.57	22.42	00.28	23.35	21.42	19.46	17.54	15.07	13.58
17	09.57	08.16	06.34	05.38	03.46	02.08	03.14	05.04	06.42	08.15	09.02	10.30
	15.00	16.50	18.22	21.01	22.46	00.30	23.32	21.38	19.42	17.51	15.04	13.58
18	09.55	08.12	06.30	05.34	03.42	02.07	03.18	05.08	06.45	08.19	09.05	10.32
	15.03	16.54	18.25	21.04	22.50	00.32	23.28	21.34	19.38	17.47	15.00	13.57
19	09.52	08.09	06.26	05.30	03.39	02.06	03.21	05.11	06.49	08.22	09.09	10.33
	15.07	16.57	18.28	21.07	22.53	00.33	23.25	21.30	19.34	17.44	14.57	13.57
20	09.49	08.05	06.22	05.26	03.35	02.06	03.25	05.14	06.52	08.25	09.12	10.34
	15.10	17.00	18.31	21.11	22.57	00.34	23.21	21.27	19.31	17.40	14.54	13.57
21	09.46	08.02	06.19	05.23	03.32	02.06	03.29	05.18	06.55	08.28	09.16	10.35
	15.14	17.04	18.34	21.14	23.01	00.34	23.17	21.23	19.27	17.36	14.51	13.57
22	09.43	07.58	06.15	05.19	03.28	02.06	03.32	05.21	06.58	08.32	09.19	10.35
	15.17	17.07	18.38	21.17	23.05	00.34	23.14	21.19	19.23	17.33	14.48	13.58
23	09.40	07.54	06.11	05.15	03.24	02.07	03.36	05.24	07.01	08.35	09.23	10.36
	15.21	17.11	18.41	21.21	23.08	00.34	23.10	21.16	19.19	17.29	14.45	13.58
24	09.37	07.51	06.08	05.11	03.21	02.08	03.40	05.28	07.04	08.38	09.26	10.36
	15.24	17.14	18.44	21.24	23.12	00.33	23.07	21.12	19.16	17.26	14.42	13.59
25	09.34	07.47	06.04	05.08	03.17	02.09	03.43	05.31	07.07	07.42	09.30	10.36
	15.28	17.17	18.47	21.27	23.16	00.33	23.03	21.08	19.12	16.22	14.39	14.00
26	09.31	07.43	06.00	05.04	03.14	02.11	03.47	05.34	07.10	07.45	09.33	10.36
	15.32	17.21	18.50	21.31	23.20	00.31	22.59	21.04	19.08	16.18	14.37	14.01
27	09.27	07.40	05.56	05.00	03.10	02.13	03.51	05.37	07.13	07.48	09.37	10.36
	15.35	17.24	18.53	21.34	23.23	00.30	22.56	21.01	19.04	16.15	14.34	14.02
28	09.24	07.36	05.53	04.56	03.07	02.15	03.54	05.40	07.16	07.52	09.40	10.35
	15.39	17.27	18.56	21.38	23.27	00.28	22.52	20.57	19.01	16.11	14.31	14.04
29	09.21		06.49	04.53	03.03	02.17	03.58	05.44	07.19	07.55	09.44	10.35
	15.43		20.00	21.41	23.31	00.26	22.48	20.53	18.57	16.08	14.28	14.05
30	09.18		06.45	04.49	03.00	02.20	04.02	05.47	07.22	07.58	09.47	10.34
	15.46		20.03	21.45	23.35	00.24	22.45	20.49	18.53	16.04	14.26	14.07
31	09.14		06.41		02.53		04.05	05.50		08.02		10.33
	15.50		20.06		23.38		22.41	20.45		16.01		14.09
Potential sun hours	155	232	362	456	585	660	631	517	395	301	187	115
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)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Last time (hh:mm) with flicker	(WTG causing flicker last time)
	Minutes with flicker		

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_2021020Shadow receptor: E - Lomarakennus B (Kantolantie 142)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.30	09.10	07.32	06.38	04.46	02.51	02.25	04.10	05.53	07.25	08.05	09.49
	14.13	15.54	17.31	20.09	21.48	23.40	00.19	22.37	20.41	18.50	15.58	14.24
2	10.29	09.07	07.29	06.34	04.42	02.48	02.28	04.13	05.56	07.28	08.08	09.52
	14.15	15.58	17.34	20.12	21.51	23.44	00.17	22.33	20.38	18.46	15.54	14.22
3	10.27	09.04	07.25	06.30	04.38	02.45	02.31	04.17	06.00	07.31	08.12	09.55
	14.18	16.01	17.37	20.15	21.55	23.47	00.14	22.29	20.34	18.42	15.51	14.20
4	10.26	09.00	07.21	06.26	04.35	02.41	02.34	04.20	06.03	07.34	08.15	09.58
	14.20	16.05	17.40	20.18	21.58	23.51	00.12	22.26	20.30	18.39	15.47	14.17
5	10.24	08.57	07.18	06.23	04.31	02.38	02.37	04.24	06.06	07.37	08.19	10.01
	14.23	16.08	17.44	20.22	22.02	23.54	00.09	22.22	20.26	18.35	15.44	14.15
6	10.22	08.54	07.14	06.19	04.27	02.35	02.40	04.27	06.09	07.40	08.22	10.04
	14.25	16.12	17.47	20.25	22.05	23.58	00.06	22.18	20.23	18.31	15.40	14.13
7	10.21	08.50	07.10	06.15	04.23	02.32	02.43	04.31	06.12	07.43	08.26	10.07
	14.28	16.15	17.50	20.28	22.09	00.01	00.03	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.30	02.47	04.34	06.15	07.47	08.29	10.10
	14.31	16.19	17.53	20.31	22.12	00.04	00.00	22.11	20.15	18.24	15.34	14.09
9	10.16	08.43	07.03	06.08	04.16	02.27	02.50	04.38	06.18	07.50	08.33	10.12
	14.34	16.23	17.56	20.34	22.16	00.07	23.57	22.07	20.12	18.20	15.30	14.08
10	10.14	08.40	06.59	06.04	04.12	02.24	02.54	04.41	06.21	07.53	08.36	10.15
	14.37	16.26	18.00	20.38	22.20	00.10	23.54	22.03	20.08	18.16	15.27	14.06
11	10.12	08.37	06.56	06.00	04.09	02.22	02.57	04.45	06.24	07.56	08.40	10.17
	14.40	16.30	18.03	20.41	22.23	00.13	23.50	22.00	20.04	18.13	15.24	14.05
12	10.10	08.33	06.52	05.57	04.05	02.19	03.01	04.48	06.27	07.59	08.43	10.20
	14.44	16.33	18.06	20.44	22.27	00.16	23.47	21.56	20.00	18.09	15.20	14.03
13	10.07	08.30	06.48	05.53	04.01	02.17	03.01	04.51	06.30	08.02	08.47	10.22
	14.47	16.37	18.09	20.47	22.30	00.19	23.44	21.52	19.57	18.06	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.15	03.04	04.55	06.33	08.05	08.50	10.24
	14.50	16.40	18.12	20.50	22.34	00.21	23.41	21.49	19.53	18.02	15.14	14.01
15	10.02	08.23	06.41	05.45	03.54	02.14	03.08	04.58	06.36	08.09	08.54	10.26
	14.53	16.44	18.16	20.54	22.38	00.23	23.37	21.45	19.49	17.58	15.11	14.00
16	09.59	08.19	06.37	05.42	03.50	02.12	03.11	05.02	06.39	08.12	08.57	10.27
	14.57	16.47	18.19	20.57	22.41	00.25	23.34	21.41	19.45	17.55	15.07	13.59
17	09.57	08.15	06.33	05.38	03.47	02.11	03.15	05.05	06.42	08.15	09.01	10.29
	15.00	16.50	18.22	21.00	22.45	00.27	23.30	21.37	19.42	17.51	15.04	13.59
18	09.54	08.12	06.30	05.34	03.43	02.10	03.19	05.08	06.45	08.18	09.05	10.30
	15.04	16.54	18.25	21.04	22.49	00.28	23.27	21.34	19.38	17.47	15.01	13.58
19	09.51	08.08	06.26	05.30	03.40	02.09	03.22	05.12	06.49	08.21	09.08	10.31
	15.07	16.57	18.28	21.07	22.52	00.30	23.23	21.30	19.34	17.44	14.58	13.58
20	09.48	08.05	06.22	05.27	03.36	02.09	03.26	05.15	06.52	08.25	09.12	10.32
	15.11	17.01	18.31	21.10	22.56	00.30	23.20	21.26	19.30	17.40	14.55	13.58
21	09.45	08.01	06.19	05.23	03.32	02.09	03.30	05.18	06.55	08.28	09.15	10.33
	15.14	17.04	18.34	21.14	23.00	00.31	23.16	21.23	19.27	17.37	14.52	13.58
22	09.42	07.58	06.15	05.19	03.29	02.09	03.33	05.21	06.58	08.31	09.19	10.34
	15.18	17.07	18.38	21.17	23.04	00.31	23.13	21.19	19.23	17.33	14.49	13.59
23	09.39	07.54	06.11	05.15	03.25	02.10	03.37	05.25	07.01	08.35	09.22	10.34
	15.21	17.11	18.41	21.20	23.07	00.31	23.09	21.15	19.19	17.29	14.46	13.59
24	09.36	07.50	06.07	05.12	03.22	02.11	03.41	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.11	00.30	23.06	21.11	19.16	17.26	14.43	14.00
25	09.33	07.47	06.04	05.08	03.18	02.12	03.44	05.31	07.07	07.41	09.29	10.35
	15.29	17.17	18.47	21.27	23.15	00.30	23.02	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.04	03.15	02.13	03.48	05.34	07.10	07.45	09.32	10.35
	15.32	17.21	18.50	21.30	23.18	00.28	22.58	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.56	05.01	03.11	02.15	03.52	05.37	07.13	07.48	09.36	10.34
	15.36	17.24	18.53	21.34	23.22	00.27	22.55	21.00	19.04	16.15	14.35	14.03
28	09.24	07.36	05.53	04.57	03.08	02.17	03.55	05.41	07.16	07.51	09.39	10.34
	15.39	17.27	18.56	21.37	23.26	00.25	22.51	20.56	19.01	16.12	14.32	14.05
29	09.20		06.49	04.53	03.04	02.20	03.59	05.44	07.19	07.55	09.43	10.33
	15.43		19.59	21.41	23.29	00.24	22.48	20.53	18.57	16.08	14.29	14.07
30	09.17		06.45	04.49	03.01	02.22	04.02	05.47	07.22	07.58	09.46	10.32
	15.47		20.03	21.44	23.33	00.21	22.44	20.49	18.53	16.05	14.27	14.08
31	09.14		06.41		02.54		04.06	05.50		08.01		10.32
	15.50		20.06		23.37		22.40	20.45		16.01		14.10
Potential sun hours	156	232	362	456	584	657	630	517	395	301	187	116
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)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
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Osmontie 34, PO Box 950
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+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_2021020Shadow receptor: F - Lomarakennus F (Merianjärvi)
Sunshine probability S (Average daily sunshine hours) [LULEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.32	09.11	07.33	06.38	04.45	02.50	02.23	04.09	05.53	07.25	08.06	09.50
	14.12	15.54	17.31	20.09	21.48	23.42	00.22	22.38	20.42	18.50	15.57	14.23
2	10.31	09.08	07.29	06.34	04.42	02.46	02.25	04.13	05.56	07.28	08.09	09.54
	14.14	15.57	17.34	20.13	21.52	23.46	00.20	22.34	20.38	18.46	15.54	14.21
3	10.29	09.05	07.25	06.30	04.38	02.43	02.28	04.16	06.00	07.31	08.12	09.57
	14.17	16.01	17.37	20.16	21.55	23.49	00.17	22.30	20.34	18.42	15.50	14.19
4	10.28	09.01	07.22	06.27	04.34	02.40	02.32	04.20	06.03	07.35	08.16	10.00
	14.19	16.04	17.41	20.19	21.59	23.53	00.14	22.27	20.31	18.39	15.47	14.16
5	10.26	08.58	07.18	06.23	04.31	02.37	02.35	04.23	06.06	07.38	08.19	10.03
	14.22	16.08	17.44	20.22	22.03	23.57	00.11	22.23	20.27	18.35	15.44	14.14
6	10.24	08.55	07.14	06.19	04.27	02.34	02.38	04.27	06.09	07.41	08.23	10.06
	14.24	16.12	17.47	20.25	22.06	00.00	00.08	22.19	20.23	18.31	15.40	14.12
7	10.22	08.51	07.11	06.15	04.23	02.31	02.42	04.30	06.12	07.44	08.26	10.09
	14.27	16.15	17.50	20.28	22.10	00.03	00.05	22.16	20.19	18.28	15.37	14.10
8	10.20	08.48	07.07	06.12	04.19	02.28	02.45	04.34	06.15	07.47	08.30	10.11
	14.30	16.19	17.53	20.32	22.13	00.07	00.02	22.12	20.16	18.24	15.33	14.08
9	10.18	08.44	07.03	06.08	04.16	02.25	02.49	04.37	06.18	07.50	08.34	10.14
	14.33	16.22	17.57	20.35	22.17	00.10	23.59	22.08	20.12	18.20	15.30	14.07
10	10.16	08.41	07.00	06.04	04.12	02.22	02.52	04.41	06.21	07.53	08.37	10.16
	14.36	16.26	18.00	20.38	22.21	00.13	23.56	22.04	20.08	18.17	15.27	14.05
11	10.13	08.37	06.56	06.00	04.08	02.20	02.56	04.44	06.24	07.56	08.41	10.19
	14.40	16.29	18.03	20.41	22.24	00.16	23.52	22.01	20.04	18.13	15.23	14.03
12	10.11	08.34	06.52	05.57	04.05	02.17	02.59	04.48	06.27	08.00	08.44	10.21
	14.43	16.33	18.06	20.45	22.28	00.19	23.49	21.57	20.01	18.09	15.20	14.02
13	10.08	08.30	06.49	05.53	04.01	02.15	03.03	04.51	06.30	08.03	08.48	10.23
	14.46	16.36	18.09	20.48	22.32	00.22	23.46	21.53	19.57	18.06	15.17	14.01
14	10.06	08.27	06.45	05.49	03.57	02.13	03.03	04.55	06.34	08.06	08.51	10.25
	14.49	16.40	18.13	20.51	22.35	00.24	23.42	21.49	19.53	18.02	15.13	14.00
15	10.03	08.23	06.41	05.45	03.54	02.11	03.07	04.58	06.37	08.09	08.55	10.27
	14.53	16.43	18.16	20.54	22.39	00.27	23.39	21.46	19.49	17.58	15.10	13.59
16	10.01	08.20	06.38	05.42	03.50	02.09	03.10	05.01	06.40	08.12	08.58	10.29
	14.56	16.47	18.19	20.58	22.43	00.29	23.35	21.42	19.46	17.55	15.07	13.58
17	09.58	08.16	06.34	05.38	03.46	02.08	03.14	05.05	06.43	08.16	09.02	10.31
	15.00	16.50	18.22	21.01	22.46	00.31	23.32	21.38	19.42	17.51	15.04	13.58
18	09.55	08.13	06.30	05.34	03.43	02.07	03.18	05.08	06.46	08.19	09.06	10.32
	15.03	16.54	18.25	21.04	22.50	00.32	23.28	21.34	19.38	17.47	15.01	13.57
19	09.52	08.09	06.26	05.30	03.39	02.06	03.21	05.11	06.49	08.22	09.09	10.33
	15.07	16.57	18.28	21.08	22.54	00.33	23.25	21.31	19.35	17.44	14.57	13.57
20	09.49	08.05	06.23	05.27	03.35	02.06	03.25	05.15	06.52	08.25	09.13	10.34
	15.10	17.01	18.32	21.11	22.57	00.34	23.21	21.27	19.31	17.40	14.54	13.57
21	09.46	08.02	06.19	05.23	03.32	02.06	03.29	05.18	06.55	08.29	09.16	10.35
	15.14	17.04	18.35	21.14	23.01	00.35	23.18	21.23	19.27	17.37	14.51	13.57
22	09.43	07.58	06.15	05.19	03.28	02.06	03.32	05.21	06.58	08.32	09.20	10.36
	15.17	17.07	18.38	21.18	23.05	00.35	23.14	21.19	19.23	17.33	14.48	13.58
23	09.40	07.55	06.11	05.15	03.25	02.07	03.36	05.24	07.01	08.35	09.23	10.36
	15.21	17.11	18.41	21.21	23.09	00.35	23.11	21.16	19.20	17.29	14.45	13.58
24	09.37	07.51	06.08	05.12	03.21	02.08	03.40	05.28	07.04	08.38	09.27	10.36
	15.25	17.14	18.44	21.24	23.12	00.34	23.07	21.12	19.16	17.26	14.42	13.59
25	09.34	07.47	06.04	05.08	03.17	02.09	03.44	05.31	07.07	07.42	09.30	10.36
	15.28	17.17	18.47	21.28	23.16	00.33	23.03	21.08	19.12	16.22	14.40	14.00
26	09.31	07.44	06.00	05.04	03.14	02.11	03.47	05.34	07.10	07.45	09.34	10.36
	15.32	17.21	18.50	21.31	23.20	00.32	23.00	21.04	19.08	16.19	14.37	14.01
27	09.28	07.40	05.57	05.00	03.10	02.13	03.51	05.37	07.13	07.49	09.37	10.36
	15.35	17.24	18.54	21.35	23.24	00.30	22.56	21.01	19.05	16.15	14.34	14.02
28	09.24	07.36	05.53	04.57	03.07	02.15	03.55	05.41	07.16	07.52	09.40	10.36
	15.39	17.27	18.57	21.38	23.27	00.29	22.52	20.57	19.01	16.12	14.31	14.04
29	09.21		06.49	04.53	03.03	02.17	03.58	05.44	07.19	07.55	09.44	10.35
	15.43		20.00	21.41	23.31	00.27	22.49	20.53	18.57	16.08	14.29	14.05
30	09.18		06.45	04.49	03.00	02.20	04.02	05.47	07.22	07.59	09.47	10.34
	15.46		20.03	21.45	23.35	00.24	22.45	20.49	18.54	16.04	14.26	14.07
31	09.15		06.42		02.53		04.05	05.50		08.02		10.33
	15.50		20.06		23.39		22.41	20.46		16.01		14.09
Potential sun hours	155	232	362	456	585	660	631	517	395	301	187	115
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)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Last time (hh:mm) with flicker	(WTG causing flicker last time)
	Minutes with flicker		

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_2021207Shadow receptor: G - Liikerakennus G (Impiivaarantie kämppä)
Sunshine probability S (Average daily sunshine hours) [LULEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

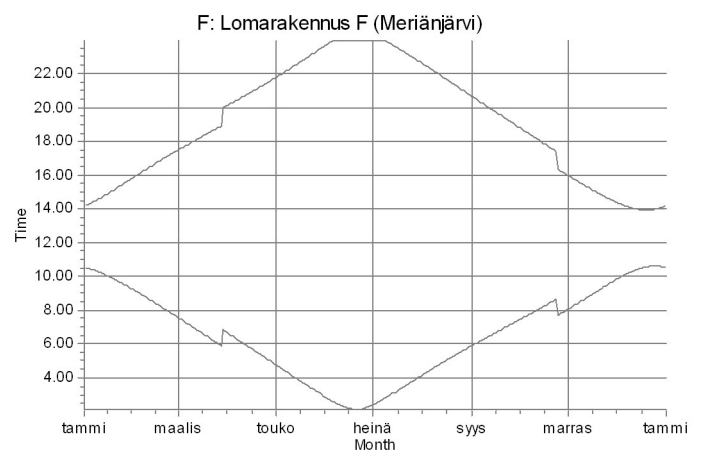
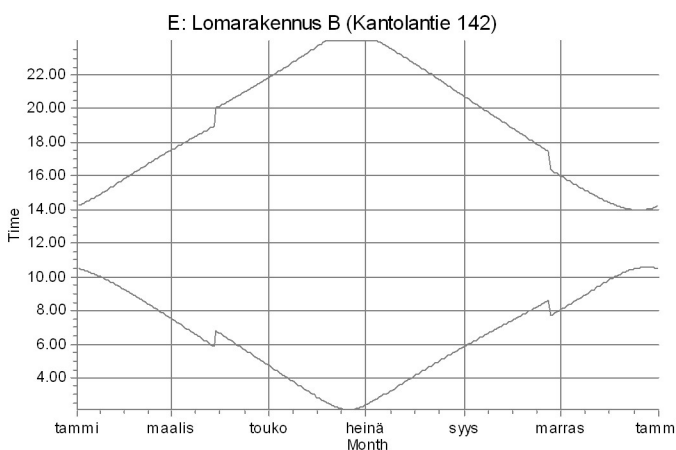
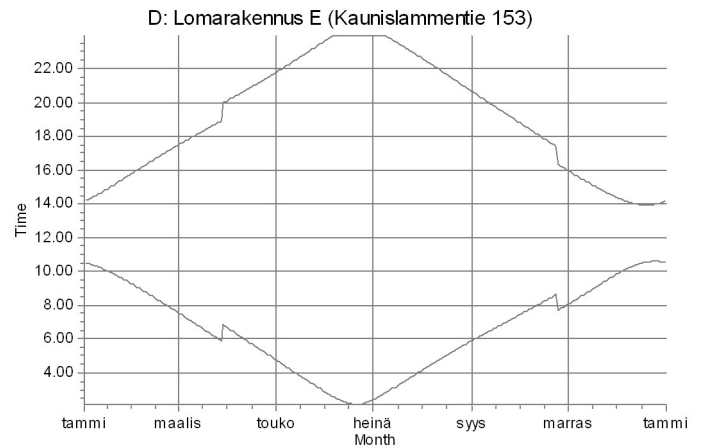
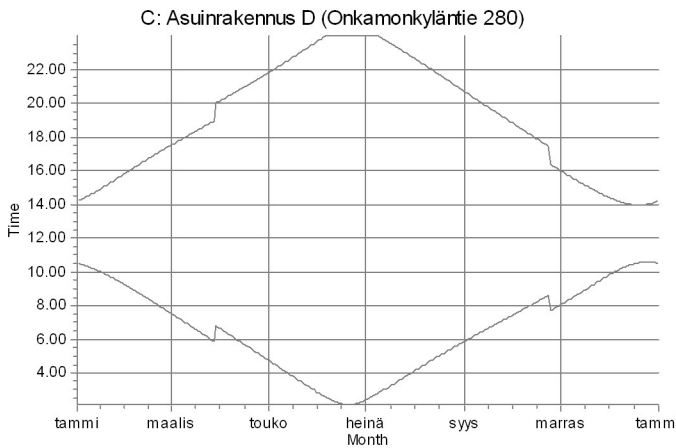
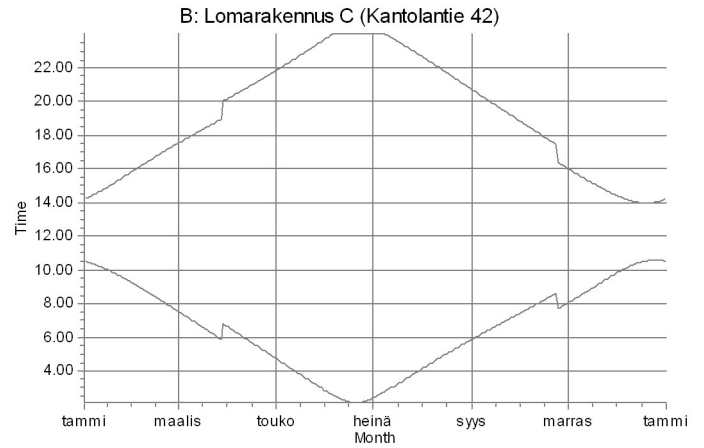
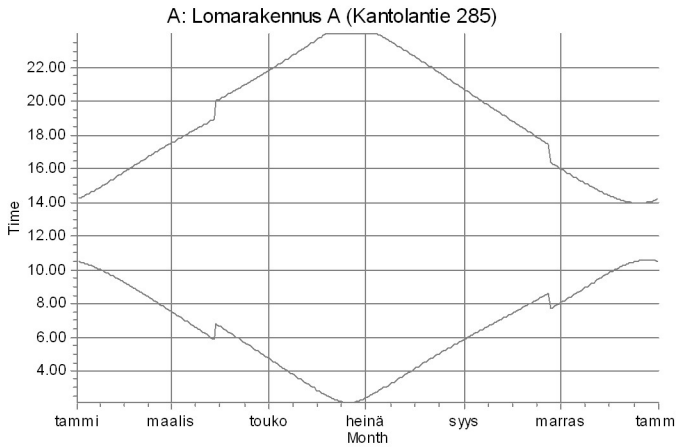
Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December							
1	10.31	09.11	07.32	15.55 (10)	06.38	04.45	02.50	02.23	04.09	05.53	07.25	08.05	13.42 (11)	09.50					
	14.12	15.54	17.30	20	16.15 (10)	20.09	21.48	23.41	00.21	22.37	20.42	18.50	15.57	28	14.10 (11)	14.24			
2	10.30	09.07	14.22 (11)	07.29	15.56 (10)	06.34	04.42	02.47	02.26	04.13	05.56	07.28	08.09		13.43 (11)	09.53			
	14.14	15.57	7	14.29 (11)	17.34	18	16.14 (10)	20.12	21.51	23.45	00.18	22.33	20.38	18.46	15.54	27	14.10 (11)	14.21	
3	10.28	09.04	14.20 (11)	07.25	15.58 (10)	06.30	04.38	02.44	02.29	04.16	05.59	07.31	08.12		13.43 (11)	09.56			
	14.17	16.01	13	14.33 (11)	17.37	15	16.13 (10)	20.15	21.55	23.48	00.16	22.30	20.34	18.42	15.50	27	14.10 (11)	14.19	
4	10.27	09.01	14.17 (11)	07.21	15.59 (10)	06.26	04.34	02.40	02.32	04.20	06.02	07.34	08.15		13.44 (11)	09.59			
	14.19	16.04	18	14.35 (11)	17.40	12	16.11 (10)	20.18	21.58	23.52	00.13	22.26	20.30	18.38	15.47	25	14.09 (11)	14.17	
5	10.25	08.57	14.16 (11)	07.18	16.03 (10)	06.23	04.30	02.37	02.35	04.23	06.06	07.37	08.19		13.45 (11)	10.02			
	14.22	16.08	21	14.37 (11)	17.44	5	16.08 (10)	20.22	22.02	23.55	00.10	22.22	20.27	18.35	15.43	22	14.07 (11)	14.14	
6	10.23	08.54	14.15 (11)	07.14		06.19	04.27	02.34	02.39	04.27	06.09	07.40	08.22		13.47 (11)	10.05			
	14.25	16.12	23	14.38 (11)	17.47		20.25	22.06	23.59	00.07	22.19	20.23	18.31	15.40	20	14.07 (11)	14.12		
7	10.21	08.51	14.14 (11)	07.10		06.15	04.23	02.31	02.42	04.30	06.12	07.44	08.26		13.48 (11)	10.08			
	14.28	16.15	25	14.39 (11)	17.50		20.28	22.09	00.02	00.04	22.15	20.19	18.27	15.37	17	14.07 (11)	14.10		
8	10.19	08.47	14.13 (11)	07.07		06.11	04.19	02.28	02.46	04.34	06.15	07.47	08.29		13.50 (11)	10.10			
	14.30	16.19	26	14.39 (11)	17.53		20.31	22.13	00.06	00.01	22.11	20.15	18.24	15.33	13	14.03 (11)	14.09		
9	10.17	08.44	14.13 (11)	07.03		06.08	04.16	02.26	02.49	04.37	06.18	07.50		16.35 (10)	08.33		13.54 (11)	10.13	
	14.33	16.22	27	14.40 (11)	17.56		20.34	22.16	00.09	23.58	22.08	20.12	18.20	9	16.44 (10)	15.30	5	13.59 (11)	14.07
10	10.15	08.40	14.12 (11)	06.59		06.04	04.12	02.23	02.53	04.41	06.21	07.53		16.33 (10)	08.37			10.16	
	14.37	16.26	29	14.41 (11)	18.00		20.38	22.20	00.12	23.55	22.04	20.08	18.16	14	16.47 (10)	15.27			14.05
11	10.13	08.37	14.12 (11)	06.56		06.00	04.08	02.20	02.56	04.44	06.24	07.56		16.31 (10)	08.40			10.18	
	14.40	16.29	29	14.41 (11)	18.03		20.41	22.24	00.15	23.51	22.00	20.04	18.13	16	16.47 (10)	15.23			14.04
12	10.10	08.33	14.12 (11)	06.52		05.56	04.05	02.18	03.00	04.48	06.27	07.59		16.30 (10)	08.44			10.20	
	14.43	16.33	30	14.42 (11)	18.06		20.44	22.27	00.18	23.48	21.56	20.00	18.09	19	16.49 (10)	15.20			14.02
13	10.08	08.30	14.12 (11)	06.48		05.53	04.01	02.16	03.00	04.51	06.30	08.02		16.29 (10)	08.47			10.22	
	14.46	16.36	30	14.42 (11)	18.09		20.47	22.31	00.20	23.45	21.53	19.57	18.05	20	16.49 (10)	15.17			14.01
14	10.05	08.26	14.12 (11)	06.45		05.49	03.57	02.14	03.03	04.54	06.33	08.06		16.28 (10)	08.51			10.24	
	14.50	16.40	30	14.42 (11)	18.12		20.51	22.35	00.23	23.41	21.49	19.53	18.02	20	16.48 (10)	15.13			14.00
15	10.02	08.23	14.13 (11)	06.41		05.45	03.54	02.12	03.07	04.58	06.36	08.09		16.28 (10)	08.54			10.26	
	14.53	16.43	29	14.42 (11)	18.15		20.54	22.38	00.25	23.38	21.45	19.49	17.58	21	16.49 (10)	15.10			13.59
16	10.00	08.19	14.13 (11)	06.37		05.41	03.50	02.10	03.11	05.01	06.39	08.12		16.27 (10)	08.58			10.28	
	14.56	16.47	28	14.41 (11)	18.19		20.57	22.42	00.27	23.35	21.41	19.45	17.54	21	16.48 (10)	15.07			13.59
17	09.57	08.16	14.13 (11)	06.33		05.38	03.46	02.09	03.14	05.05	06.42	08.15		16.28 (10)	09.01			10.30	
	15.00	16.50	28	14.41 (11)	18.22		21.00	22.46	00.29	23.31	21.38	19.42	17.51	20	16.48 (10)	15.04			13.58
18	09.54	08.12	14.14 (11)	06.30		05.34	03.43	02.08	03.18	05.08	06.45	08.18		16.28 (10)	09.05			10.31	
	15.03	16.54	26	14.40 (11)	18.25		21.04	22.49	00.30	23.28	21.34	19.38	17.47	20	16.48 (10)	15.01			13.58
19	09.51	08.08	14.15 (11)	06.26		05.30	03.39	02.07	03.22	05.11	06.48	08.22		14.53 (11)	09.08			10.32	
	15.07	16.57	24	14.39 (11)	18.28		21.07	22.53	00.32	23.24	21.30	19.34	17.44	28	16.46 (10)	14.57			13.57
20	09.49	08.05	14.16 (11)	06.22		05.26	03.35	02.07	03.25	05.15	06.51	08.25		16.46 (10)	09.12			10.33	
	15.10	17.00	32	16.12 (10)	18.31		21.10	22.57	00.32	23.21	21.27	19.30	17.40	33	16.50 (10)	14.54			13.57
21	09.46	08.01	14.17 (11)	06.19		05.23	03.32	02.07	03.29	05.18	06.55	08.28		14.47 (11)	09.16			10.34	
	15.14	17.04	34	16.14 (10)	18.34		21.14	23.00	00.33	23.17	21.23	19.27	17.36	33	16.43 (10)	14.51			13.58
22	09.43	07.58	14.20 (11)	06.15		05.19	03.28	02.07	03.33	05.21	06.58	08.31		14.45 (11)	09.19			10.35	
	15.17	17.07	31	16.15 (10)	18.38		21.17	23.04	00.33	23.13	21.19	19.23	17.33	31	16.41 (10)	14.48			13.58
23	09.40	07.54	14.24 (11)	06.11		05.15	03.25	02.08	03.36	05.24	07.01	08.35		14.44 (11)	09.23			10.35	
	15.21	17.11	25	16.16 (10)	18.41		21.20	23.08	00.33	23.10	21.15	19.19	17.29	26	15.10 (11)	14.45			13.58
24	09.36	07.51	15.56 (10)	06.07		05.11	03.21	02.09	03.40	05.28	07.04	08.38		14.44 (11)	09.26			10.35	
	15.25	17.14	21	16.17 (10)	18.44		21.24	23.12	00.32	23.06	21.12	19.16	17.26	26	15.10 (11)	14.42			13.59
25	09.33	07.47	15.56 (10)	06.04		05.08	03.18	02.10	03.44	05.31	07.07	07.41		13.43 (11)	09.30			10.36	
	15.28	17.17	21	16.17 (10)	18.47		21.27	23.15	00.31	23.03	21.08	19.12	16.22	28	14.11 (11)	14.40			14.00
26	09.30	07.43	15.55 (10)	06.00		05.04	03.14	02.12	03.47	05.34	07.10	07.45		13.42 (11)	09.33			10.35	
	15.32	17.21	22	16.17 (10)	18.50		21.31	23.19	00.30	22.59	21.04	19.08	16.18	29	14.11 (11)	14.37			14.01
27	09.27	07.40	15.55 (10)	05.56		05.00	03.11	02.13	03.51	05.37	07.13	07.48		13.42 (11)	09.36			10.35	
	15.35	17.24	21	16.16 (10)	18.53		21.34	23.23	00.29	22.55	21.00	19.04	16.15	29	14.11 (11)	14.34			14.03
28	09.24	07.36	15.55 (10)	05.53		04.57	03.07	02.16	03.55	05.40	07.16	07.51		13.41 (11)	09.40			10.35	
	15.39	17.27	21	16.16 (10)	18.56		21.37	23.27	00.27	22.52	20.57	19.01	16.11	30	14.11 (11)	14.31			14.04
29	09.21			06.49		04.53	03.04	02.18	03.58	05.44	07.19	07.55		13.41 (11)	09.43			10.34	
	15.43			20.00		21.41	23.30	00.25	22.48	20.53	18.57	16.08	30	14.11 (11)	14.29			14.06	
30	09.17			06.45		04.49	03.00	02.21	04.02	05.47	07.22	07.58		13.41 (11)	09.46			10.33	
	15.46			20.03		21.44	23.34	00.23	22.44	20.49	18.53	16.04	30	14.11 (11)	14.26			14.07	
31	09.14			06.41		04.52	02.53		04.05	05.50		08.02		13.42 (11)				10.32	
	15.50			20.06		21.44	23.38		22.41	20.45		16.01	29	14.11 (11)				14.09	
Potential sun hours	155	232	362	456	585	659	631	517	395	301	187								115
Total, worst case			70									562			184				
Sun reduction		671	0.32		0.36							0.29			0.20				
Oper. time red.		0.99	0.99		0.99							0.99			0.99				
Wind dir. red.		0.66	0.64		0.64							0.65			0.67				
Total reduction		0.21	0.23		0.23							0.18			0.13				
Total, real																			

SHADOW - Calendar, graphical

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207



WTGs

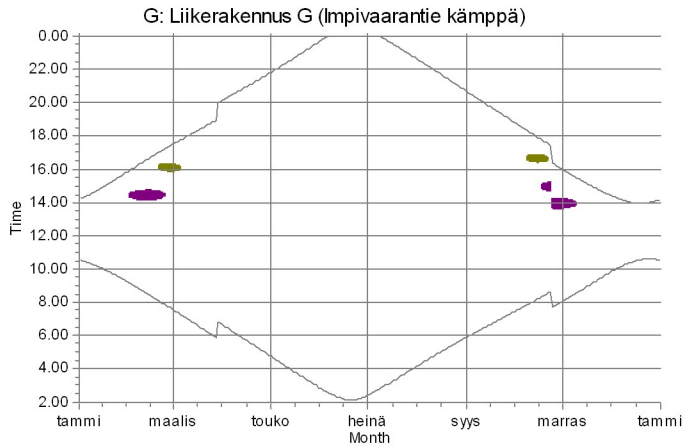
Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar, graphical

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207



WTGs

10: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (33)

11: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (34)

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207WTG: 1 - VESTAS V126-3.45 LTq 3450 126.0 !OI hub: 137,0 m (TOT: 200,0 m) (13)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.32	09.12	07.33	06.38	04.46	02.51	02.25	04.10	05.54	07.26	08.06	09.50
	14.13	15.55	17.31	20.10	21.49	23.42	00.21	22.38	20.42	18.50	15.58	14.25
2	10.30	09.08	07.30	06.35	04.43	02.48	02.28	04.14	05.57	07.29	08.09	09.53
	14.16	15.58	17.35	20.13	21.52	23.45	00.19	22.34	20.39	18.47	15.55	14.22
3	10.29	09.05	07.26	06.31	04.39	02.45	02.30	04.17	06.00	07.32	08.13	09.57
	14.18	16.02	17.38	20.16	21.56	23.49	00.16	22.30	20.35	18.43	15.51	14.20
4	10.27	09.02	07.22	06.27	04.35	02.42	02.34	04.21	06.03	07.35	08.16	10.00
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.27	20.31	18.39	15.48	14.18
5	10.26	08.58	07.19	06.23	04.31	02.39	02.37	04.24	06.06	07.38	08.20	10.03
	14.23	16.09	17.44	20.22	22.03	23.56	00.10	22.23	20.27	18.36	15.44	14.15
6	10.24	08.55	07.15	06.20	04.28	02.35	02.40	04.28	06.10	07.41	08.23	10.06
	14.26	16.12	17.48	20.26	22.06	23.59	00.08	22.19	20.24	18.32	15.41	14.13
7	10.22	08.51	07.11	06.16	04.24	02.33	02.43	04.31	06.13	07.44	08.27	10.08
	14.29	16.16	17.51	20.29	22.10	00.03	00.05	22.16	20.20	18.28	15.38	14.11
8	10.20	08.48	07.08	06.12	04.20	02.30	02.47	04.35	06.16	07.47	08.30	10.11
	14.32	16.20	17.54	20.32	22.13	00.06	00.02	22.12	20.16	18.25	15.34	14.10
9	10.18	08.44	07.04	06.09	04.17	02.27	02.50	04.38	06.19	07.51	08.34	10.14
	14.35	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.21	15.31	14.08
10	10.15	08.41	07.00	06.05	04.13	02.24	02.54	04.42	06.22	07.54	08.37	10.16
	14.38	16.27	18.00	20.38	22.21	00.12	23.55	22.05	20.09	18.17	15.27	14.06
11	10.13	08.38	06.57	06.01	04.09	02.22	02.57	04.45	06.25	07.57	08.41	10.19
	14.41	16.30	18.04	20.42	22.24	00.15	23.52	22.01	20.05	18.14	15.24	14.05
12	10.11	08.34	06.53	05.57	04.06	02.19	03.01	04.49	06.28	08.00	08.44	10.21
	14.44	16.34	18.07	20.45	22.28	00.18	23.49	21.57	20.01	18.10	15.21	14.03
13	10.08	08.31	06.49	05.54	04.02	02.17	03.01	04.52	06.31	08.03	08.48	10.23
	14.47	16.37	18.10	20.48	22.32	00.21	23.45	21.53	19.57	18.06	15.18	14.02
14	10.06	08.27	06.45	05.50	03.58	02.15	03.05	04.55	06.34	08.06	08.51	10.25
	14.51	16.41	18.13	20.51	22.35	00.23	23.42	21.50	19.54	18.03	15.14	14.01
15	10.03	08.23	06.42	05.46	03.55	02.13	03.08	04.59	06.37	08.10	08.55	10.27
	14.54	16.44	18.16	20.55	22.39	00.25	23.39	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.51	02.12	03.12	05.02	06.40	08.13	08.59	10.29
	14.57	16.48	18.20	20.58	22.43	00.27	23.35	21.42	19.46	17.55	15.08	14.00
17	09.58	08.16	06.34	05.39	03.47	02.10	03.15	05.06	06.43	08.16	09.02	10.30
	15.01	16.51	18.23	21.01	22.46	00.29	23.32	21.38	19.42	17.52	15.05	13.59
18	09.55	08.13	06.31	05.35	03.44	02.09	03.19	05.09	06.46	08.19	09.06	10.32
	15.04	16.55	18.26	21.05	22.50	00.31	23.28	21.35	19.39	17.48	15.02	13.59
19	09.52	08.09	06.27	05.31	03.40	02.09	03.23	05.12	06.49	08.22	09.09	10.33
	15.08	16.58	18.29	21.08	22.54	00.32	23.25	21.31	19.35	17.44	14.58	13.59
20	09.49	08.06	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.26	09.13	10.34
	15.11	17.01	18.32	21.11	22.57	00.33	23.21	21.27	19.31	17.41	14.55	13.59
21	09.46	08.02	06.19	05.24	03.33	02.08	03.30	05.19	06.55	08.29	09.16	10.35
	15.15	17.05	18.35	21.14	23.01	00.33	23.18	21.24	19.28	17.37	14.52	13.59
22	09.43	07.59	06.16	05.20	03.29	02.09	03.34	05.22	06.58	08.32	09.20	10.35
	15.18	17.08	18.38	21.18	23.05	00.33	23.14	21.20	19.24	17.34	14.49	13.59
23	09.40	07.55	06.12	05.16	03.26	02.09	03.37	05.25	07.01	08.36	09.23	10.36
	15.22	17.11	18.42	21.21	23.09	00.33	23.10	21.16	19.20	17.30	14.46	14.00
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.29	07.04	08.39	09.27	10.36
	15.26	17.15	18.45	21.25	23.12	00.32	23.07	21.12	19.16	17.27	14.43	14.00
25	09.34	07.48	06.05	05.09	03.19	02.11	03.45	05.32	07.08	07.42	09.30	10.36
	15.29	17.18	18.48	21.28	23.16	00.32	23.03	21.09	19.13	16.23	14.41	14.01
26	09.31	07.44	06.01	05.05	03.15	02.13	03.48	05.35	07.11	07.46	09.34	10.36
	15.33	17.21	18.51	21.31	23.20	00.30	23.00	21.05	19.09	16.19	14.38	14.02
27	09.28	07.40	05.57	05.01	03.12	02.15	03.52	05.38	07.14	07.49	09.37	10.36
	15.36	17.25	18.54	21.35	23.23	00.29	22.56	21.01	19.05	16.16	14.35	14.04
28	09.25	07.37	05.53	04.57	03.08	02.17	03.56	05.41	07.17	07.52	09.40	10.35
	15.40	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.02	16.12	14.32	14.05
29	09.21		05.50	04.54	03.05	02.19	03.59	05.45	07.20	07.56	09.44	10.35
	15.44		20.00	21.42	23.31	00.25	22.49	20.54	18.58	16.09	14.30	14.07
30	09.18		06.46	04.50	03.01	02.22	04.03	05.48	07.23	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	22.45	20.50	18.54	16.05	14.27	14.09
31	09.15		06.42		02.55		04.06	05.51		08.02		10.33
	15.51		20.07		23.38		22.41	20.46		16.02		14.11
Potential sun hours	156	232	362	456	585	658	630	517	395	301	187	116
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

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207WTG: 2 - VESTAS V126-3.45 LTq 3450 126.0 IOI hub: 137,0 m (TOT: 200,0 m) (14)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.25	04.10	05.54	07.26	08.06	09.50
	14.13	15.54	17.31	20.10	21.49	23.42	00.21	22.38	20.42	18.50	15.58	14.25
2	10.30	09.08	07.29	06.35	04.43	02.48	02.28	04.14	05.57	07.29	08.09	09.53
	14.15	15.58	17.35	20.13	21.52	23.45	00.18	22.34	20.39	18.47	15.55	14.22
3	10.29	09.05	07.26	06.31	04.39	02.45	02.30	04.17	06.00	07.32	08.13	09.56
	14.18	16.02	17.38	20.16	21.56	23.49	00.16	22.30	20.35	18.43	15.51	14.20
4	10.27	09.01	07.22	06.27	04.35	02.42	02.34	04.21	06.03	07.35	08.16	10.00
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.27	20.31	18.39	15.48	14.18
5	10.25	08.58	07.19	06.23	04.31	02.38	02.37	04.24	06.06	07.38	08.20	10.03
	14.23	16.09	17.44	20.22	22.03	23.56	00.10	22.23	20.27	18.36	15.44	14.15
6	10.24	08.55	07.15	06.20	04.28	02.35	02.40	04.28	06.10	07.41	08.23	10.05
	14.26	16.12	17.48	20.26	22.06	23.59	00.07	22.19	20.24	18.32	15.41	14.13
7	10.22	08.51	07.11	06.16	04.24	02.32	02.43	04.31	06.13	07.44	08.27	10.08
	14.29	16.16	17.51	20.29	22.10	00.03	00.04	22.16	20.20	18.28	15.38	14.11
8	10.20	08.48	07.07	06.12	04.20	02.30	02.47	04.35	06.16	07.47	08.30	10.11
	14.31	16.20	17.54	20.32	22.13	00.06	00.01	22.12	20.16	18.25	15.34	14.10
9	10.18	08.44	07.04	06.08	04.17	02.27	02.50	04.38	06.19	07.51	08.34	10.14
	14.35	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.21	15.31	14.08
10	10.15	08.41	07.00	06.05	04.13	02.24	02.54	04.42	06.22	07.54	08.37	10.16
	14.38	16.27	18.00	20.38	22.21	00.12	23.55	22.04	20.09	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.22	02.57	04.45	06.25	07.57	08.41	10.19
	14.41	16.30	18.04	20.42	22.24	00.15	23.52	22.01	20.05	18.14	15.24	14.05
12	10.11	08.34	06.53	05.57	04.06	02.19	03.01	04.49	06.28	08.00	08.44	10.21
	14.44	16.34	18.07	20.45	22.28	00.18	23.49	21.57	20.01	18.10	15.21	14.03
13	10.08	08.30	06.49	05.54	04.02	02.17	03.01	04.52	06.31	08.03	08.48	10.23
	14.47	16.37	18.10	20.48	22.31	00.20	23.45	21.53	19.57	18.06	15.18	14.02
14	10.06	08.27	06.45	05.50	03.58	02.15	03.04	04.55	06.34	08.06	08.51	10.25
	14.51	16.41	18.13	20.51	22.35	00.23	23.42	21.50	19.54	18.03	15.14	14.01
15	10.03	08.23	06.42	05.46	03.55	02.13	03.08	04.59	06.37	08.09	08.55	10.27
	14.54	16.44	18.16	20.55	22.39	00.25	23.38	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.51	02.12	03.12	05.02	06.40	08.13	08.58	10.29
	14.57	16.48	18.19	20.58	22.42	00.27	23.35	21.42	19.46	17.55	15.08	14.00
17	09.58	08.16	06.34	05.39	03.47	02.10	03.15	05.05	06.43	08.16	09.02	10.30
	15.01	16.51	18.23	21.01	22.46	00.29	23.32	21.38	19.42	17.52	15.05	13.59
18	09.55	08.13	06.31	05.35	03.44	02.09	03.19	05.09	06.46	08.19	09.06	10.31
	15.04	16.54	18.26	21.04	22.50	00.30	23.28	21.35	19.39	17.48	15.02	13.59
19	09.52	08.09	06.27	05.31	03.40	02.09	03.23	05.12	06.49	08.22	09.09	10.33
	15.08	16.58	18.29	21.08	22.54	00.32	23.25	21.31	19.35	17.44	14.58	13.59
20	09.49	08.06	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.26	09.13	10.34
	15.11	17.01	18.32	21.11	22.57	00.32	23.21	21.27	19.31	17.41	14.55	13.59
21	09.46	08.02	06.19	05.24	03.33	02.08	03.30	05.19	06.55	08.29	09.16	10.34
	15.15	17.05	18.35	21.14	23.01	00.33	23.18	21.23	19.28	17.37	14.52	13.59
22	09.43	07.58	06.16	05.20	03.29	02.09	03.34	05.22	06.58	08.32	09.20	10.35
	15.18	17.08	18.38	21.18	23.05	00.33	23.14	21.20	19.24	17.34	14.49	13.59
23	09.40	07.55	06.12	05.16	03.26	02.09	03.37	05.25	07.01	08.35	09.23	10.36
	15.22	17.11	18.41	21.21	23.08	00.33	23.10	21.16	19.20	17.30	14.46	14.00
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.28	07.04	08.39	09.27	10.36
	15.26	17.15	18.45	21.25	23.12	00.32	23.07	21.12	19.16	17.26	14.43	14.00
25	09.34	07.48	06.05	05.09	03.19	02.12	03.45	05.32	07.07	07.42	09.30	10.36
	15.29	17.18	18.48	21.28	23.16	00.31	23.03	21.08	19.13	16.23	14.41	14.01
26	09.31	07.44	06.01	05.05	03.15	02.13	03.48	05.35	07.10	07.45	09.34	10.36
	15.33	17.21	18.51	21.31	23.20	00.30	23.00	21.05	19.09	16.19	14.38	14.02
27	09.28	07.40	05.57	05.01	03.12	02.15	03.52	05.38	07.14	07.49	09.37	10.36
	15.36	17.25	18.54	21.35	23.23	00.29	22.56	21.01	19.05	16.16	14.35	14.04
28	09.25	07.37	05.53	04.57	03.08	02.17	03.56	05.41	07.17	07.52	09.40	10.35
	15.40	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		05.50	04.54	03.05	02.19	03.59	05.44	07.20	07.56	09.44	10.35
	15.44		20.00	21.42	23.31	00.25	22.49	20.54	18.58	16.09	14.30	14.07
30	09.18		06.46	04.50	03.01	02.22	04.03	05.48	07.23	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	22.45	20.50	18.54	16.05	14.27	14.09
31	09.15		06.42		02.55		04.06	05.51		08.02		10.33
	15.51		20.07		23.38		22.41	20.46		16.02		14.11
Potential sun hours	156	232	362	456	585	658	630	517	395	301	187	116
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

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207WTG: 3 - VESTAS V126-3.45 LTq 3450 126.0 !OI hub: 137,0 m (TOT: 200,0 m) (15)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.25	04.10	05.54	07.26	08.06	09.50
	14.13	15.54	17.31	20.10	21.49	23.42	00.21	22.38	20.42	18.50	15.58	14.25
2	10.30	09.08	07.29	06.35	04.42	02.48	02.27	04.14	05.57	07.29	08.09	09.53
	14.15	15.58	17.35	20.13	21.52	23.45	00.19	22.34	20.39	18.47	15.55	14.22
3	10.29	09.05	07.26	06.31	04.39	02.45	02.30	04.17	06.00	07.32	08.13	09.56
	14.18	16.02	17.38	20.16	21.56	23.49	00.16	22.30	20.35	18.43	15.51	14.20
4	10.27	09.01	07.22	06.27	04.35	02.41	02.33	04.21	06.03	07.35	08.16	10.00
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.27	20.31	18.39	15.48	14.18
5	10.25	08.58	07.18	06.23	04.31	02.38	02.37	04.24	06.06	07.38	08.20	10.03
	14.23	16.09	17.44	20.22	22.03	23.56	00.10	22.23	20.27	18.36	15.44	14.15
6	10.24	08.55	07.15	06.20	04.28	02.35	02.40	04.28	06.09	07.41	08.23	10.05
	14.26	16.12	17.48	20.26	22.06	23.59	00.08	22.19	20.24	18.32	15.41	14.13
7	10.22	08.51	07.11	06.16	04.24	02.32	02.43	04.31	06.13	07.44	08.27	10.08
	14.28	16.16	17.51	20.29	22.10	00.03	00.05	22.16	20.20	18.28	15.37	14.11
8	10.20	08.48	07.07	06.12	04.20	02.30	02.47	04.35	06.16	07.47	08.30	10.11
	14.31	16.20	17.54	20.32	22.13	00.06	00.01	22.12	20.16	18.24	15.34	14.10
9	10.18	08.44	07.04	06.08	04.17	02.27	02.50	04.38	06.19	07.50	08.34	10.14
	14.34	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.21	15.31	14.08
10	10.15	08.41	07.00	06.05	04.13	02.24	02.54	04.42	06.22	07.54	08.37	10.16
	14.38	16.27	18.00	20.38	22.21	00.12	23.55	22.04	20.09	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.22	02.57	04.45	06.25	07.57	08.41	10.19
	14.41	16.30	18.04	20.42	22.24	00.15	23.52	22.01	20.05	18.13	15.24	14.05
12	10.11	08.34	06.53	05.57	04.06	02.19	03.01	04.49	06.28	08.00	08.44	10.21
	14.44	16.34	18.07	20.45	22.28	00.18	23.49	21.57	20.01	18.10	15.21	14.03
13	10.08	08.30	06.49	05.53	04.02	02.17	03.01	04.52	06.31	08.03	08.48	10.23
	14.47	16.37	18.10	20.48	22.31	00.21	23.45	21.53	19.57	18.06	15.17	14.02
14	10.06	08.27	06.45	05.50	03.58	02.15	03.04	04.55	06.34	08.06	08.51	10.25
	14.50	16.41	18.13	20.51	22.35	00.23	23.42	21.50	19.54	18.03	15.14	14.01
15	10.03	08.23	06.42	05.46	03.55	02.13	03.08	04.59	06.37	08.09	08.55	10.27
	14.54	16.44	18.16	20.55	22.39	00.25	23.38	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.51	02.12	03.12	05.02	06.40	08.13	08.58	10.29
	14.57	16.48	18.19	20.58	22.42	00.27	23.35	21.42	19.46	17.55	15.08	14.00
17	09.58	08.16	06.34	05.38	03.47	02.10	03.15	05.05	06.43	08.16	09.02	10.30
	15.01	16.51	18.23	21.01	22.46	00.29	23.32	21.38	19.42	17.52	15.05	13.59
18	09.55	08.13	06.31	05.35	03.44	02.09	03.19	05.09	06.46	08.19	09.06	10.31
	15.04	16.54	18.26	21.04	22.50	00.30	23.28	21.35	19.39	17.48	15.01	13.59
19	09.52	08.09	06.27	05.31	03.40	02.09	03.23	05.12	06.49	08.22	09.09	10.33
	15.08	16.58	18.29	21.08	22.54	00.32	23.25	21.31	19.35	17.44	14.58	13.58
20	09.49	08.06	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.26	09.13	10.34
	15.11	17.01	18.32	21.11	22.57	00.32	23.21	21.27	19.31	17.41	14.55	13.58
21	09.46	08.02	06.19	05.24	03.33	02.08	03.30	05.19	06.55	08.29	09.16	10.34
	15.15	17.05	18.35	21.14	23.01	00.33	23.18	21.23	19.27	17.37	14.52	13.59
22	09.43	07.58	06.16	05.20	03.29	02.08	03.34	05.22	06.58	08.32	09.20	10.35
	15.18	17.08	18.38	21.18	23.05	00.33	23.14	21.20	19.24	17.34	14.49	13.59
23	09.40	07.55	06.12	05.16	03.26	02.09	03.37	05.25	07.01	08.35	09.23	10.36
	15.22	17.11	18.41	21.21	23.08	00.33	23.10	21.16	19.20	17.30	14.46	14.00
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.28	07.04	08.39	09.27	10.36
	15.25	17.15	18.45	21.24	23.12	00.32	23.07	21.12	19.16	17.26	14.43	14.00
25	09.34	07.48	06.04	05.09	03.19	02.11	03.45	05.32	07.07	07.42	09.30	10.36
	15.29	17.18	18.48	21.28	23.16	00.32	23.03	21.08	19.13	16.23	14.41	14.01
26	09.31	07.44	06.01	05.05	03.15	02.13	03.48	05.35	07.10	07.45	09.34	10.36
	15.33	17.21	18.51	21.31	23.20	00.30	23.00	21.05	19.09	16.19	14.38	14.02
27	09.28	07.40	05.57	05.01	03.12	02.15	03.52	05.38	07.14	07.49	09.37	10.36
	15.36	17.25	18.54	21.35	23.23	00.29	22.56	21.01	19.05	16.16	14.35	14.04
28	09.24	07.37	05.53	04.57	03.08	02.17	03.56	05.41	07.17	07.52	09.40	10.35
	15.40	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		05.50	04.54	03.05	02.19	03.59	05.44	07.20	07.56	09.44	10.35
	15.44		20.00	21.42	23.31	00.25	22.49	20.53	18.58	16.09	14.30	14.07
30	09.18		06.46	04.50	03.01	02.22	04.03	05.48	07.23	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	22.45	20.50	18.54	16.05	14.27	14.08
31	09.15		06.42		02.54		04.06	05.51		08.02		10.33
	15.51		20.07		23.38		22.41	20.46		16.02		14.10
Potential sun hours	156	232	362	456	585	658	630	517	395	301	187	116
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

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207WTG: 4 - VESTAS V126-3.45 LTq 3450 126.0 IOI hub: 137,0 m (TOT: 200,0 m) (16)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.25	04.10	05.54	07.26	08.06	09.50
	14.13	15.54	17.31	20.10	21.48	23.41	00.21	22.38	20.42	18.50	15.58	14.25
2	10.30	09.08	07.29	06.35	04.43	02.48	02.28	04.14	05.57	07.29	08.09	09.53
	14.16	15.58	17.35	20.13	21.52	23.45	00.18	22.34	20.38	18.47	15.55	14.22
3	10.29	09.05	07.26	06.31	04.39	02.45	02.31	04.17	06.00	07.32	08.13	09.56
	14.18	16.02	17.38	20.16	21.55	23.49	00.16	22.30	20.35	18.43	15.51	14.20
4	10.27	09.01	07.22	06.27	04.35	02.42	02.34	04.21	06.03	07.35	08.16	09.59
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.27	20.31	18.39	15.48	14.18
5	10.25	08.58	07.18	06.23	04.31	02.39	02.37	04.24	06.06	07.38	08.20	10.02
	14.23	16.09	17.44	20.22	22.03	23.56	00.10	22.23	20.27	18.36	15.44	14.15
6	10.24	08.55	07.15	06.20	04.28	02.36	02.40	04.28	06.09	07.41	08.23	10.05
	14.26	16.12	17.48	20.26	22.06	23.59	00.07	22.19	20.23	18.32	15.41	14.13
7	10.22	08.51	07.11	06.16	04.24	02.33	02.43	04.31	06.13	07.44	08.27	10.08
	14.29	16.16	17.51	20.29	22.10	00.02	00.04	22.15	20.20	18.28	15.38	14.11
8	10.20	08.48	07.07	06.12	04.20	02.30	02.47	04.35	06.16	07.47	08.30	10.11
	14.32	16.20	17.54	20.32	22.13	00.06	00.01	22.12	20.16	18.24	15.34	14.10
9	10.17	08.44	07.04	06.08	04.17	02.27	02.50	04.38	06.19	07.50	08.34	10.13
	14.35	16.23	17.57	20.35	22.17	00.09	00.09	22.08	20.12	18.21	15.31	14.08
10	10.15	08.41	07.00	06.05	04.13	02.24	02.54	04.42	06.22	07.54	08.37	10.16
	14.38	16.27	18.00	20.38	22.20	00.12	00.12	22.04	20.09	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.22	02.57	04.45	06.25	07.57	08.41	10.18
	14.41	16.30	18.04	20.42	22.24	00.15	00.15	22.01	20.05	18.13	15.24	14.05
12	10.11	08.34	06.53	05.57	04.06	02.19	03.01	04.49	06.28	08.00	08.44	10.21
	14.44	16.34	18.07	20.45	22.28	00.18	00.18	21.57	20.01	18.10	15.21	14.03
13	10.08	08.30	06.49	05.53	04.02	02.17	03.01	04.52	06.31	08.03	08.48	10.23
	14.47	16.37	18.10	20.48	22.31	00.20	00.20	21.53	19.57	18.06	15.18	14.02
14	10.06	08.27	06.45	05.50	03.58	02.15	03.05	04.55	06.34	08.06	08.51	10.25
	14.51	16.41	18.13	20.51	22.35	00.23	00.23	21.49	19.54	18.03	15.14	14.01
15	10.03	08.23	06.42	05.46	03.55	02.13	03.08	04.59	06.37	08.09	08.55	10.27
	14.54	16.44	18.16	20.55	22.39	00.25	00.25	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.51	02.12	03.12	05.02	06.40	08.13	08.58	10.28
	14.57	16.48	18.19	20.58	22.42	00.27	00.27	21.42	19.46	17.55	15.08	14.00
17	09.58	08.16	06.34	05.38	03.47	02.11	03.15	05.05	06.43	08.16	09.02	10.30
	15.01	16.51	18.23	21.01	22.46	00.29	00.29	21.38	19.42	17.52	15.05	13.59
18	09.55	08.13	06.30	05.35	03.44	02.10	03.19	05.09	06.46	08.19	09.05	10.31
	15.04	16.54	18.26	21.04	22.50	00.30	00.30	21.35	19.39	17.48	15.02	13.59
19	09.52	08.09	06.27	05.31	03.40	02.09	03.23	05.12	06.49	08.22	09.09	10.32
	15.08	16.58	18.29	21.08	22.53	00.31	00.31	21.31	19.35	17.44	14.58	13.59
20	09.49	08.06	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.26	09.13	10.33
	15.11	17.01	18.32	21.11	22.57	00.32	00.32	21.27	19.31	17.41	14.55	13.59
21	09.46	08.02	06.19	05.24	03.33	02.08	03.30	05.19	06.55	08.29	09.16	10.34
	15.15	17.05	18.35	21.14	23.01	00.33	00.33	21.23	19.27	17.37	14.52	13.59
22	09.43	07.58	06.16	05.20	03.29	02.09	03.34	05.22	06.58	08.32	09.20	10.35
	15.18	17.08	18.38	21.18	23.05	00.33	00.33	21.20	19.24	17.34	14.49	13.59
23	09.40	07.55	06.12	05.16	03.26	02.09	03.37	05.25	07.01	08.35	09.23	10.35
	15.22	17.11	18.41	21.21	23.08	00.33	00.33	21.16	19.20	17.30	14.46	14.00
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.28	07.04	08.39	09.27	10.36
	15.26	17.15	18.45	21.24	23.12	00.32	00.32	21.12	19.16	17.26	14.43	14.00
25	09.34	07.48	06.04	05.09	03.19	02.12	03.45	05.32	07.07	07.42	09.30	10.36
	15.29	17.18	18.48	21.28	23.16	00.31	00.31	21.08	19.13	16.23	14.41	14.01
26	09.31	07.44	06.01	05.05	03.15	02.13	03.48	05.35	07.10	07.45	09.33	10.36
	15.33	17.21	18.51	21.31	23.19	00.30	00.30	21.05	19.09	16.19	14.38	14.02
27	09.28	07.40	05.57	05.01	03.12	02.15	03.52	05.38	07.13	07.49	09.37	10.35
	15.36	17.25	18.54	21.35	23.23	00.29	00.29	21.01	19.05	16.16	14.35	14.04
28	09.24	07.37	05.53	04.57	03.08	02.17	03.56	05.41	07.17	07.52	09.40	10.35
	15.40	17.28	18.57	21.38	23.27	00.27	00.27	21.01	19.01	16.12	14.32	14.05
29	09.21		05.50	04.54	03.05	02.20	03.59	05.44	07.20	07.55	09.44	10.34
	15.44		20.00	21.42	23.31	00.25	00.25	20.53	18.58	16.09	14.30	14.07
30	09.18		06.46	04.50	03.01	02.22	04.03	05.48	07.23	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	00.23	22.45	18.54	16.05	14.27	14.09
31	09.15		06.42		02.55		04.06	05.51		08.02		10.33
	15.51		20.07		23.38		22.41	20.46		16.02		14.11
Potential sun hours	156	232	362	456	585	658	630	517	395	301	187	116
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, II

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207WTG: 5 - VESTAS V126-3.45 LTq 3450 126.0 !OI hub: 137,0 m (TOT: 200,0 m) (17)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.24	04.10	05.54	07.26	08.06	09.50
	14.13	15.54	17.31	20.10	21.49	23.42	00.21	22.38	20.42	18.50	15.58	14.24
2	10.30	09.08	07.29	06.35	04.42	02.48	02.27	04.13	05.57	07.29	08.09	09.53
	14.15	15.58	17.34	20.13	21.52	23.45	00.19	22.34	20.38	18.47	15.55	14.22
3	10.29	09.05	07.26	06.31	04.39	02.45	02.30	04.17	06.00	07.32	08.13	09.56
	14.18	16.02	17.38	20.16	21.56	23.49	00.16	22.30	20.35	18.43	15.51	14.20
4	10.27	09.01	07.22	06.27	04.35	02.41	02.33	04.21	06.03	07.35	08.16	10.00
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.27	20.31	18.39	15.48	14.17
5	10.26	08.58	07.18	06.23	04.31	02.38	02.37	04.24	06.06	07.38	08.20	10.03
	14.23	16.09	17.44	20.22	22.03	23.56	00.10	22.23	20.27	18.35	15.44	14.15
6	10.24	08.55	07.15	06.20	04.28	02.35	02.40	04.28	06.09	07.41	08.23	10.05
	14.26	16.12	17.47	20.26	22.06	23.59	00.08	22.19	20.23	18.32	15.41	14.13
7	10.22	08.51	07.11	06.16	04.24	02.32	02.43	04.31	06.13	07.44	08.27	10.08
	14.28	16.16	17.51	20.29	22.10	00.03	00.05	22.16	20.20	18.28	15.37	14.11
8	10.20	08.48	07.07	06.12	04.20	02.29	02.47	04.35	06.16	07.47	08.30	10.11
	14.31	16.19	17.54	20.32	22.13	00.06	00.01	22.12	20.16	18.24	15.34	14.09
9	10.18	08.44	07.04	06.08	04.16	02.27	02.50	04.38	06.19	07.50	08.34	10.14
	14.34	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.21	15.31	14.08
10	10.15	08.41	07.00	06.05	04.13	02.24	02.54	04.42	06.22	07.54	08.37	10.16
	14.37	16.27	18.00	20.38	22.21	00.12	23.55	22.04	20.09	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.21	02.57	04.45	06.25	07.57	08.41	10.19
	14.41	16.30	18.04	20.42	22.24	00.15	23.52	22.01	20.05	18.13	15.24	14.05
12	10.11	08.34	06.53	05.57	04.05	02.19	03.01	04.48	06.28	08.00	08.44	10.21
	14.44	16.34	18.07	20.45	22.28	00.18	23.49	21.57	20.01	18.10	15.21	14.03
13	10.08	08.30	06.49	05.53	04.02	02.17	03.01	04.52	06.31	08.03	08.48	10.23
	14.47	16.37	18.10	20.48	22.31	00.21	23.45	21.53	19.57	18.06	15.17	14.02
14	10.06	08.27	06.45	05.50	03.58	02.15	03.04	04.55	06.34	08.06	08.51	10.25
	14.50	16.41	18.13	20.51	22.35	00.23	23.42	21.50	19.54	18.02	15.14	14.01
15	10.03	08.23	06.42	05.46	03.54	02.13	03.08	04.59	06.37	08.09	08.55	10.27
	14.54	16.44	18.16	20.55	22.39	00.25	23.39	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.51	02.11	03.12	05.02	06.40	08.13	08.58	10.29
	14.57	16.47	18.19	20.58	22.42	00.27	23.35	21.42	19.46	17.55	15.08	13.59
17	09.58	08.16	06.34	05.38	03.47	02.10	03.15	05.05	06.43	08.16	09.02	10.30
	15.01	16.51	18.23	21.01	22.46	00.29	23.32	21.38	19.42	17.52	15.05	13.59
18	09.55	08.13	06.30	05.35	03.44	02.09	03.19	05.09	06.46	08.19	09.06	10.31
	15.04	16.54	18.26	21.04	22.50	00.31	23.28	21.35	19.39	17.48	15.01	13.59
19	09.52	08.09	06.27	05.31	03.40	02.08	03.23	05.12	06.49	08.22	09.09	10.33
	15.08	16.58	18.29	21.08	22.54	00.32	23.25	21.31	19.35	17.44	14.58	13.58
20	09.49	08.06	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.26	09.13	10.34
	15.11	17.01	18.32	21.11	22.57	00.33	23.21	21.27	19.31	17.41	14.55	13.58
21	09.46	08.02	06.19	05.23	03.33	02.08	03.30	05.19	06.55	08.29	09.16	10.35
	15.15	17.05	18.35	21.14	23.01	00.33	23.18	21.23	19.27	17.37	14.52	13.59
22	09.43	07.58	06.16	05.20	03.29	02.08	03.34	05.22	06.58	08.32	09.20	10.35
	15.18	17.08	18.38	21.18	23.05	00.33	23.14	21.20	19.24	17.34	14.49	13.59
23	09.40	07.55	06.12	05.16	03.26	02.09	03.37	05.25	07.01	08.35	09.23	10.36
	15.22	17.11	18.41	21.21	23.08	00.33	23.10	21.16	19.20	17.30	14.46	13.59
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.28	07.04	08.39	09.27	10.36
	15.25	17.15	18.45	21.24	23.12	00.33	23.07	21.12	19.16	17.26	14.43	14.00
25	09.34	07.48	06.04	05.09	03.18	02.11	03.45	05.32	07.07	07.42	09.30	10.36
	15.29	17.18	18.48	21.28	23.16	00.32	23.03	21.08	19.13	16.23	14.40	14.01
26	09.31	07.44	06.01	05.05	03.15	02.13	03.48	05.35	07.10	07.45	09.34	10.36
	15.33	17.21	18.51	21.31	23.20	00.31	23.00	21.05	19.09	16.19	14.38	14.02
27	09.28	07.40	05.57	05.01	03.11	02.15	03.52	05.38	07.13	07.49	09.37	10.36
	15.36	17.25	18.54	21.35	23.23	00.29	22.56	21.01	19.05	16.16	14.35	14.04
28	09.24	07.37	05.53	04.57	03.08	02.17	03.55	05.41	07.17	07.52	09.40	10.35
	15.40	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		05.50	04.54	03.05	02.19	03.59	05.44	07.20	07.56	09.44	10.35
	15.43		20.00	21.42	23.31	00.25	22.49	20.53	18.58	16.09	14.30	14.07
30	09.18		06.46	04.50	03.01	02.22	04.03	05.48	07.23	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	22.45	20.50	18.54	16.05	14.27	14.08
31	09.15		06.42		02.54		04.06	05.51		08.02		10.33
	15.51		20.07		23.38		22.41	20.46		16.02		14.10
Potential sun hours	155	232	362	456	585	658	630	517	395	301	187	116
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkangas tuulivoimapaisto, II

Licensed user:
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Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207WTG: 6 - VESTAS V162-6.0 HH199 6000 162.0 IOI hub: 199.0 m (TOT: 280.0 m) (29)

Assumptions for shadow calculations

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.24	04.10	05.54	07.25	08.05	09.50
	14.13	15.54	17.31	20.09	21.48	23.42	00.21	22.37	20.42	18.50	15.58	14.24
2	10.30	09.08	07.29	06.34	04.42	02.47	02.27	04.13	05.57	07.28	08.09	09.53
	14.15	15.58	17.34	20.13	21.52	23.45	00.18	22.34	20.38	18.46	15.54	14.22
3	10.29	09.04	07.25	06.30	04.38	02.44	02.30	04.17	06.00	07.32	08.12	09.56
	14.17	16.01	17.37	20.16	21.55	23.49	00.16	22.30	20.34	18.43	15.51	14.19
4	10.27	09.01	07.22	06.27	04.35	02.41	02.33	04.20	06.03	07.35	08.16	09.59
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.26	20.31	18.39	15.47	14.17
5	10.25	08.58	07.18	06.23	04.31	02.38	02.36	04.24	06.06	07.38	08.19	10.02
	14.22	16.08	17.44	20.22	22.02	23.56	00.10	22.23	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.39	04.27	06.09	07.41	08.23	10.05
	14.25	16.12	17.47	20.25	22.06	23.59	00.07	22.19	20.23	18.31	15.40	14.13
7	10.22	08.51	07.11	06.16	04.23	02.32	02.43	04.31	06.12	07.44	08.26	10.08
	14.28	16.16	17.50	20.28	22.09	00.02	00.04	22.15	20.19	18.28	15.37	14.11
8	10.20	08.47	07.07	06.12	04.20	02.29	02.46	04.34	06.15	07.47	08.30	10.11
	14.31	16.19	17.54	20.32	22.13	00.06	00.01	22.12	20.16	18.24	15.34	14.09
9	10.17	08.44	07.03	06.08	04.16	02.26	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.20	15.30	14.07
10	10.15	08.41	07.00	06.04	04.12	02.23	02.53	04.41	06.21	07.53	08.37	10.16
	14.37	16.26	18.00	20.38	22.20	00.12	23.55	22.04	20.08	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.21	02.57	04.45	06.24	07.56	08.40	10.18
	14.40	16.30	18.03	20.41	22.24	00.15	23.52	22.00	20.04	18.13	15.24	14.04
12	10.10	08.34	06.52	05.57	04.05	02.19	03.00	04.48	06.28	08.00	08.44	10.21
	14.43	16.33	18.06	20.44	22.28	00.18	23.48	21.57	20.01	18.09	15.20	14.03
13	10.08	08.30	06.49	05.53	04.01	02.16	03.00	04.52	06.31	08.03	08.47	10.23
	14.47	16.37	18.10	20.48	22.31	00.21	23.45	21.53	19.57	18.06	15.17	14.02
14	10.05	08.27	06.45	05.49	03.58	02.14	03.04	04.55	06.34	08.06	08.51	10.25
	14.50	16.40	18.13	20.51	22.35	00.23	23.42	21.49	19.53	18.02	15.14	14.01
15	10.03	08.23	06.41	05.46	03.54	02.12	03.07	04.58	06.37	08.09	08.55	10.27
	14.53	16.44	18.16	20.54	22.39	00.25	23.38	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.50	02.11	03.11	05.02	06.40	08.12	08.58	10.28
	14.57	16.47	18.19	20.58	22.42	00.27	23.35	21.42	19.46	17.55	15.07	13.59
17	09.57	08.16	06.34	05.38	03.47	02.10	03.15	05.05	06.43	08.16	09.02	10.30
	15.00	16.51	18.22	21.01	22.46	00.29	23.31	21.38	19.42	17.51	15.04	13.58
18	09.55	08.12	06.30	05.34	03.43	02.08	03.18	05.08	06.46	08.19	09.05	10.31
	15.04	16.54	18.25	21.04	22.50	00.31	23.28	21.34	19.38	17.48	15.01	13.58
19	09.52	08.09	06.26	05.31	03.39	02.08	03.22	05.12	06.49	08.22	09.09	10.32
	15.07	16.57	18.28	21.07	22.53	00.32	23.24	21.31	19.35	17.44	14.58	13.58
20	09.49	08.05	06.23	05.27	03.36	02.07	03.26	05.15	06.52	08.25	09.12	10.33
	15.11	17.01	18.32	21.11	22.57	00.33	23.21	21.27	19.31	17.40	14.55	13.58
21	09.46	08.02	06.19	05.23	03.32	02.07	03.29	05.18	06.55	08.29	09.16	10.34
	15.14	17.04	18.35	21.14	23.01	00.33	23.17	21.23	19.27	17.37	14.52	13.58
22	09.43	07.58	06.15	05.19	03.29	02.08	03.33	05.21	06.58	08.32	09.19	10.35
	15.18	17.08	18.38	21.17	23.04	00.33	23.14	21.19	19.23	17.33	14.49	13.58
23	09.40	07.54	06.12	05.16	03.25	02.08	03.37	05.25	07.01	08.35	09.23	10.35
	15.21	17.11	18.41	21.21	23.08	00.33	23.10	21.16	19.20	17.30	14.46	13.59
24	09.37	07.51	06.08	05.12	03.22	02.09	03.40	05.28	07.04	08.38	09.26	10.36
	15.25	17.14	18.44	21.24	23.12	00.32	23.07	21.12	19.16	17.26	14.43	14.00
25	09.34	07.47	06.04	05.08	03.18	02.11	03.44	05.31	07.07	07.42	09.30	10.36
	15.29	17.18	18.47	21.28	23.16	00.32	23.03	21.08	19.12	16.22	14.40	14.01
26	09.31	07.44	06.00	05.04	03.15	02.12	03.48	05.34	07.10	07.45	09.33	10.36
	15.32	17.21	18.50	21.31	23.19	00.30	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.57	05.01	03.11	02.14	03.51	05.38	07.13	07.48	09.37	10.35
	15.36	17.24	18.54	21.34	23.23	00.29	22.56	21.01	19.05	16.15	14.34	14.03
28	09.24	07.36	05.53	04.57	03.08	02.16	03.55	05.41	07.16	07.52	09.40	10.35
	15.39	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		06.49	04.53	03.04	02.19	03.59	05.44	07.19	07.55	09.43	10.34
	15.43		20.00	21.41	23.31	00.25	22.48	20.53	18.57	16.08	14.29	14.06
30	09.18		06.45	04.50	03.01	02.21	04.02	05.47	07.22	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	22.45	20.49	18.54	16.05	14.27	14.08
31	09.14		06.42		02.54		04.06	05.50		08.02		10.33
	15.50		20.06		23.38		22.41	20.46		16.01		14.10
Potential sun hours	155	232	362	456	585	658	631	517	395	301	187	115
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, II

Licensed user:
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Osmontie 34, PO Box 950
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Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207WTG: 7 - VESTAS V162-6.0 HH199 6000 162.0 IOI hub: 199.0 m (TOT: 280.0 m) (30)

Assumptions for shadow calculations

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0,60	2,61	4,18	6,47	8,80	10,60	9,50	6,88	4,22	2,77	1,22	0,17

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
619	605	559	627	758	839	939	1102	916	649	504	548	8664

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.24	04.10	05.53	07.25	08.05	09.50
	14.13	15.54	17.31	20.09	21.48	23.41	00.21	22.37	20.42	18.50	15.58	14.24
2	10.30	09.08	07.29	06.34	04.42	02.47	02.27	04.13	05.57	07.28	08.09	09.53
	14.15	15.58	17.34	20.12	21.52	23.45	00.18	22.34	20.38	18.46	15.54	14.22
3	10.28	09.04	07.25	06.30	04.38	02.44	02.30	04.17	06.00	07.31	08.12	09.56
	14.17	16.01	17.37	20.16	21.55	23.49	00.16	22.30	20.34	18.43	15.51	14.19
4	10.27	09.01	07.22	06.27	04.35	02.41	02.33	04.20	06.03	07.35	08.16	09.59
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.26	20.31	18.39	15.47	14.17
5	10.25	08.58	07.18	06.23	04.31	02.38	02.36	04.24	06.06	07.38	08.19	10.02
	14.22	16.08	17.44	20.22	22.02	23.56	00.10	22.23	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.39	04.27	06.09	07.41	08.23	10.05
	14.25	16.12	17.47	20.25	22.06	23.59	00.07	22.19	20.23	18.31	15.40	14.13
7	10.21	08.51	07.11	06.16	04.24	02.32	02.43	04.31	06.12	07.44	08.26	10.08
	14.28	16.16	17.50	20.28	22.09	00.02	00.04	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.29	02.46	04.34	06.15	07.47	08.30	10.11
	14.31	16.19	17.54	20.32	22.13	00.06	00.01	22.11	20.16	18.24	15.34	14.09
9	10.17	08.44	07.03	06.08	04.16	02.26	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.20	15.30	14.07
10	10.15	08.41	07.00	06.04	04.12	02.24	02.53	04.41	06.21	07.53	08.37	10.16
	14.37	16.26	18.00	20.38	22.20	00.12	23.55	22.04	20.08	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.21	02.57	04.45	06.24	07.56	08.40	10.18
	14.40	16.30	18.03	20.41	22.24	00.15	23.52	22.00	20.04	18.13	15.24	14.04
12	10.10	08.34	06.52	05.57	04.05	02.19	03.00	04.48	06.28	08.00	08.44	10.20
	14.43	16.33	18.06	20.44	22.27	00.18	23.48	21.57	20.01	18.09	15.20	14.03
13	10.08	08.30	06.49	05.53	04.01	02.16	03.00	04.52	06.31	08.03	08.47	10.23
	14.47	16.37	18.10	20.48	22.31	00.20	23.45	21.53	19.57	18.06	15.17	14.02
14	10.05	08.27	06.45	05.49	03.58	02.14	03.04	04.55	06.34	08.06	08.51	10.25
	14.50	16.40	18.13	20.51	22.35	00.23	23.42	21.49	19.53	18.02	15.14	14.01
15	10.03	08.23	06.41	05.46	03.54	02.13	03.08	04.58	06.37	08.09	08.54	10.26
	14.53	16.44	18.16	20.54	22.38	00.25	23.38	21.45	19.49	17.58	15.11	14.00
16	10.00	08.19	06.38	05.42	03.50	02.11	03.11	05.02	06.40	08.12	08.58	10.28
	14.57	16.47	18.19	20.57	22.42	00.27	23.35	21.42	19.46	17.55	15.07	13.59
17	09.57	08.16	06.34	05.38	03.47	02.10	03.15	05.05	06.43	08.15	09.02	10.30
	15.00	16.51	18.22	21.01	22.46	00.29	23.31	21.38	19.42	17.51	15.04	13.59
18	09.54	08.12	06.30	05.34	03.43	02.09	03.18	05.08	06.46	08.19	09.05	10.31
	15.04	16.54	18.25	21.04	22.50	00.30	23.28	21.34	19.38	17.48	15.01	13.58
19	09.52	08.09	06.26	05.31	03.40	02.08	03.22	05.12	06.49	08.22	09.09	10.32
	15.07	16.57	18.28	21.07	22.53	00.31	23.24	21.31	19.35	17.44	14.58	13.58
20	09.49	08.05	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.25	09.12	10.33
	15.11	17.01	18.32	21.11	22.57	00.32	23.21	21.27	19.31	17.40	14.55	13.58
21	09.46	08.02	06.19	05.23	03.32	02.08	03.30	05.18	06.55	08.28	09.16	10.34
	15.14	17.04	18.35	21.14	23.01	00.33	23.17	21.23	19.27	17.37	14.52	13.58
22	09.43	07.58	06.15	05.19	03.29	02.08	03.33	05.21	06.58	08.32	09.19	10.35
	15.18	17.08	18.38	21.17	23.04	00.33	23.14	21.19	19.23	17.33	14.49	13.59
23	09.40	07.54	06.12	05.16	03.25	02.09	03.37	05.25	07.01	08.35	09.23	10.35
	15.21	17.11	18.41	21.21	23.08	00.33	23.10	21.16	19.20	17.30	14.46	13.59
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.28	07.04	08.38	09.26	10.36
	15.25	17.14	18.44	21.24	23.12	00.32	23.06	21.12	19.16	17.26	14.43	14.00
25	09.34	07.47	06.04	05.08	03.18	02.11	03.44	05.31	07.07	07.42	09.30	10.36
	15.29	17.18	18.47	21.27	23.16	00.31	23.03	21.08	19.12	16.22	14.40	14.01
26	09.30	07.44	06.00	05.04	03.15	02.12	03.48	05.34	07.10	07.45	09.33	10.36
	15.32	17.21	18.50	21.31	23.19	00.30	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.57	05.01	03.11	02.14	03.51	05.38	07.13	07.48	09.37	10.35
	15.36	17.24	18.54	21.34	23.23	00.29	22.56	21.01	19.05	16.15	14.35	14.03
28	09.24	07.36	05.53	04.57	03.08	02.16	03.55	05.41	07.16	07.52	09.40	10.35
	15.39	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		06.49	04.53	03.04	02.19	03.59	05.44	07.19	07.55	09.43	10.34
	15.43		20.00	21.41	23.30	00.25	22.48	20.53	18.57	16.08	14.29	14.06
30	09.18		06.45	04.50	03.01	02.21	04.02	05.47	07.22	07.59	09.47	10.33
	15.47		20.03	21.45	23.34	00.23	22.45	20.49	18.54	16.05	14.27	14.08
31	09.14		06.42		02.54		04.06	05.50		08.02		10.32
	15.50		20.06		23.38		22.41	20.46		16.01		14.10
Potential sun hours	155	232	362	456	585	658	630	517	395	301	187	116
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
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Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207WTG: 8 - VESTAS V162-6.0 HH199 6000 162.0 IOI hub: 199.0 m (TOT: 280.0 m) (31)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.24	04.09	05.53	07.25	08.05	09.50
	14.13	15.54	17.31	20.09	21.48	23.41	00.21	22.37	20.42	18.50	15.58	14.24
2	10.30	09.08	07.29	06.34	04.42	02.47	02.27	04.13	05.57	07.28	08.09	09.53
	14.15	15.57	17.34	20.12	21.52	23.45	00.18	22.34	20.38	18.46	15.54	14.22
3	10.28	09.04	07.25	06.30	04.38	02.44	02.30	04.17	06.00	07.31	08.12	09.56
	14.17	16.01	17.37	20.16	21.55	23.48	00.16	22.30	20.34	18.42	15.51	14.19
4	10.27	09.01	07.22	06.27	04.35	02.41	02.33	04.20	06.03	07.34	08.16	09.59
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.26	20.31	18.39	15.47	14.17
5	10.25	08.58	07.18	06.23	04.31	02.38	02.36	04.24	06.06	07.38	08.19	10.02
	14.22	16.08	17.44	20.22	22.02	23.55	00.10	22.23	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.39	04.27	06.09	07.41	08.23	10.05
	14.25	16.12	17.47	20.25	22.06	23.59	00.07	22.19	20.23	18.31	15.40	14.13
7	10.21	08.51	07.11	06.15	04.23	02.32	02.43	04.31	06.12	07.44	08.26	10.08
	14.28	16.15	17.50	20.28	22.09	00.02	00.04	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.29	02.46	04.34	06.15	07.47	08.30	10.11
	14.31	16.19	17.53	20.31	22.13	00.05	00.01	22.11	20.16	18.24	15.34	14.09
9	10.17	08.44	07.03	06.08	04.16	02.26	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.23	17.57	20.35	22.16	00.09	02.58	22.08	20.12	18.20	15.30	14.07
10	10.15	08.40	07.00	06.04	04.12	02.23	02.53	04.41	06.21	07.53	08.37	10.16
	14.37	16.26	18.00	20.38	22.20	00.12	23.55	22.04	20.08	18.17	15.27	14.06
11	10.13	08.37	06.56	06.00	04.09	02.21	02.57	04.45	06.24	07.56	08.40	10.18
	14.40	16.30	18.03	20.41	22.24	00.15	23.51	22.00	20.04	18.13	15.24	14.04
12	10.10	08.33	06.52	05.57	04.05	02.19	03.00	04.48	06.27	07.59	08.44	10.20
	14.43	16.33	18.06	20.44	22.27	00.17	23.48	21.57	20.01	18.09	15.20	14.03
13	10.08	08.30	06.49	05.53	04.01	02.16	03.00	04.51	06.30	08.03	08.47	10.23
	14.47	16.37	18.09	20.48	22.31	00.20	23.45	21.53	19.57	18.06	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.14	03.04	04.55	06.34	08.06	08.51	10.25
	14.50	16.40	18.13	20.51	22.35	00.23	23.41	21.49	19.53	18.02	15.14	14.01
15	10.03	08.23	06.41	05.45	03.54	02.13	03.07	04.58	06.37	08.09	08.54	10.26
	14.53	16.44	18.16	20.54	22.38	00.25	23.38	21.45	19.49	17.58	15.10	14.00
16	10.00	08.19	06.37	05.42	03.50	02.11	03.11	05.02	06.40	08.12	08.58	10.28
	14.57	16.47	18.19	20.57	22.42	00.27	23.35	21.42	19.46	17.55	15.07	13.59
17	09.57	08.16	06.34	05.38	03.47	02.10	03.15	05.05	06.43	08.15	09.02	10.30
	15.00	16.50	18.22	21.01	22.46	00.29	23.31	21.38	19.42	17.51	15.04	13.58
18	09.54	08.12	06.30	05.34	03.43	02.09	03.18	05.08	06.46	08.19	09.05	10.31
	15.04	16.54	18.25	21.04	22.49	00.30	23.28	21.34	19.38	17.47	15.01	13.58
19	09.52	08.09	06.26	05.30	03.39	02.08	03.22	05.12	06.49	08.22	09.09	10.32
	15.07	16.57	18.28	21.07	22.53	00.31	23.24	21.30	19.34	17.44	14.58	13.58
20	09.49	08.05	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.25	09.12	10.33
	15.11	17.01	18.31	21.11	22.57	00.32	23.21	21.27	19.31	17.40	14.55	13.58
21	09.46	08.02	06.19	05.23	03.32	02.07	03.29	05.18	06.55	08.28	09.16	10.34
	15.14	17.04	18.35	21.14	23.01	00.33	23.17	21.23	19.27	17.37	14.52	13.58
22	09.43	07.58	06.15	05.19	03.29	02.08	03.33	05.21	06.58	08.32	09.19	10.35
	15.18	17.07	18.38	21.17	23.04	00.33	23.14	21.19	19.23	17.33	14.49	13.58
23	09.40	07.54	06.11	05.16	03.25	02.08	03.37	05.25	07.01	08.35	09.23	10.35
	15.21	17.11	18.41	21.21	23.08	00.33	23.10	21.15	19.20	17.29	14.46	13.59
24	09.37	07.51	06.08	05.12	03.22	02.09	03.40	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.12	00.32	23.06	21.12	19.16	17.26	14.43	14.00
25	09.34	07.47	06.04	05.08	03.18	02.11	03.44	05.31	07.07	07.42	09.30	10.36
	15.29	17.18	18.47	21.27	23.15	00.31	23.03	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.04	03.14	02.12	03.48	05.34	07.10	07.45	09.33	10.35
	15.32	17.21	18.50	21.31	23.19	00.30	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.57	05.01	03.11	02.14	03.51	05.38	07.13	07.48	09.36	10.35
	15.36	17.24	18.53	21.34	23.23	00.29	22.56	21.00	19.05	16.15	14.34	14.03
28	09.24	07.36	05.53	04.57	03.08	02.16	03.55	05.41	07.16	07.52	09.40	10.35
	15.39	17.27	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		06.49	04.53	03.04	02.19	03.59	05.44	07.19	07.55	09.43	10.34
	15.43		20.00	21.41	23.30	00.25	22.48	20.53	18.57	16.08	14.29	14.06
30	09.18		06.45	04.49	03.01	02.21	04.02	05.47	07.22	07.58	09.46	10.33
	15.47		20.03	21.45	23.34	00.23	22.45	20.49	18.54	16.05	14.27	14.08
31	09.14		06.42		02.54		04.06	05.50		08.02		10.32
	15.50		20.06		23.38		22.41	20.46		16.01		14.10
Potential sun hours	155	232	362	456	585	658	630	517	395	301	187	116
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkangas tuulivoimapuisto, II

Licensed user:
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Osmontie 34, PO Box 950
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+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207WTG: 9 - VESTAS V162-6.0 HH199 6000 162.0 IOI hub: 199.0 m (TOT: 280.0 m) (32)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.50	02.24	04.09	05.53	07.25	08.05	09.50
	14.12	15.54	17.31	20.09	21.48	23.41	00.21	22.37	20.42	18.50	15.58	14.24
2	10.30	09.08	07.29	06.34	04.42	02.47	02.27	04.13	05.56	07.28	08.09	09.53
	14.15	15.57	17.34	20.12	21.52	23.45	00.18	22.34	20.38	18.46	15.54	14.21
3	10.28	09.04	07.25	06.30	04.38	02.44	02.30	04.16	06.00	07.31	08.12	09.56
	14.17	16.01	17.37	20.15	21.55	23.48	00.16	22.30	20.34	18.42	15.51	14.19
4	10.27	09.01	07.22	06.27	04.34	02.41	02.33	04.20	06.03	07.34	08.16	09.59
	14.20	16.05	17.40	20.19	21.59	23.52	00.13	22.26	20.30	18.39	15.47	14.17
5	10.25	08.58	07.18	06.23	04.31	02.38	02.36	04.24	06.06	07.37	08.19	10.02
	14.22	16.08	17.44	20.22	22.02	23.56	00.10	22.22	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.39	04.27	06.09	07.41	08.23	10.05
	14.25	16.12	17.47	20.25	22.06	23.59	00.07	22.19	20.23	18.31	15.40	14.13
7	10.21	08.51	07.11	06.15	04.23	02.32	02.42	04.31	06.12	07.44	08.26	10.08
	14.28	16.15	17.50	20.28	22.09	00.02	00.04	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.29	02.46	04.34	06.15	07.47	08.30	10.11
	14.31	16.19	17.53	20.31	22.13	00.06	00.01	22.11	20.15	18.24	15.33	14.09
9	10.17	08.44	07.03	06.08	04.16	02.26	02.49	04.38	06.18	07.50	08.33	10.13
	14.34	16.22	17.57	20.35	22.16	00.09	02.58	22.08	20.12	18.20	15.30	14.07
10	10.15	08.40	07.00	06.04	04.12	02.23	02.53	04.41	06.21	07.53	08.37	10.16
	14.37	16.26	18.00	20.38	22.20	00.12	23.55	22.04	20.08	18.17	15.27	14.05
11	10.13	08.37	06.56	06.00	04.09	02.21	02.56	04.44	06.24	07.56	08.40	10.18
	14.40	16.30	18.03	20.41	22.24	00.15	23.52	22.00	20.04	18.13	15.23	14.04
12	10.10	08.33	06.52	05.57	04.05	02.18	03.00	04.48	06.27	07.59	08.44	10.20
	14.43	16.33	18.06	20.44	22.27	00.18	23.48	21.57	20.01	18.09	15.20	14.03
13	10.08	08.30	06.48	05.53	04.01	02.16	03.00	04.51	06.30	08.03	08.47	10.23
	14.46	16.37	18.09	20.48	22.31	00.20	23.45	21.53	19.57	18.06	15.17	14.01
14	10.05	08.26	06.45	05.49	03.58	02.14	03.04	04.55	06.33	08.06	08.51	10.25
	14.50	16.40	18.13	20.51	22.35	00.23	23.41	21.49	19.53	18.02	15.14	14.00
15	10.03	08.23	06.41	05.45	03.54	02.12	03.07	04.58	06.36	08.09	08.54	10.26
	14.53	16.43	18.16	20.54	22.38	00.25	23.38	21.45	19.49	17.58	15.10	14.00
16	10.00	08.19	06.37	05.42	03.50	02.11	03.11	05.01	06.40	08.12	08.58	10.28
	14.57	16.47	18.19	20.57	22.42	00.27	23.35	21.42	19.46	17.55	15.07	13.59
17	09.57	08.16	06.34	05.38	03.47	02.09	03.15	05.05	06.43	08.15	09.01	10.30
	15.00	16.50	18.22	21.01	22.46	00.29	23.31	21.38	19.42	17.51	15.04	13.58
18	09.54	08.12	06.30	05.34	03.43	02.08	03.18	05.08	06.46	08.19	09.05	10.31
	15.03	16.54	18.25	21.04	22.49	00.30	23.28	21.34	19.38	17.47	15.01	13.58
19	09.52	08.09	06.26	05.30	03.39	02.08	03.22	05.11	06.49	08.22	09.09	10.32
	15.07	16.57	18.28	21.07	22.53	00.31	23.24	21.30	19.34	17.44	14.58	13.58
20	09.49	08.05	06.23	05.27	03.36	02.07	03.26	05.15	06.52	08.25	09.12	10.33
	15.11	17.01	18.31	21.11	22.57	00.32	23.21	21.27	19.31	17.40	14.55	13.58
21	09.46	08.01	06.19	05.23	03.32	02.07	03.29	05.18	06.55	08.28	09.16	10.34
	15.14	17.04	18.35	21.14	23.01	00.33	23.17	21.23	19.27	17.37	14.52	13.58
22	09.43	07.58	06.15	05.19	03.29	02.07	03.33	05.21	06.58	08.32	09.19	10.35
	15.18	17.07	18.38	21.17	23.04	00.33	23.14	21.19	19.23	17.33	14.49	13.58
23	09.40	07.54	06.11	05.15	03.25	02.08	03.37	05.25	07.01	08.35	09.23	10.35
	15.21	17.11	18.41	21.21	23.08	00.33	23.10	21.15	19.19	17.29	14.46	13.59
24	09.37	07.51	06.08	05.12	03.21	02.09	03.40	05.28	07.04	08.38	09.26	10.36
	15.25	17.14	18.44	21.24	23.12	00.32	23.06	21.12	19.16	17.26	14.43	14.00
25	09.34	07.47	06.04	05.08	03.18	02.10	03.44	05.31	07.07	07.42	09.30	10.36
	15.28	17.17	18.47	21.27	23.15	00.31	23.03	21.08	19.12	16.22	14.40	14.00
26	09.30	07.43	06.00	05.04	03.14	02.12	03.48	05.34	07.10	07.45	09.33	10.36
	15.32	17.21	18.50	21.31	23.19	00.30	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.56	05.00	03.11	02.14	03.51	05.37	07.13	07.48	09.36	10.35
	15.36	17.24	18.53	21.34	23.23	00.29	22.56	21.00	19.05	16.15	14.34	14.03
28	09.24	07.36	05.53	04.57	03.07	02.16	03.55	05.41	07.16	07.52	09.40	10.35
	15.39	17.27	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.04
29	09.21		06.49	04.53	03.04	02.18	03.58	05.44	07.19	07.55	09.43	10.34
	15.43		20.00	21.41	23.30	00.25	22.48	20.53	18.57	16.08	14.29	14.06
30	09.18		06.45	04.49	03.00	02.21	04.02	05.47	07.22	07.58	09.46	10.33
	15.47		20.03	21.45	23.34	00.23	22.45	20.49	18.53	16.05	14.26	14.08
31	09.14		06.42		02.54		04.06	05.50		08.02		10.32
	15.50		20.06		23.38		22.41	20.45		16.01		14.10
Potential sun hours	155	232	362	456	585	658	631	517	395	301	187	115
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207 WTG: 10 - VESTAS V162-6.0 HH199 6000 162.0 IOI hub: 199.0 m (TOT: 280.0 m) (33)
Sunshine probability S (Average daily sunshine hours) [LULEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1102 916 649 504 548 8664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31 14.12	09.11 15.54	07.32 17.31	15.55-16.15/20 20.09	06.38 20.09	04.46 21.48	02.50 23.41	02.24 00.20	04.09 22.37	05.53 20.42	07.25 18.50	08.05 15.58
2	10.30 14.15	09.08 15.57	07.29 17.34	15.56-16.14/18 20.12	06.34 20.12	04.42 21.51	02.47 23.45	02.27 00.18	22.37 22.33	04.13 20.38	07.28 18.46	08.09 15.54
3	10.28 14.17	09.04 16.01	07.25 17.37	15.58-16.13/15 20.15	06.30 20.15	04.38 21.55	02.44 23.48	02.30 00.15	04.16 22.30	06.00 20.34	07.31 18.42	08.12 15.51
4	10.27 14.20	09.01 16.05	07.22 17.40	15.59-16.11/12 20.19	06.27 20.19	04.34 21.58	02.41 23.52	02.33 00.13	04.20 22.26	06.03 20.30	07.34 18.39	08.16 15.47
5	10.25 14.22	08.57 16.08	07.18 17.44	16.03-16.08/5 20.22	06.23 20.22	04.31 21.55	02.38 23.55	02.36 00.10	04.24 22.22	06.06 20.27	07.37 18.35	08.19 15.44
6	10.23 14.25	08.54 16.12	07.14 17.47	20.19	06.19 20.25	04.27 22.06	02.35 23.59	02.39 00.07	04.27 22.19	06.09 20.23	07.41 18.31	08.22 15.40
7	10.21 14.28	08.51 16.15	07.11 17.50	20.18	06.15 20.28	04.23 22.09	02.32 00.02	02.43 00.04	04.31 22.15	06.12 20.19	07.44 18.28	08.26 15.37
8	10.19 14.31	08.47 16.19	07.07 17.53	20.17	06.12 20.31	04.20 22.13	02.29 00.05	02.46 00.01	04.34 22.11	06.15 20.15	07.47 18.24	08.30 15.33
9	10.17 14.34	08.44 16.22	07.03 17.57	20.16	06.08 20.35	04.16 22.16	02.26 00.09	02.49 23.58	04.38 22.08	06.18 20.12	07.50 18.20	08.33 15.30
10	10.15 14.37	08.40 16.26	06.59 18.00	20.15	06.04 20.38	04.12 22.20	02.23 00.12	02.53 23.55	04.41 22.04	06.21 20.08	07.53 18.17	08.37 15.27
11	10.12 14.40	08.37 16.29	06.56 18.03	20.14	06.00 20.41	04.09 22.24	02.21 00.15	02.57 23.51	04.44 22.00	06.24 20.04	07.56 18.13	08.40 15.23
12	10.10 14.43	08.33 16.33	06.52 18.06	20.13	05.57 20.44	04.05 22.27	02.18 00.17	03.00 23.48	04.48 21.56	06.27 20.00	07.59 18.09	08.44 15.20
13	10.08 14.46	08.30 16.37	06.48 18.09	20.12	05.53 20.47	04.01 22.31	02.16 00.20	03.00 23.45	04.51 21.53	06.30 19.57	08.02 18.06	08.47 15.17
14	10.05 14.50	08.26 16.40	06.45 18.12	20.11	05.49 20.51	03.58 22.35	02.14 00.23	03.04 23.41	04.55 21.49	06.33 19.53	08.06 18.02	08.51 15.14
15	10.02 14.53	08.23 16.43	06.41 18.16	20.10	05.45 20.54	03.54 22.38	02.12 00.25	03.07 23.38	04.58 21.45	06.36 19.49	08.09 17.58	08.54 15.10
16	10.00 14.57	08.19 16.47	06.37 18.19	20.09	05.42 20.57	03.50 22.42	02.11 00.27	03.11 23.34	05.01 21.42	06.39 19.46	08.12 17.55	08.58 15.07
17	09.57 15.00	08.16 16.50	06.34 18.22	20.08	05.38 21.01	03.47 22.46	02.09 00.29	03.15 23.31	05.05 21.38	06.43 19.42	08.15 17.51	09.01 15.04
18	09.54 15.03	08.12 16.54	06.30 18.25	20.07	05.34 21.04	03.43 22.49	02.08 00.30	03.18 23.28	05.08 21.34	06.46 19.38	08.18 17.47	09.05 15.01
19	09.51 15.07	08.09 16.57	06.26 18.28	20.06	05.30 21.07	03.39 22.53	02.08 00.31	03.22 23.24	05.11 21.30	06.49 19.34	08.22 17.44	09.08 14.58
20	09.49 15.11	08.05 17.01	16.02-16.12/10 18.31	20.05	06.22 21.10	06.22 22.57	02.07 00.32	03.26 23.21	05.15 21.27	06.52 19.31	08.25 17.40	09.12 14.55
21	09.46 15.14	08.01 17.04	16.00-16.14/14 18.35	20.04	06.19 21.14	06.21 23.00	02.07 00.33	03.29 23.17	05.18 21.23	06.55 19.27	08.28 17.37	09.16 14.52
22	09.43 15.18	07.58 17.07	15.58-16.15/17 18.38	20.03	06.15 21.17	06.23 23.04	02.08 00.33	03.33 23.13	05.21 21.19	06.58 19.23	08.32 17.33	09.19 14.49
23	09.40 15.21	07.54 17.11	15.57-16.16/19 18.41	20.02	06.11 21.21	06.25 23.08	02.08 00.32	03.37 23.10	05.25 21.15	07.01 19.19	08.35 17.29	09.23 14.46
24	09.37 15.25	07.51 17.14	15.56-16.17/21 18.44	20.01	06.08 21.24	06.27 23.12	02.09 00.32	03.40 23.06	05.28 21.12	07.04 19.16	08.38 17.26	09.26 14.43
25	09.33 15.28	07.47 17.17	15.56-16.17/21 18.47	20.00	06.04 21.27	06.29 23.15	02.11 00.31	03.44 23.03	05.31 21.08	07.07 19.12	07.41 16.22	09.30 14.40
26	09.30 15.32	07.43 17.21	15.55-16.17/22 18.50	20.00	06.00 21.31	06.30 23.19	02.12 00.30	03.48 22.59	05.34 21.04	07.10 19.08	07.45 16.19	09.33 14.37
27	09.27 15.36	07.40 17.24	15.55-16.16/21 18.53	20.00	05.56 21.34	06.31 23.23	02.14 00.29	03.51 22.55	05.37 21.00	07.13 19.05	07.48 16.15	09.36 14.34
28	09.24 15.39	07.36 17.27	15.55-16.16/21 18.56	20.00	05.53 21.38	06.32 23.26	02.16 00.27	03.55 22.52	05.41 20.57	07.16 19.01	07.52 16.12	09.40 14.32
29	09.21 15.43	07.33 17.31	15.54-16.16/21 18.59	20.00	05.49 21.41	06.33 23.29	02.17 00.25	03.58 22.48	05.44 20.53	07.19 18.57	07.55 16.08	09.43 14.29
30	09.17 15.47	07.30 17.34	15.53-16.16/21 19.02	20.00	05.45 21.44	06.34 23.30	02.19 00.25	03.58 22.48	05.44 20.53	07.19 18.57	07.55 16.08	09.43 14.29
31	09.14 15.50	07.27 17.37	15.52-16.16/21 19.05	20.00	05.41 21.44	06.35 23.31	02.21 00.23	04.02 22.44	05.47 20.49	07.22 18.53	07.58 16.05	09.46 14.26
Potential sun hours	155	232	362	456	585	658	630	517	395	301	187	116
Sum of minutes with flicker	0	166	70	0	0	0	0	0	0	236	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

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, li

Licensed user:
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Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.02/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207 WTG: 11 - VESTAS V162-6.0 HH199 6000 162.0 IOI hub: 199,0 m (TOT: 280,0 m) (34)
Sunshine probability S (Average daily sunshine hours) [LULEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December		
1	10.31	09.11	07.32	06.38	04.45	02.50	02.24	04.09	05.53	07.25	08.05	13.42-14.10/28	09.50	
	14.12	15.54	17.31	20.09	21.48	23.41	00.20	22.37	20.42	18.50	15.57		14.24	
2	10.30	09.07	14.22-14.29/7	07.29	06.34	04.42	02.47	02.27	04.13	05.56	07.28	08.09	13.43-14.10/27	09.53
	14.15	15.57	17.34	20.12	21.51	23.45	00.18	22.33	20.38	18.46	15.54		14.21	
3	10.28	09.04	14.20-14.33/13	07.25	06.30	04.38	02.44	02.30	04.16	05.59	07.31	08.12	13.43-14.10/27	09.56
	14.17	16.01	17.37	20.15	21.55	23.48	00.15	22.30	20.34	18.42	15.50		14.19	
4	10.27	09.01	14.17-14.35/18	07.21	06.26	04.34	02.41	02.33	04.20	06.03	07.34	08.15	13.44-14.09/25	09.59
	14.20	16.04	17.40	20.19	21.58	23.52	00.13	22.26	20.30	18.39	15.47		14.17	
5	10.25	08.57	14.16-14.37/21	07.18	06.23	04.31	02.38	02.36	04.23	06.06	07.37	08.19	13.45-14.07/22	10.02
	14.22	16.08	17.44	20.22	22.02	23.55	00.10	22.22	20.27	18.35	15.44		14.15	
6	10.23	08.54	14.15-14.38/23	07.14	06.19	04.27	02.35	02.39	04.27	06.09	07.40	08.22	13.47-14.07/20	10.05
	14.25	16.12	17.47	20.25	22.06	23.59	00.07	22.19	20.23	18.31	15.40		14.13	
7	10.21	08.51	14.14-14.39/25	07.10	06.15	04.23	02.32	02.43	04.31	06.12	07.44	08.26	13.48-14.05/17	10.08
	14.28	16.15	17.50	20.28	22.09	00.02	00.04	22.15	20.19	18.27	15.37		14.11	
8	10.19	08.47	14.13-14.39/26	07.07	06.11	04.20	02.29	02.46	04.34	06.15	07.47	08.29	13.50-14.03/13	10.10
	14.31	16.19	17.53	20.31	22.13	00.05	00.01	22.11	20.15	18.24	15.33		14.09	
9	10.17	08.44	14.13-14.40/27	07.03	06.08	04.16	02.26	02.49	04.37	06.18	07.50	08.33	13.54-13.59/5	10.13
	14.34	16.22	17.56	20.34	22.16	00.08	23.58	22.07	20.12	18.20	15.30		14.07	
10	10.15	08.40	14.12-14.41/29	06.59	06.04	04.12	02.23	02.53	04.41	06.21	07.53	08.36		10.16
	14.37	16.26	18.00	20.38	22.20	00.12	23.54	22.04	20.08	18.16	15.27		14.05	
11	10.12	08.37	14.12-14.41/29	06.56	06.00	04.08	02.21	02.56	04.44	06.24	07.56	08.40		10.18
	14.40	16.29	18.03	20.41	22.24	00.14	23.51	22.00	20.04	18.13	15.23		14.04	
12	10.10	08.33	14.12-14.42/30	06.52	05.56	04.05	02.18	03.00	04.48	06.27	07.59	08.44		10.20
	14.43	16.33	18.06	20.44	22.27	00.17	23.48	21.56	20.00	18.09	15.20		14.03	
13	10.08	08.30	14.12-14.42/30	06.48	05.53	04.01	02.16	03.00	04.51	06.30	08.02	08.47		10.22
	14.46	16.36	18.09	20.47	22.31	00.20	23.45	21.53	19.57	18.05	15.17		14.01	
14	10.05	08.26	14.12-14.42/30	06.45	05.49	03.57	02.14	03.04	04.55	06.33	08.06	08.51		10.24
	14.50	16.40	18.12	20.51	22.34	00.22	23.41	21.49	19.53	18.02	15.13		14.00	
15	10.02	08.23	14.13-14.42/29	06.41	05.45	03.54	02.12	03.07	04.58	06.36	08.09	08.54		10.26
	14.53	16.43	18.16	20.54	22.38	00.25	23.38	21.45	19.49	17.58	15.10		14.00	
16	10.00	08.19	14.13-14.41/28	06.37	05.42	03.50	02.11	03.11	05.01	06.39	08.12	08.58		10.28
	14.56	16.47	18.19	20.57	22.42	00.27	23.34	21.41	19.45	17.55	15.07		13.59	
17	09.57	08.16	14.13-14.41/28	06.34	05.38	03.46	02.09	03.15	05.05	06.42	08.15	09.01		10.29
	15.00	16.50	18.22	21.00	22.46	00.28	23.31	21.38	19.42	17.51	15.04		13.58	
18	09.54	08.12	14.14-14.40/26	06.30	05.34	03.43	02.08	03.18	05.08	06.45	08.18	09.05		10.31
	15.03	16.54	18.25	21.04	22.49	00.30	23.27	21.34	19.38	17.47	15.01		13.58	
19	09.51	08.08	14.15-14.39/24	06.26	05.30	03.39	02.08	03.22	05.11	06.49	08.22	14.53-15.03/10		10.32
	15.07	16.57	18.28	21.07	22.53	00.31	23.24	21.30	19.34	17.44	14.58		13.58	
20	09.48	08.05	14.16-14.38/22	06.22	05.27	03.36	02.07	03.26	05.15	06.52	08.25	14.50-15.06/16		10.33
	15.10	17.01	18.31	21.10	22.57	00.32	23.20	21.26	19.31	17.40	14.55		13.58	
21	09.45	08.01	14.17-14.37/20	06.19	05.23	03.32	02.07	03.29	05.18	06.55	08.28	14.47-15.07/20		10.34
	15.14	17.04	18.34	21.14	23.00	00.32	23.17	21.23	19.27	17.36	14.52		13.58	
22	09.43	07.58	14.20-14.34/14	06.15	05.19	03.28	02.08	03.33	05.21	06.58	08.31	14.45-15.08/23		10.35
	15.18	17.07	18.38	21.17	23.04	00.33	23.13	21.19	19.23	17.33	14.49		13.58	
23	09.39	07.54	14.24-14.30/6	06.11	05.15	03.25	02.08	03.37	05.24	07.01	08.35	14.44-15.10/26		10.35
	15.21	17.11	18.41	21.20	23.08	00.32	23.10	21.15	19.19	17.29	14.46		13.59	
24	09.36	07.51		06.08	05.12	03.21	02.09	03.40	05.28	07.04	08.38	14.44-15.10/26		10.35
	15.25	17.14		18.44	21.24	23.12	00.32	23.06	21.12	19.16	17.26		14.43	
25	09.33	07.47		06.04	05.08	03.18	02.11	03.44	05.31	07.07	07.41	13.43-14.11/28		10.35
	15.28	17.17		18.47	21.27	23.15	00.31	23.03	21.08	19.12	16.22		14.40	
26	09.30	07.43		06.00	05.04	03.14	02.12	03.48	05.34	07.10	07.45	13.42-14.11/29		10.35
	15.32	17.21		18.50	21.31	23.19	00.30	22.59	21.04	19.08	16.19		14.37	
27	09.27	07.40		05.56	05.00	03.11	02.14	03.51	05.37	07.13	07.48	13.42-14.11/29		10.35
	15.36	17.24		18.53	21.34	23.23	00.28	22.55	21.00	19.04	16.15		14.34	
28	09.24	07.36		05.53	04.57	03.07	02.16	03.55	05.41	07.16	07.51	13.41-14.11/30		10.35
	15.39	17.27		18.56	21.37	23.26	00.27	22.52	20.57	19.01	16.11		14.32	
29	09.21			06.49	04.53	03.04	02.18	03.58	05.44	07.19	07.55	13.41-14.11/30		10.34
	15.43			20.00	21.41	23.30	00.25	22.48	20.53	18.57	16.08		14.29	
30	09.17			06.45	04.49	03.00	02.21	04.02	05.47	07.22	07.58	13.41-14.11/30		10.33
	15.46			20.03	21.44	23.34	00.23	22.44	20.49	18.53	16.04		14.28	
31	09.14			06.41		02.54		04.06	05.50		08.02	13.42-14.11/29		10.32
	15.50			20.06		23.37		22.41	20.45		16.01		14.10	
Potential sun hours	155	232	362	456	585	658	630	517	395	301	187	184	116	
Sum of minutes with flicker	0	505	0	0	0	0	0	0	0	326	184	0	0	

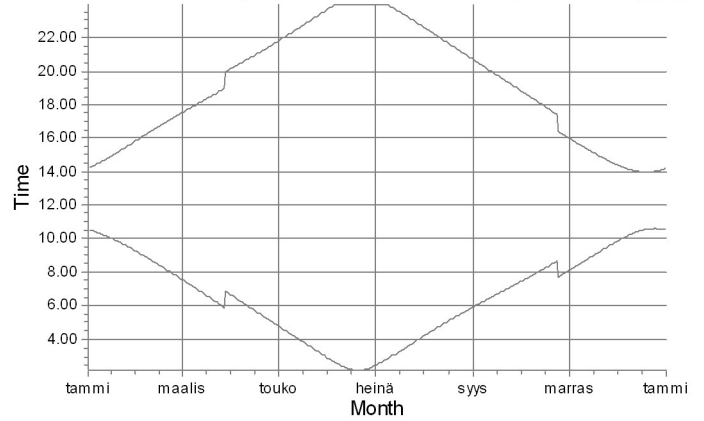
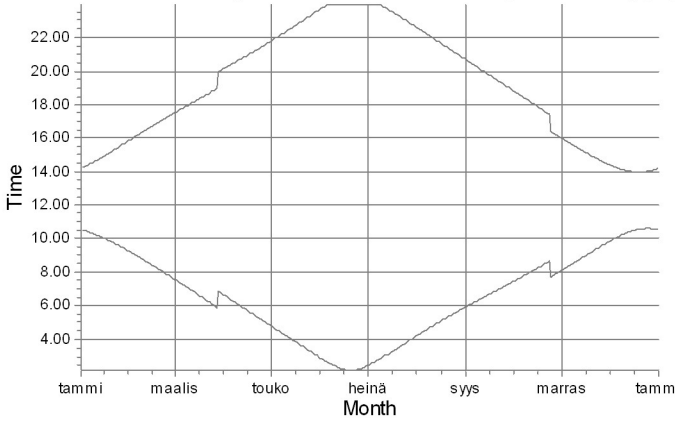
Table layout: For each day in each month the following matrix apply

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

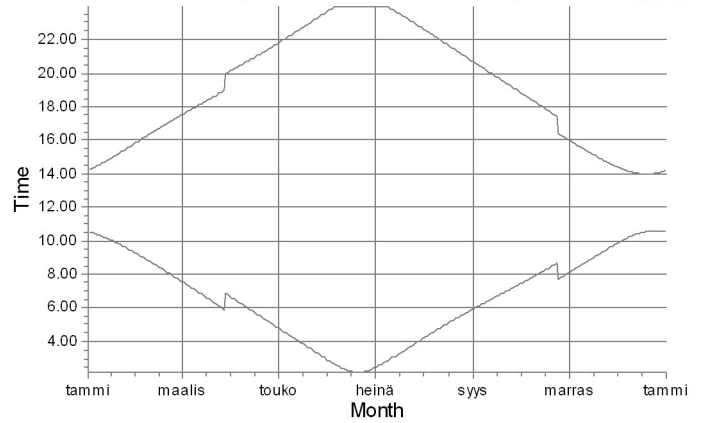
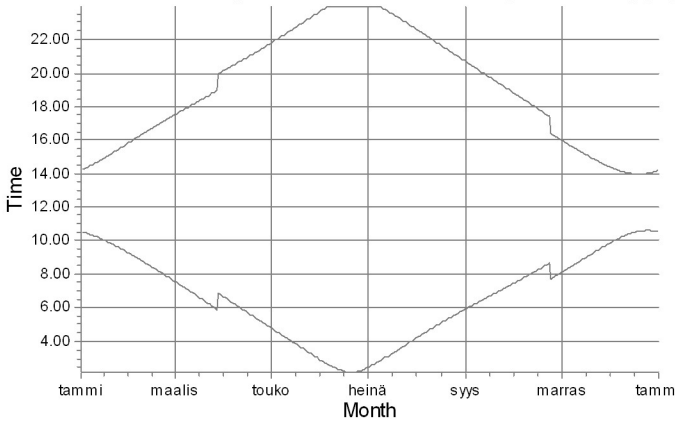
SHADOW - Calendar per WTG, graphical

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207

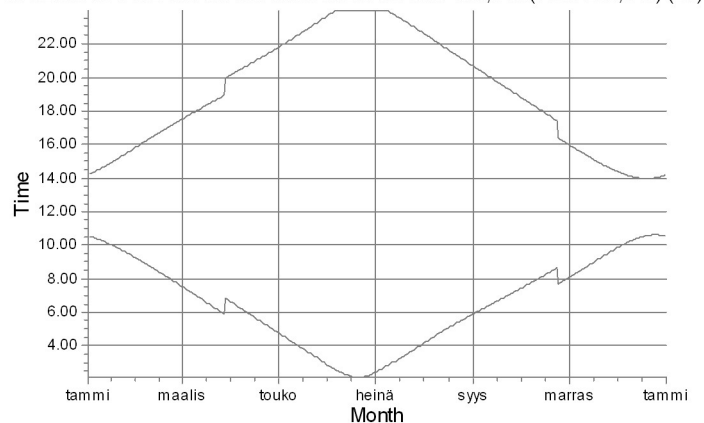
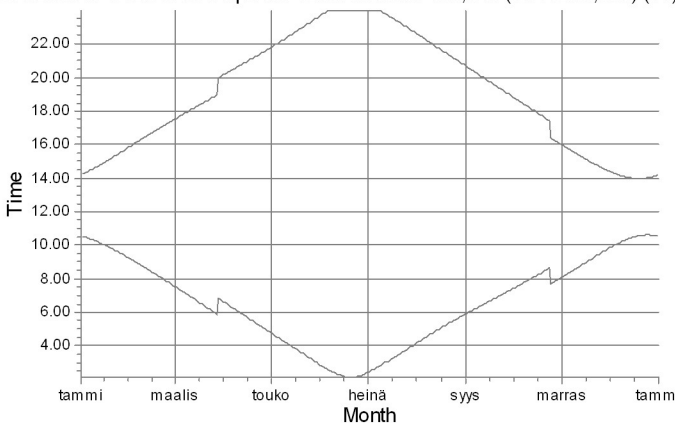
1: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (13) 2: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (14)



3: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (15) 4: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (16)



5: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (17) 6: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (29)

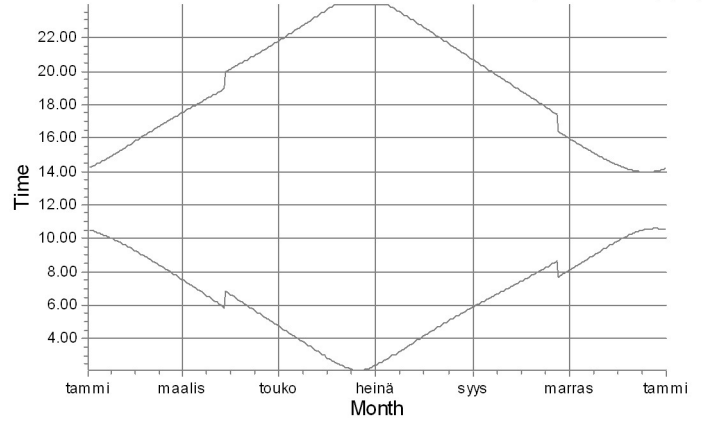
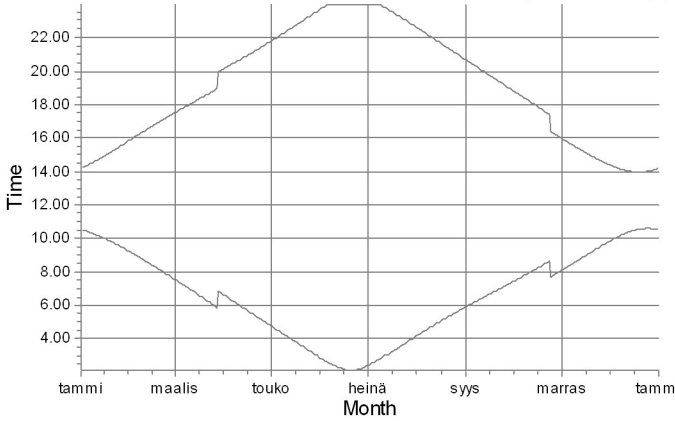


Shadow receptors

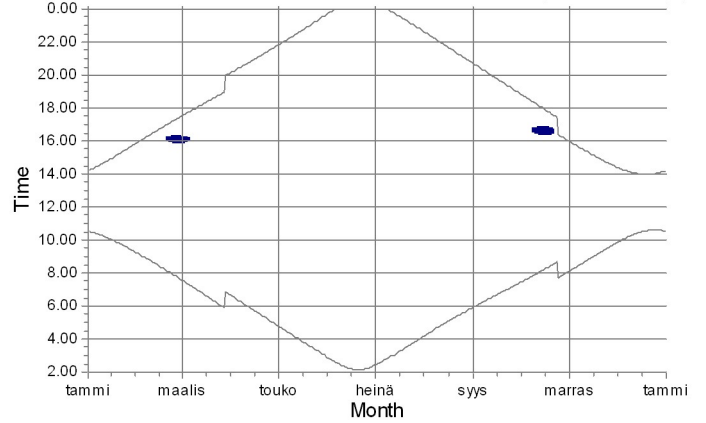
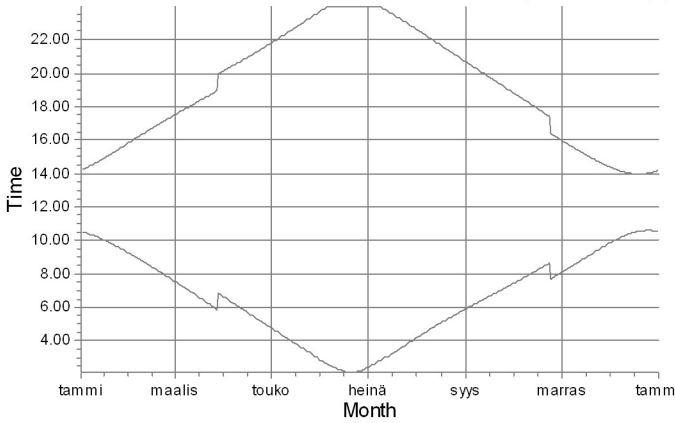
SHADOW - Calendar per WTG, graphical

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207

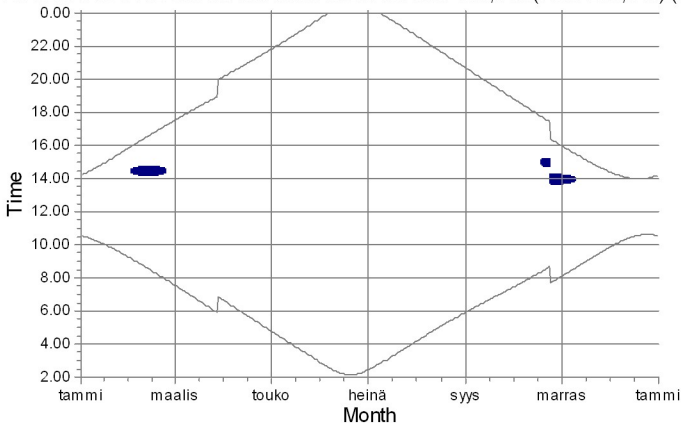
7: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (3) 8: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (31)




9: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (3) 10: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (33)



11: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (34)

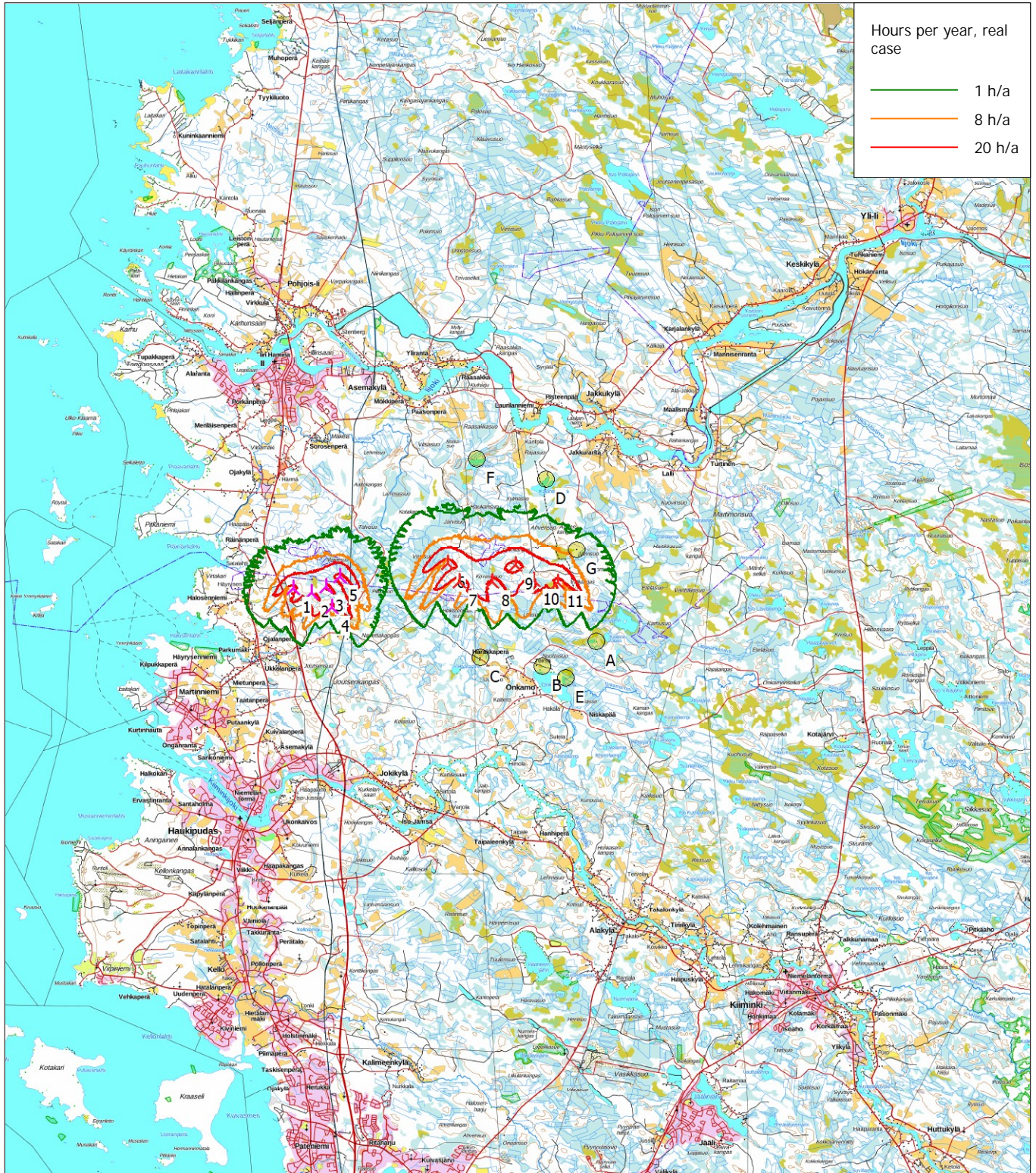


Shadow receptors

 G: Liikerakennus G (Impivaarantie kämpä)

SHADOW - Map

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_no forest_20201207



Map: Maastokarttarasteri100K , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 432 420 North: 7 237 530
New WTG Shadow receptor
Flicker map level: Height Contours: CONTOURLINE_Kovasinkangas_20191009_4.wpo (4)

18.1.2021

Liite 4

Liite 4: Kivasinkankaan tuulivoimahanke - Varjostusmallinnusten tulokset "real case, Luke forest"

SHADOW - Main Result

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207
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) [LULEA]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

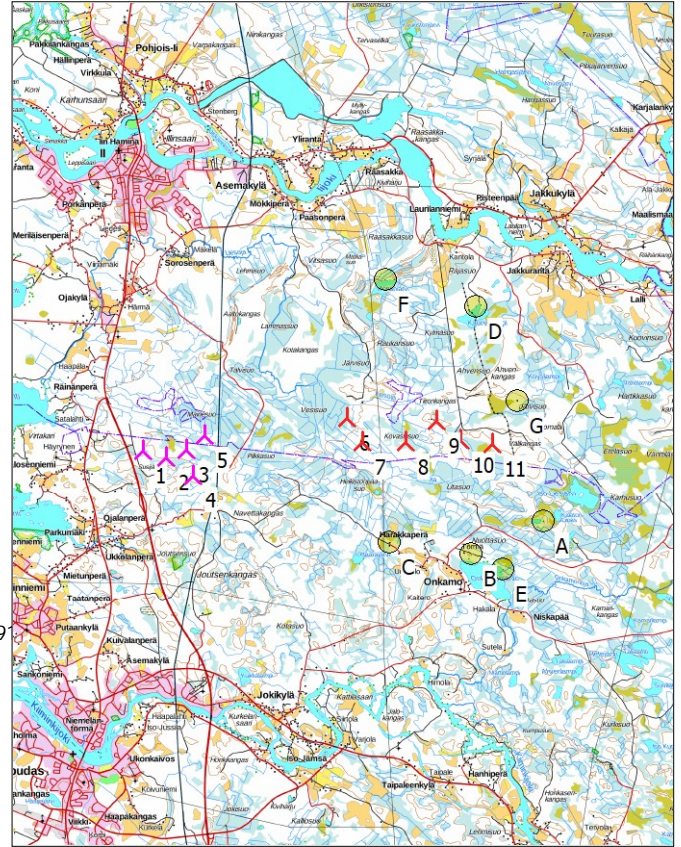
Operational hours are calculated from WTGs in calculation and wind distribution:
Default Meteo data description (2)

Operational time
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
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_Kovasinkangas_2019

Area object(s) used in calculation:
Area object (N1): (4)
Area object (N2): (5)
Area object (S): (6)
Obstacles used in calculation
Eye height for map: 2,0 m
Grid resolution: 10,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:200 000
New WTG Shadow receptor

WTGs

	East	North	Z	Row data/Description	WTG type		Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact. Type-generator				Calculation distance [m]	RPM [RPM]
			[m]								
1	424 583	7 237 533	16,1	VESTAS V126-3.45 LTq 345...	Yes	VESTAS V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
2	425 215	7 237 368	20,0	VESTAS V126-3.45 LTq 345...	Yes	VESTAS V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
3	425 739	7 237 570	22,5	VESTAS V126-3.45 LTq 345...	Yes	VESTAS V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
4	425 926	7 236 878	21,5	VESTAS V126-3.45 LTq 345...	Yes	VESTAS V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
5	426 209	7 237 939	25,0	VESTAS V126-3.45 LTq 345...	Yes	VESTAS V126-3.45 LTq-3 450	3 450	126,0	137,0	1 718	13,4
6	429 984	7 238 403	28,3	VESTAS V162-6.0 HH199 60...	Yes	VESTAS V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
7	430 394	7 237 760	31,7	VESTAS V162-6.0 HH199 60...	Yes	VESTAS V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
8	431 537	7 237 767	35,0	VESTAS V162-6.0 HH199 60...	Yes	VESTAS V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
9	432 336	7 238 334	42,4	VESTAS V162-6.0 HH199 60...	Yes	VESTAS V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
10	432 986	7 237 817	40,0	VESTAS V162-6.0 HH199 60...	Yes	VESTAS V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	10,4
11	433 822	7 237 725	38,7	VESTAS V162-6.0 HH199 60...	Yes	VESTAS V162-6.0 HH199-6 000	6 000	162,0	199,0	2 038	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.
A	Lomarakennus A (Kantolantie 285)	435 168	7 235 667	40,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Lomarakennus C (Kantolantie 42)	433 269	7 234 801	35,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Asuinrakennus D (Onkamonylantie 280)	431 108	7 235 103	32,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Lomarakennus E (Kaunislammentie 153)	433 395	7 241 348	37,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus B (Kantolantie 142)	434 099	7 234 395	35,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Lomarakennus F (Merianjärvi)	430 991	7 242 055	30,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Liikerakennus G (Impivaarantie kämppä)	434 473	7 238 869	37,8	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, Ii

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Main Result

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours per year	[h/year]
A	Lomarakennus A (Kantolantie 285)	0:00	
B	Lomarakennus C (Kantolantie 42)	0:00	
C	Asuinrakennus D (Onkamonkyläntie 280)	0:00	
D	Lomarakennus E (Kaunislammentie 153)	0:00	
E	Lomarakennus B (Kantolantie 142)	0:00	
F	Lomarakennus F (Merijärvi)	0:00	
G	Liikerakennus G (Impivaarantie kämppä)	3:09	

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

No.	Name						Worst case	Expected
							[h/year]	[h/year]
1	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(13)	0:00	0:00			
2	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(14)	0:00	0:00			
3	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(15)	0:00	0:00			
4	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(16)	0:00	0:00			
5	VESTAS V126-3.45 LTq 3450 126.0 !O!	hub: 137,0 m (TOT: 200,0 m)	(17)	0:00	0:00			
6	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(29)	0:00	0:00			
7	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(30)	0:00	0:00			
8	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(31)	0:00	0:00			
9	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(32)	0:00	0:00			
10	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(33)	0:00	0:00			
11	VESTAS V162-6.0 HH199 6000 162.0 !O!	hub: 199,0 m (TOT: 280,0 m)	(34)	16:55	3:09			

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.

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_2020120Shadow receptor: A - Lomarakennus A (Kantolantie 285)
Sunshine probability S (Average daily sunshine hours) [LULEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.30	09.11	07.32	06.38	04.46	02.51	02.24	04.09	05.53	07.25	08.05	09.49
	14.13	15.54	17.30	20.09	21.48	23.40	00.20	22.37	20.41	18.50	15.57	14.24
2	10.29	09.07	07.29	06.34	04.42	02.47	02.27	04.13	05.56	07.28	08.08	09.52
	14.15	15.57	17.34	20.12	21.51	23.44	00.17	22.33	20.38	18.46	15.54	14.22
3	10.28	09.04	07.25	06.30	04.38	02.44	02.30	04.16	05.59	07.31	08.12	09.55
	14.17	16.01	17.37	20.15	21.55	23.48	00.15	22.29	20.34	18.42	15.50	14.19
4	10.26	09.00	07.21	06.26	04.34	02.41	02.33	04.20	06.03	07.34	08.15	09.58
	14.20	16.05	17.40	20.18	21.58	23.51	00.12	22.26	20.30	18.38	15.47	14.17
5	10.24	08.57	07.18	06.23	04.31	02.38	02.36	04.24	06.06	07.37	08.19	10.01
	14.22	16.08	17.44	20.22	22.02	23.55	00.09	22.22	20.26	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.40	04.27	06.09	07.40	08.22	10.04
	14.25	16.12	17.47	20.25	22.05	23.58	00.06	22.18	20.23	18.31	15.40	14.13
7	10.21	08.50	07.10	06.15	04.23	02.32	02.43	04.31	06.12	07.43	08.26	10.07
	14.28	16.15	17.50	20.28	22.09	00.01	00.03	22.15	20.19	18.27	15.37	14.11
8	10.19	08.47	07.07	06.11	04.20	02.29	02.46	04.34	06.15	07.47	08.29	10.10
	14.31	16.19	17.53	20.31	22.12	00.05	00.00	22.11	20.15	18.24	15.33	14.09
9	10.17	08.43	07.03	06.08	04.16	02.26	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.22	17.56	20.34	22.16	00.08	23.57	22.07	20.11	18.20	15.30	14.07
10	10.14	08.40	06.59	06.04	04.12	02.24	02.53	04.41	06.21	07.53	08.36	10.15
	14.37	16.26	18.00	20.37	22.20	00.11	23.54	22.04	20.08	18.16	15.27	14.06
11	10.12	08.37	06.56	06.00	04.09	02.21	02.57	04.44	06.24	07.56	08.40	10.17
	14.40	16.29	18.03	20.41	22.23	00.14	23.51	22.00	20.04	18.13	15.23	14.04
12	10.10	08.33	06.52	05.56	04.05	02.19	03.00	04.48	06.27	07.59	08.43	10.20
	14.43	16.33	18.06	20.44	22.27	00.16	23.47	21.56	20.00	18.09	15.20	14.03
13	10.07	08.30	06.48	05.53	04.01	02.17	03.00	04.51	06.30	08.02	08.47	10.22
	14.47	16.36	18.09	20.47	22.30	00.19	23.44	21.52	19.56	18.05	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.15	03.04	04.55	06.33	08.05	08.50	10.24
	14.50	16.40	18.12	20.50	22.34	00.22	23.41	21.49	19.53	18.02	15.14	14.01
15	10.02	08.22	06.41	05.45	03.54	02.13	03.08	04.58	06.36	08.09	08.54	10.26
	14.53	16.43	18.15	20.54	22.38	00.24	23.37	21.45	19.49	17.58	15.10	14.00
16	09.59	08.19	06.37	05.41	03.50	02.11	03.11	05.01	06.39	08.12	08.57	10.27
	14.57	16.47	18.19	20.57	22.41	00.26	23.34	21.41	19.45	17.54	15.07	13.59
17	09.57	08.15	06.33	05.38	03.47	02.10	03.15	05.05	06.42	08.15	09.01	10.29
	15.00	16.50	18.22	21.00	22.45	00.28	23.30	21.37	19.42	17.51	15.04	13.59
18	09.54	08.12	06.30	05.34	03.43	02.09	03.18	05.08	06.45	08.18	09.05	10.30
	15.04	16.54	18.25	21.04	22.49	00.29	23.27	21.34	19.38	17.47	15.01	13.58
19	09.51	08.08	06.26	05.30	03.39	02.08	03.22	05.11	06.48	08.21	09.08	10.31
	15.07	16.57	18.28	21.07	22.53	00.30	23.24	21.30	19.34	17.44	14.58	13.58
20	09.48	08.05	06.22	05.27	03.36	02.08	03.26	05.15	06.51	08.25	09.12	10.33
	15.11	17.00	18.31	21.10	22.56	00.31	23.20	21.26	19.30	17.40	14.55	13.58
21	09.45	08.01	06.19	05.23	03.32	02.08	03.29	05.18	06.54	08.28	09.15	10.33
	15.14	17.04	18.34	21.13	23.00	00.31	23.16	21.23	19.27	17.36	14.52	13.58
22	09.42	07.58	06.15	05.19	03.29	02.08	03.33	05.21	06.57	08.31	09.19	10.34
	15.18	17.07	18.37	21.17	23.04	00.32	23.13	21.19	19.23	17.33	14.49	13.59
23	09.39	07.54	06.11	05.15	03.25	02.09	03.37	05.24	07.01	08.35	09.22	10.34
	15.21	17.11	18.41	21.20	23.07	00.31	23.09	21.15	19.19	17.29	14.46	13.59
24	09.36	07.50	06.07	05.12	03.22	02.10	03.40	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.11	00.31	23.06	21.11	19.15	17.26	14.43	14.00
25	09.33	07.47	06.04	05.08	03.18	02.11	03.44	05.31	07.07	07.41	09.29	10.35
	15.28	17.17	18.47	21.27	23.15	00.30	23.02	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.04	03.14	02.13	03.48	05.34	07.10	07.45	09.33	10.35
	15.32	17.21	18.50	21.30	23.19	00.29	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.39	05.56	05.00	03.11	02.15	03.51	05.37	07.13	07.48	09.36	10.34
	15.36	17.24	18.53	21.34	23.22	00.27	22.55	21.00	19.04	16.15	14.34	14.03
28	09.24	07.36	05.52	04.57	03.08	02.17	03.55	05.41	07.16	07.51	09.39	10.34
	15.39	17.27	18.56	21.37	23.26	00.26	22.51	20.56	19.01	16.11	14.32	14.05
29	09.20		06.49	04.53	03.04	02.19	03.59	05.44	07.19	07.55	09.43	10.33
	15.43		19.59	21.41	23.30	00.24	22.48	20.53	18.57	16.08	14.29	14.06
30	09.17		06.45	04.49	03.01	02.22	04.02	05.47	07.22	07.58	09.46	10.33
	15.46		20.03	21.44	23.33	00.22	22.44	20.49	18.53	16.04	14.26	14.08
31	09.14		06.41		02.54		04.06	05.50		08.01		10.32
	15.50		20.06		23.37		22.40	20.45		16.01		14.10
Potential sun hours	156	232	362	456	584	657	630	517	395	301	187	116
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)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_2020120Shadow receptor: B - Lomarakennus C (Kantolantie 42)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.30	09.11	07.32	06.38	04.46	02.51	02.25	04.10	05.53	07.25	08.05	09.49
	14.13	15.54	17.31	20.09	21.48	23.40	00.19	22.37	20.42	18.50	15.58	14.24
2	10.29	09.07	07.29	06.34	04.42	02.48	02.28	04.13	05.56	07.28	08.08	09.52
	14.15	15.58	17.34	20.12	21.51	23.44	00.17	22.33	20.38	18.46	15.54	14.22
3	10.28	09.04	07.25	06.30	04.38	02.45	02.31	04.17	06.00	07.31	08.12	09.55
	14.18	16.01	17.37	20.15	21.55	23.48	00.14	22.29	20.34	18.42	15.51	14.20
4	10.26	09.01	07.21	06.27	04.35	02.41	02.34	04.20	06.03	07.34	08.15	09.58
	14.20	16.05	17.40	20.18	21.58	23.51	00.12	22.26	20.30	18.39	15.47	14.17
5	10.24	08.57	07.18	06.23	04.31	02.38	02.37	04.24	06.06	07.37	08.19	10.01
	14.23	16.08	17.44	20.22	22.02	23.55	00.09	22.22	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.40	04.27	06.09	07.40	08.22	10.04
	14.25	16.12	17.47	20.25	22.05	23.58	00.06	22.18	20.23	18.31	15.40	14.13
7	10.21	08.50	07.10	06.15	04.24	02.32	02.43	04.31	06.12	07.44	08.26	10.07
	14.28	16.15	17.50	20.28	22.09	00.01	00.03	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.30	02.47	04.34	06.15	07.47	08.29	10.10
	14.31	16.19	17.53	20.31	22.12	00.04	00.00	22.11	20.15	18.24	15.34	14.09
9	10.17	08.44	07.03	06.08	04.16	02.27	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.23	17.57	20.34	22.16	00.08	23.57	22.07	20.12	18.20	15.30	14.08
10	10.14	08.40	06.59	06.04	04.12	02.24	02.54	04.41	06.21	07.53	08.36	10.15
	14.37	16.26	18.00	20.38	22.20	00.11	23.54	22.04	20.08	18.17	15.27	14.06
11	10.12	08.37	06.56	06.00	04.09	02.22	02.57	04.45	06.24	07.56	08.40	10.17
	14.40	16.30	18.03	20.41	22.23	00.14	23.51	22.00	20.04	18.13	15.24	14.05
12	10.10	08.33	06.52	05.57	04.05	02.19	03.01	04.48	06.27	07.59	08.43	10.20
	14.44	16.33	18.06	20.44	22.27	00.16	23.47	21.56	20.00	18.09	15.20	14.03
13	10.07	08.30	06.48	05.53	04.01	02.17	03.01	04.51	06.30	08.02	08.47	10.22
	14.47	16.37	18.09	20.47	22.31	00.19	23.44	21.52	19.57	18.06	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.15	03.04	04.55	06.33	08.06	08.50	10.24
	14.50	16.40	18.12	20.51	22.34	00.21	23.41	21.49	19.53	18.02	15.14	14.01
15	10.02	08.23	06.41	05.45	03.54	02.13	03.08	04.58	06.36	08.09	08.54	10.26
	14.53	16.44	18.16	20.54	22.38	00.24	23.37	21.45	19.49	17.58	15.11	14.00
16	09.59	08.19	06.37	05.42	03.51	02.12	03.11	05.02	06.39	08.12	08.58	10.27
	14.57	16.47	18.19	20.57	22.42	00.26	23.34	21.41	19.45	17.55	15.07	13.59
17	09.57	08.16	06.34	05.38	03.47	02.11	03.15	05.05	06.43	08.15	09.01	10.29
	15.00	16.50	18.22	21.00	22.45	00.27	23.30	21.38	19.42	17.51	15.04	13.59
18	09.54	08.12	06.30	05.34	03.43	02.10	03.19	05.08	06.46	08.18	09.05	10.30
	15.04	16.54	18.25	21.04	22.49	00.29	23.27	21.34	19.38	17.47	15.01	13.58
19	09.51	08.08	06.26	05.30	03.40	02.09	03.22	05.12	06.49	08.22	09.08	10.31
	15.07	16.57	18.28	21.07	22.53	00.30	23.24	21.30	19.34	17.44	14.58	13.58
20	09.48	08.05	06.22	05.27	03.36	02.09	03.26	05.15	06.52	08.25	09.12	10.32
	15.11	17.01	18.31	21.10	22.56	00.31	23.20	21.26	19.31	17.40	14.55	13.58
21	09.45	08.01	06.19	05.23	03.32	02.09	03.30	05.18	06.55	08.28	09.15	10.33
	15.14	17.04	18.34	21.14	23.00	00.31	23.16	21.23	19.27	17.37	14.52	13.58
22	09.42	07.58	06.15	05.19	03.29	02.09	03.33	05.21	06.58	08.31	09.19	10.34
	15.18	17.07	18.38	21.17	23.04	00.31	23.13	21.19	19.23	17.33	14.49	13.59
23	09.39	07.54	06.11	05.16	03.25	02.10	03.37	05.25	07.01	08.35	09.22	10.34
	15.21	17.11	18.41	21.20	23.07	00.31	23.09	21.15	19.19	17.29	14.46	13.59
24	09.36	07.50	06.08	05.12	03.22	02.11	03.41	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.11	00.31	23.06	21.11	19.16	17.26	14.43	14.00
25	09.33	07.47	06.04	05.08	03.18	02.12	03.44	05.31	07.07	07.41	09.29	10.35
	15.29	17.17	18.47	21.27	23.15	00.30	23.02	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.04	03.15	02.13	03.48	05.34	07.10	07.45	09.33	10.35
	15.32	17.21	18.50	21.30	23.19	00.29	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.56	05.01	03.11	02.15	03.52	05.38	07.13	07.48	09.36	10.34
	15.36	17.24	18.53	21.34	23.22	00.27	22.55	21.00	19.05	16.15	14.35	14.03
28	09.24	07.36	05.53	04.57	03.08	02.17	03.55	05.41	07.16	07.51	09.39	10.34
	15.39	17.27	18.56	21.37	23.26	00.26	22.51	20.56	19.01	16.12	14.32	14.05
29	09.20		06.49	04.53	03.04	02.20	03.59	05.44	07.19	07.55	09.43	10.33
	15.43		20.00	21.41	23.30	00.24	22.48	20.53	18.57	16.08	14.29	14.07
30	09.17		06.45	04.49	03.01	02.22	04.02	05.47	07.22	07.58	09.46	10.33
	15.47		20.03	21.44	23.33	00.22	22.44	20.49	18.53	16.05	14.27	14.08
31	09.14		06.41		02.54		04.06	05.50		08.02		10.32
	15.50		20.06		23.37		22.40	20.45		16.01		14.10
Potential sun hours	156	232	362	456	584	657	630	517	395	301	187	116
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)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Kovasinkangas V162-6.0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207Shadow receptor: C - Asuinrakennus D (Onkamonylantie 280)
Sunshine probability S (Average daily sunshine hours) [LULEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.25	04.10	05.54	07.25	08.05	09.49
	14.13	15.54	17.31	20.09	21.48	23.41	00.20	22.37	20.42	18.50	15.58	14.24
2	10.29	09.07	07.29	06.34	04.42	02.48	02.28	04.13	05.57	07.28	08.09	09.53
	14.15	15.58	17.34	20.12	21.51	23.44	00.17	22.33	20.38	18.46	15.54	14.22
3	10.28	09.04	07.25	06.30	04.38	02.45	02.31	04.17	06.00	07.31	08.12	09.56
	14.18	16.01	17.37	20.15	21.55	23.48	00.15	22.30	20.34	18.42	15.51	14.20
4	10.26	09.01	07.22	06.27	04.35	02.42	02.34	04.20	06.03	07.34	08.16	09.59
	14.20	16.05	17.41	20.19	21.58	23.51	00.12	22.26	20.30	18.39	15.47	14.17
5	10.25	08.57	07.18	06.23	04.31	02.39	02.37	04.24	06.06	07.38	08.19	10.02
	14.23	16.09	17.44	20.22	22.02	23.55	00.09	22.22	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.36	02.40	04.27	06.09	07.41	08.22	10.05
	14.26	16.12	17.47	20.25	22.06	23.58	00.06	22.19	20.23	18.31	15.41	14.13
7	10.21	08.51	07.11	06.16	04.24	02.33	02.43	04.31	06.12	07.44	08.26	10.07
	14.28	16.16	17.50	20.28	22.09	00.01	00.03	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.30	02.47	04.34	06.15	07.47	08.29	10.10
	14.31	16.19	17.54	20.31	22.13	00.05	00.00	22.11	20.16	18.24	15.34	14.09
9	10.17	08.44	07.03	06.08	04.16	02.27	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.23	17.57	20.35	22.16	00.08	23.57	22.08	20.12	18.20	15.30	14.08
10	10.15	08.40	07.00	06.04	04.13	02.24	02.54	04.41	06.21	07.53	08.37	10.15
	14.37	16.26	18.00	20.38	22.20	00.11	23.54	22.04	20.08	18.17	15.27	14.06
11	10.12	08.37	06.56	06.01	04.09	02.22	02.57	04.45	06.24	07.56	08.40	10.18
	14.41	16.30	18.03	20.41	22.23	00.14	23.51	22.00	20.04	18.13	15.24	14.05
12	10.10	08.33	06.52	05.57	04.05	02.20	03.01	04.48	06.28	07.59	08.44	10.20
	14.44	16.33	18.06	20.44	22.27	00.17	23.48	21.56	20.01	18.09	15.20	14.03
13	10.07	08.30	06.49	05.53	04.02	02.17	03.01	04.52	06.31	08.03	08.47	10.22
	14.47	16.37	18.09	20.48	22.31	00.19	23.44	21.53	19.57	18.06	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.15	03.04	04.55	06.34	08.06	08.51	10.24
	14.50	16.40	18.13	20.51	22.34	00.22	23.41	21.49	19.53	18.02	15.14	14.01
15	10.02	08.23	06.41	05.46	03.54	02.14	03.08	04.58	06.37	08.09	08.54	10.26
	14.54	16.44	18.16	20.54	22.38	00.24	23.38	21.45	19.49	17.58	15.11	14.00
16	10.00	08.19	06.37	05.42	03.51	02.12	03.12	05.02	06.40	08.12	08.58	10.28
	14.57	16.47	18.19	20.57	22.42	00.26	23.34	21.41	19.46	17.55	15.08	14.00
17	09.57	08.16	06.34	05.38	03.47	02.11	03.15	05.05	06.43	08.15	09.01	10.29
	15.00	16.51	18.22	21.01	22.45	00.28	23.31	21.38	19.42	17.51	15.04	13.59
18	09.54	08.12	06.30	05.34	03.43	02.10	03.19	05.08	06.46	08.19	09.05	10.31
	15.04	16.54	18.25	21.04	22.49	00.29	23.27	21.34	19.38	17.48	15.01	13.59
19	09.51	08.09	06.26	05.31	03.40	02.09	03.23	05.12	06.49	08.22	09.08	10.32
	15.07	16.57	18.28	21.07	22.53	00.30	23.24	21.30	19.34	17.44	14.58	13.58
20	09.48	08.05	06.23	05.27	03.36	02.09	03.26	05.15	06.52	08.25	09.12	10.33
	15.11	17.01	18.32	21.10	22.56	00.31	23.20	21.27	19.31	17.40	14.55	13.58
21	09.45	08.01	06.19	05.23	03.33	02.09	03.30	05.18	06.55	08.28	09.15	10.34
	15.15	17.04	18.35	21.14	23.00	00.31	23.17	21.23	19.27	17.37	14.52	13.59
22	09.42	07.58	06.15	05.19	03.29	02.09	03.34	05.22	06.58	08.32	09.19	10.34
	15.18	17.08	18.38	21.17	23.04	00.32	23.13	21.19	19.23	17.33	14.49	13.59
23	09.39	07.54	06.11	05.16	03.26	02.10	03.37	05.25	07.01	08.35	09.22	10.35
	15.22	17.11	18.41	21.21	23.08	00.31	23.10	21.15	19.20	17.30	14.46	14.00
24	09.36	07.51	06.08	05.12	03.22	02.11	03.41	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.11	00.31	23.06	21.12	19.16	17.26	14.43	14.00
25	09.33	07.47	06.04	05.08	03.18	02.12	03.44	05.31	07.07	07.41	09.29	10.35
	15.29	17.18	18.47	21.27	23.15	00.30	23.02	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.05	03.15	02.13	03.48	05.34	07.10	07.45	09.33	10.35
	15.32	17.21	18.50	21.31	23.19	00.29	22.59	21.04	19.08	16.19	14.38	14.02
27	09.27	07.40	05.57	05.01	03.11	02.15	03.52	05.38	07.13	07.48	09.36	10.35
	15.36	17.24	18.53	21.34	23.22	00.28	22.55	21.00	19.05	16.15	14.35	14.04
28	09.24	07.36	05.53	04.57	03.08	02.17	03.55	05.41	07.16	07.52	09.40	10.34
	15.40	17.28	18.57	21.38	23.26	00.26	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		06.49	04.53	03.05	02.20	03.59	05.44	07.19	07.55	09.43	10.34
	15.43		20.00	21.41	23.30	00.24	22.48	20.53	18.57	16.08	14.29	14.07
30	09.17		06.45	04.50	03.01	02.22	04.03	05.47	07.22	07.58	09.46	10.33
	15.47		20.03	21.44	23.33	00.22	22.44	20.49	18.54	16.05	14.27	14.08
31	09.14		06.42		02.54		04.06	05.50		08.02		10.32
	15.51		20.06		23.37		22.41	20.45		16.01		14.10
Potential sun hours	156	232	362	456	584	657	630	517	395	301	187	116
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)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Last time (hh:mm) with flicker	(WTG causing flicker last time)
	Minutes with flicker		

SHADOW - Calendar

Calculation: Kovasinkangas V162-6.0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207Shadow receptor: D - Lomarakennus E (Kaunistamentielle 153)
Sunshine probability S (Average daily sunshine hours) [LULEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.32	09.11	07.33	06.38	04.45	02.50	02.23	04.09	05.53	07.25	08.05	09.50
	14.12	15.53	17.31	20.09	21.48	23.42	00.22	22.37	20.42	18.50	15.57	14.23
2	10.30	09.08	07.29	06.34	04.42	02.46	02.25	04.12	05.56	07.28	08.09	09.53
	14.14	15.57	17.34	20.12	21.52	23.46	00.19	22.34	20.38	18.46	15.54	14.21
3	10.29	09.04	07.25	06.30	04.38	02.43	02.28	04.16	05.59	07.31	08.12	09.56
	14.16	16.01	17.37	20.15	21.55	23.49	00.17	22.30	20.34	18.42	15.50	14.19
4	10.27	09.01	07.22	06.26	04.34	02.40	02.32	04.20	06.03	07.34	08.16	09.59
	14.19	16.04	17.40	20.19	21.59	23.53	00.14	22.26	20.30	18.39	15.47	14.16
5	10.25	08.58	07.18	06.23	04.30	02.37	02.35	04.23	06.06	07.37	08.19	10.02
	14.22	16.08	17.44	20.22	22.02	23.56	00.11	22.23	20.27	18.35	15.43	14.14
6	10.24	08.54	07.14	06.19	04.27	02.34	02.38	04.27	06.09	07.41	08.23	10.05
	14.24	16.11	17.47	20.25	22.06	00.00	00.08	22.19	20.23	18.31	15.40	14.12
7	10.22	08.51	07.11	06.15	04.23	02.31	02.42	04.30	06.12	07.44	08.26	10.08
	14.27	16.15	17.50	20.28	22.09	00.03	00.05	22.15	20.19	18.27	15.37	14.10
8	10.20	08.47	07.07	06.11	04.19	02.28	02.45	04.34	06.15	07.47	08.30	10.11
	14.30	16.19	17.53	20.31	22.13	00.06	00.02	22.12	20.15	18.24	15.33	14.08
9	10.18	08.44	07.03	06.08	04.16	02.25	02.49	04.37	06.18	07.50	08.33	10.14
	14.33	16.22	17.56	20.35	22.17	00.10	23.59	22.08	20.12	18.20	15.30	14.06
10	10.15	08.40	07.00	06.04	04.12	02.22	02.52	04.41	06.21	07.53	08.37	10.16
	14.36	16.26	18.00	20.38	22.20	00.13	23.55	22.04	20.08	18.16	15.26	14.05
11	10.13	08.37	06.56	06.00	04.08	02.20	02.56	04.44	06.24	07.56	08.40	10.19
	14.39	16.29	18.03	20.41	22.24	00.16	23.52	22.00	20.04	18.13	15.23	14.03
12	10.11	08.33	06.52	05.56	04.04	02.17	02.59	04.48	06.27	07.59	08.44	10.21
	14.43	16.33	18.06	20.44	22.28	00.19	23.49	21.57	20.00	18.09	15.20	14.02
13	10.08	08.30	06.48	05.53	04.01	02.15	03.03	04.51	06.30	08.03	08.47	10.23
	14.46	16.36	18.09	20.48	22.31	00.21	23.45	21.53	19.57	18.05	15.16	14.01
14	10.06	08.26	06.45	05.49	03.57	02.13	03.03	04.54	06.33	08.06	08.51	10.25
	14.49	16.40	18.12	20.51	22.35	00.24	23.42	21.49	19.53	18.02	15.13	14.00
15	10.03	08.23	06.41	05.45	03.53	02.11	03.07	04.58	06.36	08.09	08.55	10.27
	14.53	16.43	18.16	20.54	22.39	00.26	23.39	21.45	19.49	17.58	15.10	13.59
16	10.00	08.19	06.37	05.41	03.50	02.09	03.10	05.01	06.39	08.12	08.58	10.29
	14.56	16.47	18.19	20.57	22.42	00.28	23.35	21.42	19.46	17.54	15.07	13.58
17	09.57	08.16	06.34	05.38	03.46	02.08	03.14	05.04	06.42	08.15	09.02	10.30
	15.00	16.50	18.22	21.01	22.46	00.30	23.32	21.38	19.42	17.51	15.04	13.58
18	09.55	08.12	06.30	05.34	03.42	02.07	03.18	05.08	06.45	08.19	09.05	10.32
	15.03	16.54	18.25	21.04	22.50	00.32	23.28	21.34	19.38	17.47	15.00	13.57
19	09.52	08.09	06.26	05.30	03.39	02.06	03.21	05.11	06.49	08.22	09.09	10.33
	15.07	16.57	18.28	21.07	22.53	00.33	23.25	21.30	19.34	17.44	14.57	13.57
20	09.49	08.05	06.22	05.26	03.35	02.06	03.25	05.14	06.52	08.25	09.12	10.34
	15.10	17.00	18.31	21.11	22.57	00.34	23.21	21.27	19.31	17.40	14.54	13.57
21	09.46	08.02	06.19	05.23	03.32	02.06	03.29	05.18	06.55	08.28	09.16	10.35
	15.14	17.04	18.34	21.14	23.01	00.34	23.17	21.23	19.27	17.36	14.51	13.57
22	09.43	07.58	06.15	05.19	03.28	02.06	03.32	05.21	06.58	08.32	09.19	10.35
	15.17	17.07	18.38	21.17	23.05	00.34	23.14	21.19	19.23	17.33	14.48	13.58
23	09.40	07.54	06.11	05.15	03.24	02.07	03.36	05.24	07.01	08.35	09.23	10.36
	15.21	17.11	18.41	21.21	23.08	00.34	23.10	21.16	19.19	17.29	14.45	13.58
24	09.37	07.51	06.08	05.11	03.21	02.08	03.40	05.28	07.04	08.38	09.26	10.36
	15.24	17.14	18.44	21.24	23.12	00.33	23.07	21.12	19.16	17.26	14.42	13.59
25	09.34	07.47	06.04	05.08	03.17	02.09	03.43	05.31	07.07	07.42	09.30	10.36
	15.28	17.17	18.47	21.27	23.16	00.33	23.03	21.08	19.12	16.22	14.39	14.00
26	09.31	07.43	06.00	05.04	03.14	02.11	03.47	05.34	07.10	07.45	09.33	10.36
	15.32	17.21	18.50	21.31	23.20	00.31	22.59	21.04	19.08	16.18	14.37	14.01
27	09.27	07.40	05.56	05.00	03.10	02.13	03.51	05.37	07.13	07.48	09.37	10.36
	15.35	17.24	18.53	21.34	23.23	00.30	22.56	21.01	19.04	16.15	14.34	14.02
28	09.24	07.36	05.53	04.56	03.07	02.15	03.54	05.40	07.16	07.52	09.40	10.35
	15.39	17.27	18.56	21.38	23.27	00.28	22.52	20.57	19.01	16.11	14.31	14.04
29	09.21		06.49	04.53	03.03	02.17	03.58	05.44	07.19	07.55	09.44	10.35
	15.43		20.00	21.41	23.31	00.26	22.48	20.53	18.57	16.08	14.28	14.05
30	09.18		06.45	04.49	03.00	02.20	04.02	05.47	07.22	07.58	09.47	10.34
	15.46		20.03	21.45	23.35	00.24	22.45	20.49	18.53	16.04	14.26	14.07
31	09.14		06.41		02.53		04.05	05.50		08.02		10.33
	15.50		20.06		23.38		22.41	20.45		16.01		14.09
Potential sun hours	155	232	362	456	585	660	631	517	395	301	187	115
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)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Last time (hh:mm) with flicker	(WTG causing flicker last time)
	Minutes with flicker		

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapaisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_2020120Shadow receptor: E - Lomarakennus B (Kantolantie 142)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.30	09.10	07.32	06.38	04.46	02.51	02.25	04.10	05.53	07.25	08.05	09.49
	14.13	15.54	17.31	20.09	21.48	23.40	00.19	22.37	20.41	18.50	15.58	14.24
2	10.29	09.07	07.29	06.34	04.42	02.48	02.28	04.13	05.56	07.28	08.08	09.52
	14.15	15.58	17.34	20.12	21.51	23.44	00.17	22.33	20.38	18.46	15.54	14.22
3	10.27	09.04	07.25	06.30	04.38	02.45	02.31	04.17	06.00	07.31	08.12	09.55
	14.18	16.01	17.37	20.15	21.55	23.47	00.14	22.29	20.34	18.42	15.51	14.20
4	10.26	09.00	07.21	06.26	04.35	02.41	02.34	04.20	06.03	07.34	08.15	09.58
	14.20	16.05	17.40	20.18	21.58	23.51	00.12	22.26	20.30	18.39	15.47	14.17
5	10.24	08.57	07.18	06.23	04.31	02.38	02.37	04.24	06.06	07.37	08.19	10.01
	14.23	16.08	17.44	20.22	22.02	23.54	00.09	22.22	20.26	18.35	15.44	14.15
6	10.22	08.54	07.14	06.19	04.27	02.35	02.40	04.27	06.09	07.40	08.22	10.04
	14.25	16.12	17.47	20.25	22.05	23.58	00.06	22.18	20.23	18.31	15.40	14.13
7	10.21	08.50	07.10	06.15	04.23	02.32	02.43	04.31	06.12	07.43	08.26	10.07
	14.28	16.15	17.50	20.28	22.09	00.01	00.03	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.30	02.47	04.34	06.15	07.47	08.29	10.10
	14.31	16.19	17.53	20.31	22.12	00.04	00.00	22.11	20.15	18.24	15.34	14.09
9	10.16	08.43	07.03	06.08	04.16	02.27	02.50	04.38	06.18	07.50	08.33	10.12
	14.34	16.23	17.56	20.34	22.16	00.07	23.57	22.07	20.12	18.20	15.30	14.08
10	10.14	08.40	06.59	06.04	04.12	02.24	02.54	04.41	06.21	07.53	08.36	10.15
	14.37	16.26	18.00	20.38	22.20	00.10	23.54	22.03	20.08	18.16	15.27	14.06
11	10.12	08.37	06.56	06.00	04.09	02.22	02.57	04.45	06.24	07.56	08.40	10.17
	14.40	16.30	18.03	20.41	22.23	00.13	23.50	22.00	20.04	18.13	15.24	14.05
12	10.10	08.33	06.52	05.57	04.05	02.19	03.01	04.48	06.27	07.59	08.43	10.20
	14.44	16.33	18.06	20.44	22.27	00.16	23.47	21.56	20.00	18.09	15.20	14.03
13	10.07	08.30	06.48	05.53	04.01	02.17	03.01	04.51	06.30	08.02	08.47	10.22
	14.47	16.37	18.09	20.47	22.30	00.19	23.44	21.52	19.57	18.06	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.15	03.04	04.55	06.33	08.05	08.50	10.24
	14.50	16.40	18.12	20.50	22.34	00.21	23.41	21.49	19.53	18.02	15.14	14.01
15	10.02	08.23	06.41	05.45	03.54	02.14	03.08	04.58	06.36	08.09	08.54	10.26
	14.53	16.44	18.16	20.54	22.38	00.23	23.37	21.45	19.49	17.58	15.11	14.00
16	09.59	08.19	06.37	05.42	03.50	02.12	03.11	05.02	06.39	08.12	08.57	10.27
	14.57	16.47	18.19	20.57	22.41	00.25	23.34	21.41	19.45	17.55	15.07	13.59
17	09.57	08.15	06.33	05.38	03.47	02.11	03.15	05.05	06.42	08.15	09.01	10.29
	15.00	16.50	18.22	21.00	22.45	00.27	23.30	21.37	19.42	17.51	15.04	13.59
18	09.54	08.12	06.30	05.34	03.43	02.10	03.19	05.08	06.45	08.18	09.05	10.30
	15.04	16.54	18.25	21.04	22.49	00.28	23.27	21.34	19.38	17.47	15.01	13.58
19	09.51	08.08	06.26	05.30	03.40	02.09	03.22	05.12	06.49	08.21	09.08	10.31
	15.07	16.57	18.28	21.07	22.52	00.30	23.23	21.30	19.34	17.44	14.58	13.58
20	09.48	08.05	06.22	05.27	03.36	02.09	03.26	05.15	06.52	08.25	09.12	10.32
	15.11	17.01	18.31	21.10	22.56	00.30	23.20	21.26	19.30	17.40	14.55	13.58
21	09.45	08.01	06.19	05.23	03.32	02.09	03.30	05.18	06.55	08.28	09.15	10.33
	15.14	17.04	18.34	21.14	23.00	00.31	23.16	21.23	19.27	17.37	14.52	13.58
22	09.42	07.58	06.15	05.19	03.29	02.09	03.33	05.21	06.58	08.31	09.19	10.34
	15.18	17.07	18.38	21.17	23.04	00.31	23.13	21.19	19.23	17.33	14.49	13.59
23	09.39	07.54	06.11	05.15	03.25	02.10	03.37	05.25	07.01	08.35	09.22	10.34
	15.21	17.11	18.41	21.20	23.07	00.31	23.09	21.15	19.19	17.29	14.46	13.59
24	09.36	07.50	06.07	05.12	03.22	02.11	03.41	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.11	00.30	23.06	21.11	19.16	17.26	14.43	14.00
25	09.33	07.47	06.04	05.08	03.18	02.12	03.44	05.31	07.07	07.41	09.29	10.35
	15.29	17.17	18.47	21.27	23.15	00.30	23.02	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.04	03.15	02.13	03.48	05.34	07.10	07.45	09.32	10.35
	15.32	17.21	18.50	21.30	23.18	00.28	22.58	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.56	05.01	03.11	02.15	03.52	05.37	07.13	07.48	09.36	10.34
	15.36	17.24	18.53	21.34	23.22	00.27	22.55	21.00	19.04	16.15	14.35	14.03
28	09.24	07.36	05.53	04.57	03.08	02.17	03.55	05.41	07.16	07.51	09.39	10.34
	15.39	17.27	18.56	21.37	23.26	00.25	22.51	20.56	19.01	16.12	14.32	14.05
29	09.20		06.49	04.53	03.04	02.20	03.59	05.44	07.19	07.55	09.43	10.33
	15.43		19.59	21.41	23.29	00.24	22.48	20.53	18.57	16.08	14.29	14.07
30	09.17		06.45	04.49	03.01	02.22	04.02	05.47	07.22	07.58	09.46	10.32
	15.47		20.03	21.44	23.33	00.21	22.44	20.49	18.53	16.05	14.27	14.08
31	09.14		06.41		02.54		04.06	05.50		08.01		10.32
	15.50		20.06		23.37		22.40	20.45		16.01		14.10
Potential sun hours	156	232	362	456	584	657	630	517	395	301	187	116
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)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, li

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
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+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207 Shadow receptor: F - Lomarakennus F (Merijärvi)
Sunshine probability S (Average daily sunshine hours) [LULEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.32	09.11	07.33	06.38	04.45	02.50	02.23	04.09	05.53	07.25	08.06	09.50
	14.12	15.54	17.31	20.09	21.48	23.42	00.22	22.38	20.42	18.50	15.57	14.23
2	10.31	09.08	07.29	06.34	04.42	02.46	02.25	04.13	05.56	07.28	08.09	09.54
	14.14	15.57	17.34	20.13	21.52	23.46	00.20	22.34	20.38	18.46	15.54	14.21
3	10.29	09.05	07.25	06.30	04.38	02.43	02.28	04.16	06.00	07.31	08.12	09.57
	14.17	16.01	17.37	20.16	21.55	23.49	00.17	22.30	20.34	18.42	15.50	14.19
4	10.28	09.01	07.22	06.27	04.34	02.40	02.32	04.20	06.03	07.35	08.16	10.00
	14.19	16.04	17.41	20.19	21.59	23.53	00.14	22.27	20.31	18.39	15.47	14.16
5	10.26	08.58	07.18	06.23	04.31	02.37	02.35	04.23	06.06	07.38	08.19	10.03
	14.22	16.08	17.44	20.22	22.03	23.57	00.11	22.23	20.27	18.35	15.44	14.14
6	10.24	08.55	07.14	06.19	04.27	02.34	02.38	04.27	06.09	07.41	08.23	10.06
	14.24	16.12	17.47	20.25	22.06	00.00	00.08	22.19	20.23	18.31	15.40	14.12
7	10.22	08.51	07.11	06.15	04.23	02.31	02.42	04.30	06.12	07.44	08.26	10.09
	14.27	16.15	17.50	20.28	22.10	00.03	00.05	22.16	20.19	18.28	15.37	14.10
8	10.20	08.48	07.07	06.12	04.19	02.28	02.45	04.34	06.15	07.47	08.30	10.11
	14.30	16.19	17.53	20.32	22.13	00.07	00.02	22.12	20.16	18.24	15.33	14.08
9	10.18	08.44	07.03	06.08	04.16	02.25	02.49	04.37	06.18	07.50	08.34	10.14
	14.33	16.22	17.57	20.35	22.17	00.10	23.59	22.08	20.12	18.20	15.30	14.07
10	10.16	08.41	07.00	06.04	04.12	02.22	02.52	04.41	06.21	07.53	08.37	10.16
	14.36	16.26	18.00	20.38	22.21	00.13	23.56	22.04	20.08	18.17	15.27	14.05
11	10.13	08.37	06.56	06.00	04.08	02.20	02.56	04.44	06.24	07.56	08.41	10.19
	14.40	16.29	18.03	20.41	22.24	00.16	23.52	22.01	20.04	18.13	15.23	14.03
12	10.11	08.34	06.52	05.57	04.05	02.17	02.59	04.48	06.27	08.00	08.44	10.21
	14.43	16.33	18.06	20.45	22.28	00.19	23.49	21.57	20.01	18.09	15.20	14.02
13	10.08	08.30	06.49	05.53	04.01	02.15	03.03	04.51	06.30	08.03	08.48	10.23
	14.46	16.36	18.09	20.48	22.32	00.22	23.46	21.53	19.57	18.06	15.17	14.01
14	10.06	08.27	06.45	05.49	03.57	02.13	03.03	04.55	06.34	08.06	08.51	10.25
	14.49	16.40	18.13	20.51	22.35	00.24	23.42	21.49	19.53	18.02	15.13	14.00
15	10.03	08.23	06.41	05.45	03.54	02.11	03.07	04.58	06.37	08.09	08.55	10.27
	14.53	16.43	18.16	20.54	22.39	00.27	23.39	21.46	19.49	17.58	15.10	13.59
16	10.01	08.20	06.38	05.42	03.50	02.09	03.10	05.01	06.40	08.12	08.58	10.29
	14.56	16.47	18.19	20.58	22.43	00.29	23.35	21.42	19.46	17.55	15.07	13.58
17	09.58	08.16	06.34	05.38	03.46	02.08	03.14	05.05	06.43	08.16	09.02	10.31
	15.00	16.50	18.22	21.01	22.46	00.31	23.32	21.38	19.42	17.51	15.04	13.58
18	09.55	08.13	06.30	05.34	03.43	02.07	03.18	05.08	06.46	08.19	09.06	10.32
	15.03	16.54	18.25	21.04	22.50	00.32	23.28	21.34	19.38	17.47	15.01	13.57
19	09.52	08.09	06.26	05.30	03.39	02.06	03.21	05.11	06.49	08.22	09.09	10.33
	15.07	16.57	18.28	21.08	22.54	00.33	23.25	21.31	19.35	17.44	14.57	13.57
20	09.49	08.05	06.23	05.27	03.35	02.06	03.25	05.15	06.52	08.25	09.13	10.34
	15.10	17.01	18.32	21.11	22.57	00.34	23.21	21.27	19.31	17.40	14.54	13.57
21	09.46	08.02	06.19	05.23	03.32	02.06	03.29	05.18	06.55	08.29	09.16	10.35
	15.14	17.04	18.35	21.14	23.01	00.35	23.18	21.23	19.27	17.37	14.51	13.57
22	09.43	07.58	06.15	05.19	03.28	02.06	03.32	05.21	06.58	08.32	09.20	10.36
	15.17	17.07	18.38	21.18	23.05	00.35	23.14	21.19	19.23	17.33	14.48	13.58
23	09.40	07.55	06.11	05.15	03.25	02.07	03.36	05.24	07.01	08.35	09.23	10.36
	15.21	17.11	18.41	21.21	23.09	00.35	23.11	21.16	19.20	17.29	14.45	13.58
24	09.37	07.51	06.08	05.12	03.21	02.08	03.40	05.28	07.04	08.38	09.27	10.36
	15.25	17.14	18.44	21.24	23.12	00.34	23.07	21.12	19.16	17.26	14.42	13.59
25	09.34	07.47	06.04	05.08	03.17	02.09	03.44	05.31	07.07	07.42	09.30	10.36
	15.28	17.17	18.47	21.28	23.16	00.33	23.03	21.08	19.12	16.22	14.40	14.00
26	09.31	07.44	06.00	05.04	03.14	02.11	03.47	05.34	07.10	07.45	09.34	10.36
	15.32	17.21	18.50	21.31	23.20	00.32	23.00	21.04	19.08	16.19	14.37	14.01
27	09.28	07.40	05.57	05.00	03.10	02.13	03.51	05.37	07.13	07.49	09.37	10.36
	15.35	17.24	18.54	21.35	23.24	00.30	22.56	21.01	19.05	16.15	14.34	14.02
28	09.24	07.36	05.53	04.57	03.07	02.15	03.55	05.41	07.16	07.52	09.40	10.36
	15.39	17.27	18.57	21.38	23.27	00.29	22.52	20.57	19.01	16.12	14.31	14.04
29	09.21		06.49	04.53	03.03	02.17	03.58	05.44	07.19	07.55	09.44	10.35
	15.43		20.00	21.41	23.31	00.27	22.49	20.53	18.57	16.08	14.29	14.05
30	09.18		06.45	04.49	03.00	02.20	04.02	05.47	07.22	07.59	09.47	10.34
	15.46		20.03	21.45	23.35	00.24	22.45	20.49	18.54	16.04	14.26	14.07
31	09.15		06.42		02.53		04.05	05.50		08.02		10.33
	15.50		20.06		23.39		22.41	20.46		16.01		14.09
Potential sun hours	155	232	362	456	585	660	631	517	395	301	187	115
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)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Kovasinkangas_20191009

Kovasinkankaan tuulivoimapuisto, li

FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
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+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated: 30.12.2020 17:09/3.4.388

SHADOW - Calendar

Calculation: Kovasinkangas V162-6.0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207Shadow receptor: G - Liikerakennus G (Impivaarantie kämpä)
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [LULEA]
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664

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

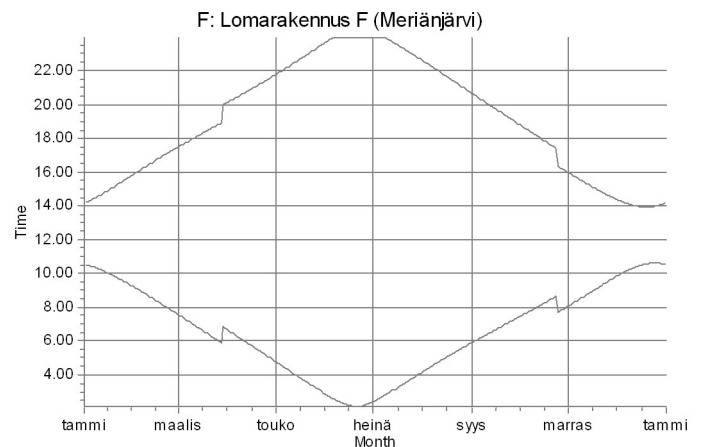
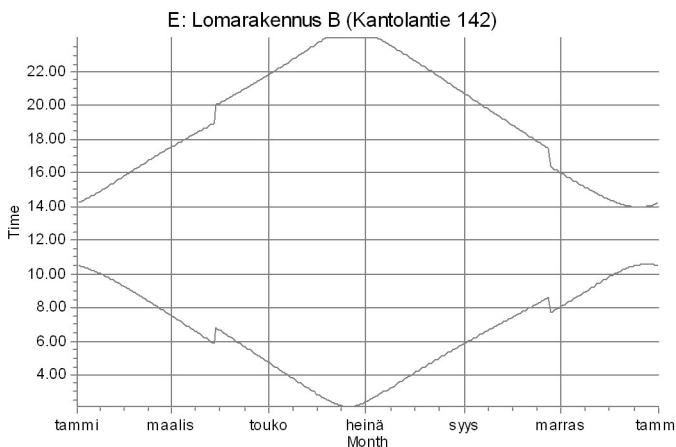
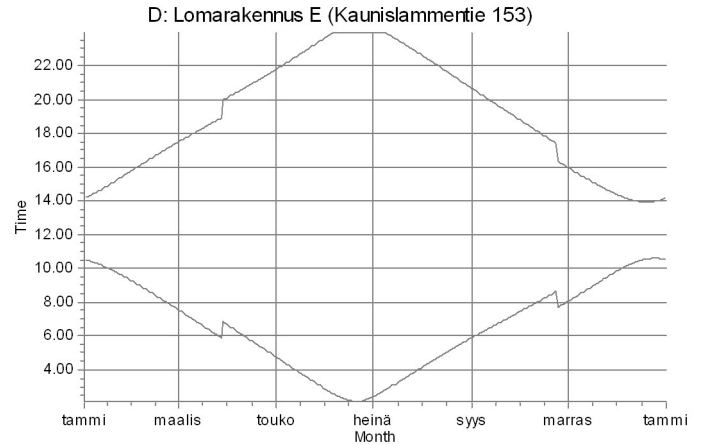
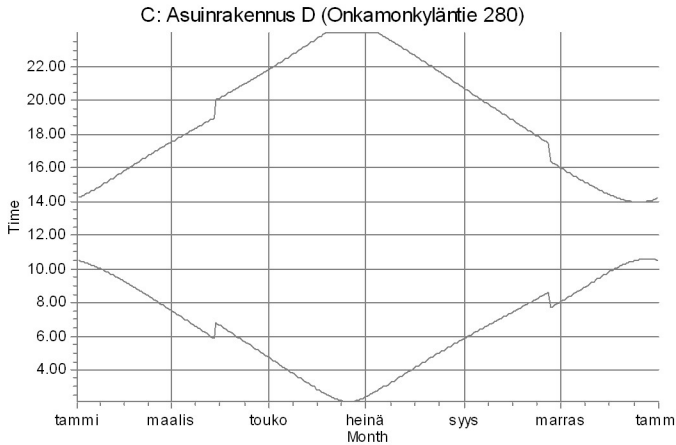
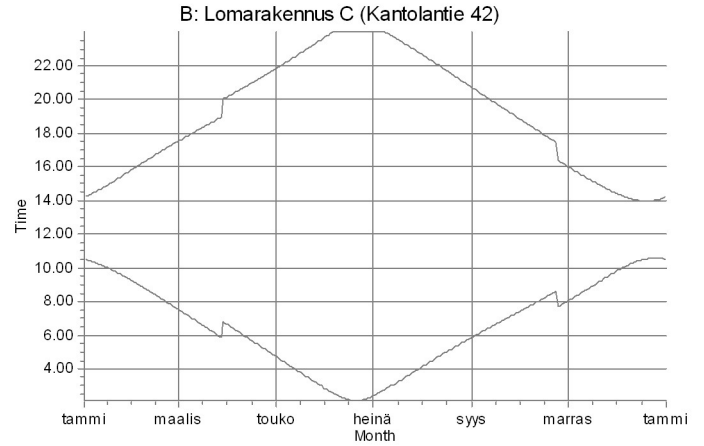
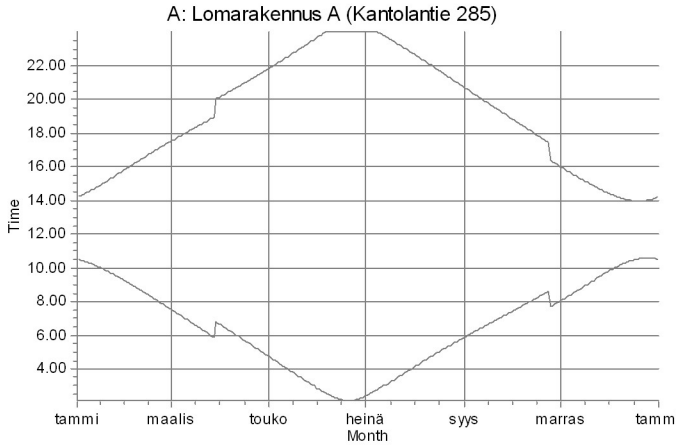
Table with columns for months (January to December) and rows for potential sun hours, sun rise/set times, and reductions. Includes summary rows at the bottom.

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

Matrix table with columns: 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)

SHADOW - Calendar, graphical

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207



WTGs

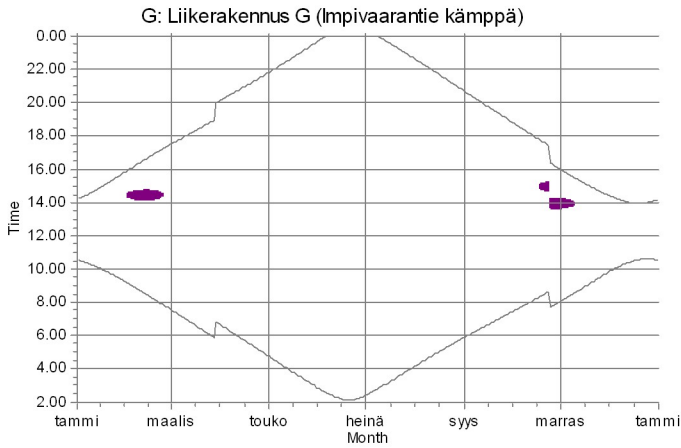
Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, Ii

Licensed user:
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Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar, graphical

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207



WTGs

11: VESTAS V162-6.0 HH199 6000 162.0 !0! hub: 199,0 m (TOT: 280,0 m) (34)

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, II

Licensed user:
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Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207WTG: 2 - VESTAS V126-3.45 LTq 3450 126.0 IOI hub: 137,0 m (TOT: 200,0 m) (14)
Assumptions for shadow calculations

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.25	04.10	05.54	07.26	08.06	09.50
	14.13	15.54	17.31	20.10	21.49	23.42	00.21	22.38	20.42	18.50	15.58	14.25
2	10.30	09.08	07.29	06.35	04.43	02.48	02.28	04.14	05.57	07.29	08.09	09.53
	14.15	15.58	17.35	20.13	21.52	23.45	00.18	22.34	20.39	18.47	15.55	14.22
3	10.29	09.05	07.26	06.31	04.39	02.45	02.30	04.17	06.00	07.32	08.13	09.56
	14.18	16.02	17.38	20.16	21.56	23.49	00.16	22.30	20.35	18.43	15.51	14.20
4	10.27	09.01	07.22	06.27	04.35	02.42	02.34	04.21	06.03	07.35	08.16	10.00
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.27	20.31	18.39	15.48	14.18
5	10.25	08.58	07.19	06.23	04.31	02.38	02.37	04.24	06.06	07.38	08.20	10.03
	14.23	16.09	17.44	20.22	22.03	23.56	00.10	22.23	20.27	18.36	15.44	14.15
6	10.24	08.55	07.15	06.20	04.28	02.35	02.40	04.28	06.10	07.41	08.23	10.05
	14.26	16.12	17.48	20.26	22.06	23.59	00.07	22.19	20.24	18.32	15.41	14.13
7	10.22	08.51	07.11	06.16	04.24	02.32	02.43	04.31	06.13	07.44	08.27	10.08
	14.29	16.16	17.51	20.29	22.10	00.03	00.04	22.16	20.20	18.28	15.38	14.11
8	10.20	08.48	07.07	06.12	04.20	02.30	02.47	04.35	06.16	07.47	08.30	10.11
	14.31	16.20	17.54	20.32	22.13	00.06	00.01	22.12	20.16	18.25	15.34	14.10
9	10.18	08.44	07.04	06.08	04.17	02.27	02.50	04.38	06.19	07.51	08.34	10.14
	14.35	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.21	15.31	14.08
10	10.15	08.41	07.00	06.05	04.13	02.24	02.54	04.42	06.22	07.54	08.37	10.16
	14.38	16.27	18.00	20.38	22.21	00.12	23.55	22.04	20.09	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.22	02.57	04.45	06.25	07.57	08.41	10.19
	14.41	16.30	18.04	20.42	22.24	00.15	23.52	22.01	20.05	18.14	15.24	14.05
12	10.11	08.34	06.53	05.57	04.06	02.19	03.01	04.49	06.28	08.00	08.44	10.21
	14.44	16.34	18.07	20.45	22.28	00.18	23.49	21.57	20.01	18.10	15.21	14.03
13	10.08	08.30	06.49	05.54	04.02	02.17	03.01	04.52	06.31	08.03	08.48	10.23
	14.47	16.37	18.10	20.48	22.31	00.20	23.45	21.53	19.57	18.06	15.18	14.02
14	10.06	08.27	06.45	05.50	03.58	02.15	03.04	04.55	06.34	08.06	08.51	10.25
	14.51	16.41	18.13	20.51	22.35	00.23	23.42	21.50	19.54	18.03	15.14	14.01
15	10.03	08.23	06.42	05.46	03.55	02.13	03.08	04.59	06.37	08.09	08.55	10.27
	14.54	16.44	18.16	20.55	22.39	00.25	23.38	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.51	02.12	03.12	05.02	06.40	08.13	08.58	10.29
	14.57	16.48	18.19	20.58	22.42	00.27	23.35	21.42	19.46	17.55	15.08	14.00
17	09.58	08.16	06.34	05.39	03.47	02.10	03.15	05.05	06.43	08.16	09.02	10.30
	15.01	16.51	18.23	21.01	22.46	00.29	23.32	21.38	19.42	17.52	15.05	13.59
18	09.55	08.13	06.31	05.35	03.44	02.09	03.19	05.09	06.46	08.19	09.06	10.31
	15.04	16.54	18.26	21.04	22.50	00.30	23.28	21.35	19.39	17.48	15.02	13.59
19	09.52	08.09	06.27	05.31	03.40	02.09	03.23	05.12	06.49	08.22	09.09	10.33
	15.08	16.58	18.29	21.08	22.54	00.32	23.25	21.31	19.35	17.44	14.58	13.59
20	09.49	08.06	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.26	09.13	10.34
	15.11	17.01	18.32	21.11	22.57	00.32	23.21	21.27	19.31	17.41	14.55	13.59
21	09.46	08.02	06.19	05.24	03.33	02.08	03.30	05.19	06.55	08.29	09.16	10.34
	15.15	17.05	18.35	21.14	23.01	00.33	23.18	21.23	19.28	17.37	14.52	13.59
22	09.43	07.58	06.16	05.20	03.29	02.09	03.34	05.22	06.58	08.32	09.20	10.35
	15.18	17.08	18.38	21.18	23.05	00.33	23.14	21.20	19.24	17.34	14.49	13.59
23	09.40	07.55	06.12	05.16	03.26	02.09	03.37	05.25	07.01	08.35	09.23	10.36
	15.22	17.11	18.41	21.21	23.08	00.33	23.10	21.16	19.20	17.30	14.46	14.00
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.28	07.04	08.39	09.27	10.36
	15.26	17.15	18.45	21.25	23.12	00.32	23.07	21.12	19.16	17.26	14.43	14.00
25	09.34	07.48	06.05	05.09	03.19	02.12	03.45	05.32	07.07	07.42	09.30	10.36
	15.29	17.18	18.48	21.28	23.16	00.31	23.03	21.08	19.13	16.23	14.41	14.01
26	09.31	07.44	06.01	05.05	03.15	02.13	03.48	05.35	07.10	07.45	09.34	10.36
	15.33	17.21	18.51	21.31	23.20	00.30	23.00	21.05	19.09	16.19	14.38	14.02
27	09.28	07.40	05.57	05.01	03.12	02.15	03.52	05.38	07.14	07.49	09.37	10.36
	15.36	17.25	18.54	21.35	23.23	00.29	22.56	21.01	19.05	16.16	14.35	14.04
28	09.25	07.37	05.53	04.57	03.08	02.17	03.56	05.41	07.17	07.52	09.40	10.35
	15.40	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		05.50	04.54	03.05	02.19	03.59	05.44	07.20	07.56	09.44	10.35
	15.44		20.00	21.42	23.31	00.25	22.49	20.54	18.58	16.09	14.30	14.07
30	09.18		06.46	04.50	03.01	02.22	04.03	05.48	07.23	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	22.45	20.50	18.54	16.05	14.27	14.09
31	09.15		06.42		02.55		04.06	05.51		08.02		10.33
	15.51		20.07		23.38		22.41	20.46		16.02		14.11
Potential sun hours	156	232	362	456	585	658	630	517	395	301	187	116
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, II

Licensed user:
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Osmontie 34, PO Box 950
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+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207WTG: 3 - VESTAS V126-3.45 LTq 3450 126.0 IOI hub: 137,0 m (TOT: 200,0 m) (15)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.25	04.10	05.54	07.26	08.06	09.50
	14.13	15.54	17.31	20.10	21.49	23.42	00.21	22.38	20.42	18.50	15.58	14.25
2	10.30	09.08	07.29	06.35	04.42	02.48	02.27	04.14	05.57	07.29	08.09	09.53
	14.15	15.58	17.35	20.13	21.52	23.45	00.19	22.34	20.39	18.47	15.55	14.22
3	10.29	09.05	07.26	06.31	04.39	02.45	02.30	04.17	06.00	07.32	08.13	09.56
	14.18	16.02	17.38	20.16	21.56	23.49	00.16	22.30	20.35	18.43	15.51	14.20
4	10.27	09.01	07.22	06.27	04.35	02.41	02.33	04.21	06.03	07.35	08.16	10.00
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.27	20.31	18.39	15.48	14.18
5	10.25	08.58	07.18	06.23	04.31	02.38	02.37	04.24	06.06	07.38	08.20	10.03
	14.23	16.09	17.44	20.22	22.03	23.56	00.10	22.23	20.27	18.36	15.44	14.15
6	10.24	08.55	07.15	06.20	04.28	02.35	02.40	04.28	06.09	07.41	08.23	10.05
	14.26	16.12	17.48	20.26	22.06	23.59	00.08	22.19	20.24	18.32	15.41	14.13
7	10.22	08.51	07.11	06.16	04.24	02.32	02.43	04.31	06.13	07.44	08.27	10.08
	14.28	16.16	17.51	20.29	22.10	00.03	00.05	22.16	20.20	18.28	15.37	14.11
8	10.20	08.48	07.07	06.12	04.20	02.30	02.47	04.35	06.16	07.47	08.30	10.11
	14.31	16.20	17.54	20.32	22.13	00.06	00.01	22.12	20.16	18.24	15.34	14.10
9	10.18	08.44	07.04	06.08	04.17	02.27	02.50	04.38	06.19	07.50	08.34	10.14
	14.34	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.21	15.31	14.08
10	10.15	08.41	07.00	06.05	04.13	02.24	02.54	04.42	06.22	07.54	08.37	10.16
	14.38	16.27	18.00	20.38	22.21	00.12	23.55	22.04	20.09	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.22	02.57	04.45	06.25	07.57	08.41	10.19
	14.41	16.30	18.04	20.42	22.24	00.15	23.52	22.01	20.05	18.13	15.24	14.05
12	10.11	08.34	06.53	05.57	04.06	02.19	03.01	04.49	06.28	08.00	08.44	10.21
	14.44	16.34	18.07	20.45	22.28	00.18	23.49	21.57	20.01	18.10	15.21	14.03
13	10.08	08.30	06.49	05.53	04.02	02.17	03.01	04.52	06.31	08.03	08.48	10.23
	14.47	16.37	18.10	20.48	22.31	00.21	23.45	21.53	19.57	18.06	15.17	14.02
14	10.06	08.27	06.45	05.50	03.58	02.15	03.04	04.55	06.34	08.06	08.51	10.25
	14.50	16.41	18.13	20.51	22.35	00.23	23.42	21.50	19.54	18.03	15.14	14.01
15	10.03	08.23	06.42	05.46	03.55	02.13	03.08	04.59	06.37	08.09	08.55	10.27
	14.54	16.44	18.16	20.55	22.39	00.25	23.38	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.51	02.12	03.12	05.02	06.40	08.13	08.58	10.29
	14.57	16.48	18.19	20.58	22.42	00.27	23.35	21.42	19.46	17.55	15.08	14.00
17	09.58	08.16	06.34	05.38	03.47	02.10	03.15	05.05	06.43	08.16	09.02	10.30
	15.01	16.51	18.23	21.01	22.46	00.29	23.32	21.38	19.42	17.52	15.05	13.59
18	09.55	08.13	06.31	05.35	03.44	02.09	03.19	05.09	06.46	08.19	09.06	10.31
	15.04	16.54	18.26	21.04	22.50	00.30	23.28	21.35	19.39	17.48	15.01	13.59
19	09.52	08.09	06.27	05.31	03.40	02.09	03.23	05.12	06.49	08.22	09.09	10.33
	15.08	16.58	18.29	21.08	22.54	00.32	23.25	21.31	19.35	17.44	14.58	13.58
20	09.49	08.06	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.26	09.13	10.34
	15.11	17.01	18.32	21.11	22.57	00.32	23.21	21.27	19.31	17.41	14.55	13.58
21	09.46	08.02	06.19	05.24	03.33	02.08	03.30	05.19	06.55	08.29	09.16	10.34
	15.15	17.05	18.35	21.14	23.01	00.33	23.18	21.23	19.27	17.37	14.52	13.59
22	09.43	07.58	06.16	05.20	03.29	02.08	03.34	05.22	06.58	08.32	09.20	10.35
	15.18	17.08	18.38	21.18	23.05	00.33	23.14	21.20	19.24	17.34	14.49	13.59
23	09.40	07.55	06.12	05.16	03.26	02.09	03.37	05.25	07.01	08.35	09.23	10.36
	15.22	17.11	18.41	21.21	23.08	00.33	23.10	21.16	19.20	17.30	14.46	14.00
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.28	07.04	08.39	09.27	10.36
	15.25	17.15	18.45	21.24	23.12	00.32	23.07	21.12	19.16	17.26	14.43	14.00
25	09.34	07.48	06.04	05.09	03.19	02.11	03.45	05.32	07.07	07.42	09.30	10.36
	15.29	17.18	18.48	21.28	23.16	00.32	23.03	21.08	19.13	16.23	14.41	14.01
26	09.31	07.44	06.01	05.05	03.15	02.13	03.48	05.35	07.10	07.45	09.34	10.36
	15.33	17.21	18.51	21.31	23.20	00.30	23.00	21.05	19.09	16.19	14.38	14.02
27	09.28	07.40	05.57	05.01	03.12	02.15	03.52	05.38	07.14	07.49	09.37	10.36
	15.36	17.25	18.54	21.35	23.23	00.29	22.56	21.01	19.05	16.16	14.35	14.04
28	09.24	07.37	05.53	04.57	03.08	02.17	03.56	05.41	07.17	07.52	09.40	10.35
	15.40	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		05.50	04.54	03.05	02.19	03.59	05.44	07.20	07.56	09.44	10.35
	15.44		20.00	21.42	23.31	00.25	22.49	20.53	18.58	16.09	14.30	14.07
30	09.18		06.46	04.50	03.01	02.22	04.03	05.48	07.23	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	22.45	20.50	18.54	16.05	14.27	14.08
31	09.15		06.42		02.54		04.06	05.51		08.02		10.33
	15.51		20.07		23.38		22.41	20.46		16.02		14.10
Potential sun hours	156	232	362	456	585	658	630	517	395	301	187	116
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

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207WTG: 4 - VESTAS V126-3.45 LTq 3450 126.0 IOI hub: 137,0 m (TOT: 200,0 m) (16)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.25	04.10	05.54	07.26	08.06	09.50
	14.13	15.54	17.31	20.10	21.48	23.41	00.21	22.38	20.42	18.50	15.58	14.25
2	10.30	09.08	07.29	06.35	04.43	02.48	02.28	04.14	05.57	07.29	08.09	09.53
	14.16	15.58	17.35	20.13	21.52	23.45	00.18	22.34	20.38	18.47	15.55	14.22
3	10.29	09.05	07.26	06.31	04.39	02.45	02.31	04.17	06.00	07.32	08.13	09.56
	14.18	16.02	17.38	20.16	21.55	23.49	00.16	22.30	20.35	18.43	15.51	14.20
4	10.27	09.01	07.22	06.27	04.35	02.42	02.34	04.21	06.03	07.35	08.16	09.59
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.27	20.31	18.39	15.48	14.18
5	10.25	08.58	07.18	06.23	04.31	02.39	02.37	04.24	06.06	07.38	08.20	10.02
	14.23	16.09	17.44	20.22	22.03	23.56	00.10	22.23	20.27	18.36	15.44	14.15
6	10.24	08.55	07.15	06.20	04.28	02.36	02.40	04.28	06.09	07.41	08.23	10.05
	14.26	16.12	17.48	20.26	22.06	23.59	00.07	22.19	20.23	18.32	15.41	14.13
7	10.22	08.51	07.11	06.16	04.24	02.33	02.43	04.31	06.13	07.44	08.27	10.08
	14.29	16.16	17.51	20.29	22.10	00.02	00.04	22.15	20.20	18.28	15.38	14.11
8	10.20	08.48	07.07	06.12	04.20	02.30	02.47	04.35	06.16	07.47	08.30	10.11
	14.32	16.20	17.54	20.32	22.13	00.06	00.01	22.12	20.16	18.24	15.34	14.10
9	10.17	08.44	07.04	06.08	04.17	02.27	02.50	04.38	06.19	07.50	08.34	10.13
	14.35	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.21	15.31	14.08
10	10.15	08.41	07.00	06.05	04.13	02.24	02.54	04.42	06.22	07.54	08.37	10.16
	14.38	16.27	18.00	20.38	22.20	00.12	23.55	22.04	20.09	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.22	02.57	04.45	06.25	07.57	08.41	10.18
	14.41	16.30	18.04	20.42	22.24	00.15	23.52	22.01	20.05	18.13	15.24	14.05
12	10.11	08.34	06.53	05.57	04.06	02.19	03.01	04.49	06.28	08.00	08.44	10.21
	14.44	16.34	18.07	20.45	22.28	00.18	23.48	21.57	20.01	18.10	15.21	14.03
13	10.08	08.30	06.49	05.53	04.02	02.17	03.01	04.52	06.31	08.03	08.48	10.23
	14.47	16.37	18.10	20.48	22.31	00.20	23.45	21.53	19.57	18.06	15.18	14.02
14	10.06	08.27	06.45	05.50	03.58	02.15	03.05	04.55	06.34	08.06	08.51	10.25
	14.51	16.41	18.13	20.51	22.35	00.23	23.42	21.49	19.54	18.03	15.14	14.01
15	10.03	08.23	06.42	05.46	03.55	02.13	03.08	04.59	06.37	08.09	08.55	10.27
	14.54	16.44	18.16	20.55	22.39	00.25	23.38	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.51	02.12	03.12	05.02	06.40	08.13	08.58	10.28
	14.57	16.48	18.19	20.58	22.42	00.27	23.35	21.42	19.46	17.55	15.08	14.00
17	09.58	08.16	06.34	05.38	03.47	02.11	03.15	05.05	06.43	08.16	09.02	10.30
	15.01	16.51	18.23	21.01	22.46	00.29	23.31	21.38	19.42	17.52	15.05	13.59
18	09.55	08.13	06.30	05.35	03.44	02.10	03.19	05.09	06.46	08.19	09.05	10.31
	15.04	16.54	18.26	21.04	22.50	00.30	23.28	21.35	19.39	17.48	15.02	13.59
19	09.52	08.09	06.27	05.31	03.40	02.09	03.23	05.12	06.49	08.22	09.09	10.32
	15.08	16.58	18.29	21.08	22.53	00.31	23.24	21.31	19.35	17.44	14.58	13.59
20	09.49	08.06	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.26	09.13	10.33
	15.11	17.01	18.32	21.11	22.57	00.32	23.21	21.27	19.31	17.41	14.55	13.59
21	09.46	08.02	06.19	05.24	03.33	02.08	03.30	05.19	06.55	08.29	09.16	10.34
	15.15	17.05	18.35	21.14	23.01	00.33	23.17	21.23	19.27	17.37	14.52	13.59
22	09.43	07.58	06.16	05.20	03.29	02.09	03.34	05.22	06.58	08.32	09.20	10.35
	15.18	17.08	18.38	21.18	23.05	00.33	23.14	21.20	19.24	17.34	14.49	13.59
23	09.40	07.55	06.12	05.16	03.26	02.09	03.37	05.25	07.01	08.35	09.23	10.35
	15.22	17.11	18.41	21.21	23.08	00.33	23.10	21.16	19.20	17.30	14.46	14.00
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.28	07.04	08.39	09.27	10.36
	15.26	17.15	18.45	21.24	23.12	00.32	23.07	21.12	19.16	17.26	14.43	14.00
25	09.34	07.48	06.04	05.09	03.19	02.12	03.45	05.32	07.07	07.42	09.30	10.36
	15.29	17.18	18.48	21.28	23.16	00.31	23.03	21.08	19.13	16.23	14.41	14.01
26	09.31	07.44	06.01	05.05	03.15	02.13	03.48	05.35	07.10	07.45	09.33	10.36
	15.33	17.21	18.51	21.31	23.19	00.30	22.59	21.05	19.09	16.19	14.38	14.02
27	09.28	07.40	05.57	05.01	03.12	02.15	03.52	05.38	07.13	07.49	09.37	10.35
	15.36	17.25	18.54	21.35	23.23	00.29	22.56	21.01	19.05	16.16	14.35	14.04
28	09.24	07.37	05.53	04.57	03.08	02.17	03.56	05.41	07.17	07.52	09.40	10.35
	15.40	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		06.50	04.54	03.05	02.20	03.59	05.44	07.20	07.55	09.44	10.34
	15.44		20.00	21.42	23.31	00.25	22.49	20.53	18.58	16.09	14.30	14.07
30	09.18		06.46	04.50	03.01	02.22	04.03	05.48	07.23	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	22.45	20.50	18.54	16.05	14.27	14.09
31	09.15		06.42		02.55		04.06	05.51		08.02		10.33
	15.51		20.07		23.38		22.41	20.46		16.02		14.11
Potential sun hours	156	232	362	456	585	658	630	517	395	301	187	116
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, Ii

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207WTG: 5 - VESTAS V126-3.45 LTq 3450 126.0 IOI hub: 137,0 m (TOT: 200,0 m) (17)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.24	04.10	05.54	07.26	08.06	09.50
	14.13	15.54	17.31	20.10	21.49	23.42	00.21	22.38	20.42	18.50	15.58	14.24
2	10.30	09.08	07.29	06.35	04.42	02.48	02.27	04.13	05.57	07.29	08.09	09.53
	14.15	15.58	17.34	20.13	21.52	23.45	00.19	22.34	20.38	18.47	15.55	14.22
3	10.29	09.05	07.26	06.31	04.39	02.45	02.30	04.17	06.00	07.32	08.13	09.56
	14.18	16.02	17.38	20.16	21.56	23.49	00.16	22.30	20.35	18.43	15.51	14.20
4	10.27	09.01	07.22	06.27	04.35	02.41	02.33	04.21	06.03	07.35	08.16	10.00
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.27	20.31	18.39	15.48	14.17
5	10.26	08.58	07.18	06.23	04.31	02.38	02.37	04.24	06.06	07.38	08.20	10.03
	14.23	16.09	17.44	20.22	22.03	23.56	00.10	22.23	20.27	18.35	15.44	14.15
6	10.24	08.55	07.15	06.20	04.28	02.35	02.40	04.28	06.09	07.41	08.23	10.05
	14.26	16.12	17.47	20.26	22.06	23.59	00.08	22.19	20.23	18.32	15.41	14.13
7	10.22	08.51	07.11	06.16	04.24	02.32	02.43	04.31	06.13	07.44	08.27	10.08
	14.28	16.16	17.51	20.29	22.10	00.03	00.05	22.16	20.20	18.28	15.37	14.11
8	10.20	08.48	07.07	06.12	04.20	02.29	02.47	04.35	06.16	07.47	08.30	10.11
	14.31	16.19	17.54	20.32	22.13	00.06	00.01	22.12	20.16	18.24	15.34	14.09
9	10.18	08.44	07.04	06.08	04.16	02.27	02.50	04.38	06.19	07.50	08.34	10.14
	14.34	16.23	17.57	20.35	22.17	00.09	02.58	22.08	20.12	18.21	15.31	14.08
10	10.15	08.41	07.00	06.05	04.13	02.24	02.54	04.42	06.22	07.54	08.37	10.16
	14.37	16.27	18.00	20.38	22.21	00.12	23.55	22.04	20.09	18.17	15.27	14.06
11	10.13	08.37	06.56	06.01	04.09	02.21	02.57	04.45	06.25	07.57	08.41	10.19
	14.41	16.30	18.04	20.42	22.24	00.15	23.52	22.01	20.05	18.13	15.24	14.05
12	10.11	08.34	06.53	05.57	04.05	02.19	03.01	04.48	06.28	08.00	08.44	10.21
	14.44	16.34	18.07	20.45	22.28	00.18	23.49	21.57	20.01	18.10	15.21	14.03
13	10.08	08.30	06.49	05.53	04.02	02.17	03.01	04.52	06.31	08.03	08.48	10.23
	14.47	16.37	18.10	20.48	22.31	00.21	23.45	21.53	19.57	18.06	15.17	14.02
14	10.06	08.27	06.45	05.50	03.58	02.15	03.04	04.55	06.34	08.06	08.51	10.25
	14.50	16.41	18.13	20.51	22.35	00.23	23.42	21.50	19.54	18.02	15.14	14.01
15	10.03	08.23	06.42	05.46	03.54	02.13	03.08	04.59	06.37	08.09	08.55	10.27
	14.54	16.44	18.16	20.55	22.39	00.25	23.39	21.46	19.50	17.59	15.11	14.00
16	10.00	08.20	06.38	05.42	03.51	02.11	03.12	05.02	06.40	08.13	08.58	10.29
	14.57	16.47	18.19	20.58	22.42	00.27	23.35	21.42	19.46	17.55	15.08	13.59
17	09.58	08.16	06.34	05.38	03.47	02.10	03.15	05.05	06.43	08.16	09.02	10.30
	15.01	16.51	18.23	21.01	22.46	00.29	23.32	21.38	19.42	17.52	15.05	13.59
18	09.55	08.13	06.30	05.35	03.44	02.09	03.19	05.09	06.46	08.19	09.06	10.31
	15.04	16.54	18.26	21.04	22.50	00.31	23.28	21.35	19.39	17.48	15.01	13.59
19	09.52	08.09	06.27	05.31	03.40	02.08	03.23	05.12	06.49	08.22	09.09	10.33
	15.08	16.58	18.29	21.08	22.54	00.32	23.25	21.31	19.35	17.44	14.58	13.58
20	09.49	08.06	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.26	09.13	10.34
	15.11	17.01	18.32	21.11	22.57	00.33	23.21	21.27	19.31	17.41	14.55	13.58
21	09.46	08.02	06.19	05.23	03.33	02.08	03.30	05.19	06.55	08.29	09.16	10.35
	15.15	17.05	18.35	21.14	23.01	00.33	23.18	21.23	19.27	17.37	14.52	13.59
22	09.43	07.58	06.16	05.20	03.29	02.08	03.34	05.22	06.58	08.32	09.20	10.35
	15.18	17.08	18.38	21.18	23.05	00.33	23.14	21.20	19.24	17.34	14.49	13.59
23	09.40	07.55	06.12	05.16	03.26	02.09	03.37	05.25	07.01	08.35	09.23	10.36
	15.22	17.11	18.41	21.21	23.08	00.33	23.10	21.16	19.20	17.30	14.46	13.59
24	09.37	07.51	06.08	05.12	03.22	02.10	03.41	05.28	07.04	08.39	09.27	10.36
	15.25	17.15	18.45	21.24	23.12	00.33	23.07	21.12	19.16	17.26	14.43	14.00
25	09.34	07.48	06.04	05.09	03.18	02.11	03.45	05.32	07.07	07.42	09.30	10.36
	15.29	17.18	18.48	21.28	23.16	00.32	23.03	21.08	19.13	16.23	14.40	14.01
26	09.31	07.44	06.01	05.05	03.15	02.13	03.48	05.35	07.10	07.45	09.34	10.36
	15.33	17.21	18.51	21.31	23.20	00.31	23.00	21.05	19.09	16.19	14.38	14.02
27	09.28	07.40	05.57	05.01	03.11	02.15	03.52	05.38	07.13	07.49	09.37	10.36
	15.36	17.25	18.54	21.35	23.23	00.29	22.56	21.01	19.05	16.16	14.35	14.04
28	09.24	07.37	05.53	04.57	03.08	02.17	03.55	05.41	07.17	07.52	09.40	10.35
	15.40	17.28	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		05.50	04.54	03.05	02.19	03.59	05.44	07.20	07.56	09.44	10.35
	15.43		20.00	21.42	23.31	00.25	22.49	20.53	18.58	16.09	14.30	14.07
30	09.18		06.46	04.50	03.01	02.22	04.03	05.48	07.23	07.59	09.47	10.34
	15.47		20.03	21.45	23.34	00.23	22.45	20.50	18.54	16.05	14.27	14.08
31	09.15		06.42		02.54		04.06	05.51		08.02		10.33
	15.51		20.07		23.38		22.41	20.46		16.02		14.10
Potential sun hours	155	232	362	456	585	658	630	517	395	301	187	116
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, II

Licensed user:
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Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207 WTG: 6 - VESTAS V162-6.0 HH199 6000 162.0 IO! hub: 199.0 m (TOT: 280.0 m) (29)

Assumptions for shadow calculations

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31 14.13	09.11 15.54	07.33 17.31	06.38 20.09	04.46 21.48	02.51 23.42	02.24 00.21	04.10 22.37	05.54 20.42	07.25 18.50	08.05 15.58	09.50 14.24
2	10.30 14.15	09.08 15.58	07.29 17.34	06.34 20.13	04.42 21.52	02.47 23.45	02.27 00.18	04.13 22.34	05.57 20.38	07.28 18.46	08.09 15.54	09.53 14.22
3	10.29 14.17	09.04 16.01	07.25 17.37	06.30 20.16	04.38 21.55	02.44 23.49	02.30 00.16	04.17 22.30	06.00 20.34	07.32 18.43	08.12 15.51	09.56 14.19
4	10.27 14.20	09.01 16.05	07.22 17.41	06.27 20.19	04.35 21.59	02.41 23.52	02.33 00.13	04.20 22.26	06.03 20.31	07.35 18.39	08.16 15.47	09.59 14.17
5	10.25 14.22	08.58 16.08	07.18 17.44	06.23 20.22	04.31 22.02	02.38 23.56	02.36 00.10	04.24 22.23	06.06 20.27	07.38 18.35	08.19 15.44	10.02 14.15
6	10.23 14.25	08.54 16.12	07.14 17.47	06.19 20.25	04.27 22.06	02.35 23.59	02.39 00.07	04.27 22.19	06.09 20.23	07.41 18.31	08.23 15.40	10.05 14.13
7	10.22 14.28	08.51 16.16	07.11 17.50	06.16 20.28	04.23 22.09	02.32 00.02	02.43 00.04	04.31 22.15	06.12 20.19	07.44 18.28	08.26 15.37	10.08 14.11
8	10.20 14.31	08.47 16.19	07.07 17.54	06.12 20.32	04.20 22.13	02.29 00.06	02.46 00.01	04.34 22.12	06.15 20.16	07.47 18.24	08.30 15.34	10.11 14.09
9	10.17 14.34	08.44 16.23	07.03 17.57	06.08 20.35	04.16 22.17	02.26 00.09	02.50 23.58	04.38 22.08	06.18 20.12	07.50 18.20	08.33 15.30	10.13 14.07
10	10.15 14.37	08.41 16.26	07.00 18.00	06.04 20.38	04.12 22.20	02.23 00.12	02.53 23.55	04.41 22.04	06.21 20.08	07.53 18.17	08.37 15.27	10.16 14.06
11	10.13 14.40	08.37 16.30	06.56 18.03	06.01 20.41	04.09 22.24	02.21 00.15	02.57 23.52	04.45 22.00	06.24 20.04	07.56 18.13	08.40 15.24	10.18 14.04
12	10.10 14.43	08.34 16.33	06.52 18.06	05.57 20.44	04.05 22.28	02.19 00.18	03.00 23.48	04.48 21.57	06.28 20.01	08.00 18.09	08.44 15.20	10.21 14.03
13	10.08 14.47	08.30 16.37	06.49 18.10	05.53 20.48	04.01 22.31	02.16 00.21	03.00 23.45	04.52 21.53	06.31 19.57	08.03 18.06	08.47 15.17	10.23 14.02
14	10.05 14.50	08.27 16.40	06.45 18.13	05.49 20.51	03.58 22.35	02.14 00.23	03.04 23.42	04.55 21.49	06.34 19.53	08.06 18.02	08.51 15.14	10.25 14.01
15	10.03 14.53	08.23 16.44	06.41 18.16	05.46 20.54	03.54 22.39	02.12 00.25	03.07 23.38	04.58 21.46	06.37 19.50	08.09 17.59	08.55 15.11	10.27 14.00
16	10.00 14.57	08.20 16.47	06.38 18.19	05.42 20.58	03.50 22.42	02.11 00.27	03.11 23.35	05.02 21.42	06.40 19.46	08.12 17.55	08.58 15.07	10.28 13.59
17	09.57 15.00	08.16 16.51	06.34 18.22	05.38 21.01	03.47 22.46	02.10 00.29	03.15 23.31	05.05 21.38	06.43 19.42	08.16 17.51	09.02 15.04	10.30 13.58
18	09.55 15.04	08.12 16.54	06.30 18.25	05.34 21.04	03.43 22.50	02.08 00.31	03.18 23.28	05.08 21.34	06.46 19.38	08.19 17.48	09.05 15.01	10.31 13.58
19	09.52 15.07	08.09 16.57	06.26 18.28	05.31 21.07	03.39 22.53	02.08 00.32	03.22 23.24	05.12 21.31	06.49 19.35	08.22 17.44	09.09 14.58	10.32 13.58
20	09.49 15.11	08.05 17.01	06.23 18.32	05.27 21.11	03.36 22.57	02.07 00.33	03.26 23.21	05.15 21.27	06.52 19.31	08.25 17.40	09.12 14.55	10.33 13.58
21	09.46 15.14	08.02 17.04	06.19 18.35	05.23 21.14	03.32 23.01	02.07 00.33	03.29 23.17	05.18 21.23	06.55 19.27	08.29 17.37	09.16 14.52	10.34 13.58
22	09.43 15.18	07.58 17.08	06.15 18.38	05.19 21.17	03.29 23.04	02.08 00.33	03.33 23.14	05.21 21.19	06.58 19.23	08.32 17.33	09.19 14.49	10.35 13.58
23	09.40 15.21	07.54 17.11	06.12 18.41	05.16 21.21	03.25 23.08	02.08 00.33	03.37 23.10	05.25 21.16	07.01 19.20	08.35 17.30	09.23 14.46	10.35 13.59
24	09.37 15.25	07.51 17.14	06.08 18.44	05.12 21.24	03.22 23.12	02.09 00.32	03.40 23.07	05.28 21.12	07.04 19.16	08.38 17.26	09.26 14.43	10.36 14.00
25	09.34 15.29	07.47 17.18	06.04 18.47	05.08 21.28	03.18 23.16	02.11 00.32	03.44 23.03	05.31 21.08	07.07 19.12	07.42 16.22	09.30 14.40	10.36 14.01
26	09.31 15.32	07.44 17.21	06.00 18.50	05.04 21.31	03.15 23.19	02.12 00.30	03.48 22.59	05.34 21.04	07.10 19.08	07.45 16.19	09.33 14.37	10.36 14.02
27	09.27 15.36	07.40 17.24	05.57 18.54	05.01 21.34	03.11 23.23	02.14 00.29	03.51 22.56	05.38 21.01	07.13 19.05	07.48 16.15	09.37 14.34	10.35 14.03
28	09.24 15.39	07.36 17.28	05.53 18.57	04.57 21.38	03.08 23.27	02.16 00.27	03.55 22.52	05.41 20.57	07.16 19.01	07.52 16.12	09.40 14.32	10.35 14.05
29	09.21 15.43	07.33 17.31	05.49 19.00	04.53 21.41	03.04 23.31	02.19 00.25	03.59 22.48	05.44 20.53	07.19 18.57	07.55 16.08	09.43 14.29	10.34 14.06
30	09.18 15.47	07.30 17.34	05.45 19.03	04.50 21.44	03.01 23.34	02.21 00.23	04.02 22.45	05.47 20.49	07.22 18.54	07.59 16.05	09.47 14.27	10.34 14.08
31	09.14 15.50	07.27 17.37	05.42 19.06	04.47 21.47	02.98 23.38	02.24 00.26	04.06 22.41	05.50 20.46	07.25 16.01	08.02 16.01	09.50 14.27	10.33 14.10
Potential sun hours	155	232	362	456	585	658	631	517	395	301	187	115
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkangas tuulivoimapaisto, II

Licensed user:
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Osmontie 34, PO Box 950
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Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207 WTG: 7 - VESTAS V162-6.0 HH199 6000 162.0 IO! hub: 199.0 m (TOT: 280.0 m) (30)

Assumptions for shadow calculations

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1 102 916 649 504 548 8 664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31 14.13	09.11 15.54	07.33 17.31	06.38 20.09	04.46 21.48	02.51 23.41	02.24 00.21	04.10 22.37	05.53 20.42	07.25 18.50	08.05 15.58	09.50 14.24
2	10.30 14.15	09.08 15.58	07.29 17.34	06.34 20.12	04.42 21.52	02.47 23.45	02.27 00.18	04.13 22.34	05.57 20.38	07.28 18.46	08.09 15.54	09.53 14.22
3	10.28 14.17	09.04 16.01	07.25 17.37	06.30 20.16	04.38 21.55	02.44 23.49	02.30 00.16	04.17 22.30	06.00 20.34	07.31 18.43	08.12 15.51	09.56 14.19
4	10.27 14.20	09.01 16.05	07.22 17.41	06.27 20.19	04.35 21.59	02.41 23.52	02.33 00.13	04.20 22.26	06.03 20.31	07.35 18.39	08.16 15.47	09.59 14.17
5	10.25 14.22	08.58 16.08	07.18 17.44	06.23 20.22	04.31 22.02	02.38 23.56	02.36 00.10	04.24 22.23	06.06 20.27	07.38 18.35	08.19 15.44	10.02 14.15
6	10.23 14.25	08.54 16.12	07.14 17.47	06.19 20.25	04.27 22.06	02.35 23.59	02.39 00.07	04.27 22.19	06.09 20.23	07.41 18.31	08.23 15.40	10.05 14.13
7	10.21 14.28	08.51 16.16	07.11 17.50	06.16 20.28	04.24 22.09	02.32 00.02	02.43 00.04	04.31 22.15	06.12 20.19	07.44 18.28	08.26 15.37	10.08 14.11
8	10.19 14.31	08.47 16.19	07.07 17.54	06.12 20.32	04.20 22.13	02.29 00.06	02.46 00.01	04.34 22.11	06.15 20.16	07.47 18.24	08.30 15.34	10.11 14.09
9	10.17 14.34	08.44 16.23	07.03 17.57	06.08 20.35	04.16 22.17	02.26 00.09	02.50 23.58	04.38 22.08	06.18 20.12	07.50 18.20	08.33 15.30	10.13 14.07
10	10.15 14.37	08.41 16.26	07.00 18.00	06.04 20.38	04.12 22.20	02.24 00.12	02.53 23.55	04.41 22.04	06.21 20.08	07.53 18.17	08.37 15.27	10.16 14.06
11	10.13 14.40	08.37 16.30	06.56 18.03	06.01 20.41	04.09 22.24	02.21 00.15	02.57 23.52	04.45 22.00	06.24 20.04	07.56 18.13	08.40 15.24	10.18 14.04
12	10.10 14.43	08.34 16.33	06.52 18.06	05.57 20.44	04.05 22.27	02.19 00.18	03.00 23.48	04.48 21.57	06.28 20.01	08.00 18.09	08.44 15.20	10.20 14.03
13	10.08 14.47	08.30 16.37	06.49 18.10	05.53 20.48	04.01 22.31	02.16 00.20	03.00 23.45	04.52 21.53	06.31 19.57	08.03 18.06	08.47 15.17	10.23 14.02
14	10.05 14.50	08.27 16.40	06.45 18.13	05.49 20.51	03.58 22.35	02.14 00.23	03.04 23.42	04.55 21.49	06.34 19.53	08.06 18.02	08.51 15.14	10.25 14.01
15	10.03 14.53	08.23 16.44	06.41 18.16	05.46 20.54	03.54 22.38	02.13 00.25	03.08 23.38	04.58 21.45	06.37 19.49	08.09 17.58	08.54 15.11	10.26 14.00
16	10.00 14.57	08.19 16.47	06.38 18.19	05.42 20.57	03.50 22.42	02.11 00.27	03.11 23.35	05.02 21.42	06.40 19.46	08.12 17.55	08.58 15.07	10.28 13.59
17	09.57 15.00	08.16 16.51	06.34 18.22	05.38 21.01	03.47 22.46	02.10 00.29	03.15 23.31	05.05 21.38	06.43 19.42	08.15 17.51	09.02 15.04	10.30 13.59
18	09.54 15.04	08.12 16.54	06.30 18.25	05.34 21.04	03.43 22.50	02.09 00.30	03.18 23.28	05.08 21.34	06.46 19.38	08.19 17.48	09.05 15.01	10.31 13.58
19	09.52 15.07	08.09 16.57	06.26 18.28	05.31 21.07	03.40 22.53	02.08 00.31	03.22 23.24	05.12 21.31	06.49 19.35	08.22 17.44	09.09 14.58	10.32 13.58
20	09.49 15.11	08.05 17.01	06.23 18.32	05.27 21.11	03.36 22.57	02.08 00.32	03.26 23.21	05.15 21.27	06.52 19.31	08.25 17.40	09.12 14.55	10.33 13.58
21	09.46 15.14	08.02 17.04	06.19 18.35	05.23 21.14	03.32 23.01	02.08 00.33	03.30 23.17	05.18 21.23	06.55 19.27	08.28 17.37	09.16 14.52	10.34 13.54
22	09.43 15.18	07.58 17.08	06.15 18.38	05.19 21.17	03.29 23.04	02.08 00.33	03.33 23.14	05.21 21.19	06.58 19.23	08.32 17.33	09.19 14.49	10.35 13.59
23	09.40 15.21	07.54 17.11	06.12 18.41	05.16 21.21	03.25 23.08	02.09 00.33	03.37 23.10	05.25 21.16	07.01 19.20	08.35 17.30	09.23 14.46	10.35 13.59
24	09.37 15.25	07.51 17.14	06.08 18.44	05.12 21.24	03.22 23.12	02.10 00.32	03.41 23.06	05.28 21.12	07.04 19.16	08.38 17.26	09.26 14.43	10.36 14.00
25	09.34 15.29	07.47 17.18	06.04 18.47	05.08 21.27	03.18 23.16	02.11 00.31	03.44 23.03	05.31 21.08	07.07 19.12	07.42 16.22	09.30 14.40	10.36 14.01
26	09.30 15.32	07.44 17.21	06.00 18.50	05.04 21.31	03.15 23.19	02.12 00.30	03.48 22.59	05.34 21.04	07.10 19.08	07.45 16.19	09.33 14.37	10.36 14.02
27	09.27 15.36	07.40 17.24	05.57 18.54	05.01 21.34	03.11 23.23	02.14 00.29	03.51 22.56	05.38 21.01	07.13 19.05	07.48 16.15	09.37 14.35	10.35 14.03
28	09.24 15.39	07.36 17.28	05.53 18.57	04.57 21.38	03.08 23.27	02.16 00.27	03.55 22.52	05.41 20.57	07.16 19.01	07.52 16.12	09.40 14.32	10.35 14.05
29	09.21 15.43		06.49 20.00	04.53 21.41	03.04 23.30	02.19 00.25	03.59 22.48	05.44 20.53	07.19 18.57	07.55 16.08	09.43 14.29	10.34 14.06
30	09.18 15.47		06.45 20.03	04.50 21.45	03.01 23.34	02.21 00.23	04.02 22.45	05.47 20.49	07.22 18.54	07.59 16.05	09.47 14.27	10.33 14.08
31	09.14 15.50		06.42 20.06		02.54 23.38		04.06 22.41	05.50 20.46		08.02 16.01		10.32 14.10
Potential sun hours	155	232	362	456	585	658	630	517	395	301	187	116
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

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207 WTG: 8 - VESTAS V162-6.0 HH199 6000 162.0 IO! hub: 199.0 m (TOT: 280.0 m) (31)

Assumptions for shadow calculations

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0,60	2,61	4,18	6,47	8,80	10,60	9,50	6,88	4,22	2,77	1,22	0,17

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
619	605	559	627	758	839	939	1102	916	649	504	548	8664

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.51	02.24	04.09	05.53	07.25	08.05	09.50
	14.13	15.54	17.31	20.09	21.48	23.41	00.21	22.37	20.42	18.50	15.58	14.24
2	10.30	09.08	07.29	06.34	04.42	02.47	02.27	04.13	05.57	07.28	08.09	09.53
	14.15	15.57	17.34	20.12	21.52	23.45	00.18	22.34	20.38	18.46	15.54	14.22
3	10.28	09.04	07.25	06.30	04.38	02.44	02.30	04.17	06.00	07.31	08.12	09.56
	14.17	16.01	17.37	20.16	21.55	23.48	00.16	22.30	20.34	18.42	15.51	14.19
4	10.27	09.01	07.22	06.27	04.35	02.41	02.33	04.20	06.03	07.34	08.16	09.59
	14.20	16.05	17.41	20.19	21.59	23.52	00.13	22.26	20.31	18.39	15.47	14.17
5	10.25	08.58	07.18	06.23	04.31	02.38	02.36	04.24	06.06	07.38	08.19	10.02
	14.22	16.08	17.44	20.22	22.02	23.55	00.10	22.23	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.39	04.27	06.09	07.41	08.23	10.05
	14.25	16.12	17.47	20.25	22.06	23.59	00.07	22.19	20.23	18.31	15.40	14.13
7	10.21	08.51	07.11	06.15	04.23	02.32	02.43	04.31	06.12	07.44	08.26	10.08
	14.28	16.15	17.50	20.28	22.09	00.02	00.04	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.29	02.46	04.34	06.15	07.47	08.30	10.11
	14.31	16.19	17.53	20.31	22.13	00.05	00.01	22.11	20.16	18.24	15.34	14.09
9	10.17	08.44	07.03	06.08	04.16	02.26	02.50	04.38	06.18	07.50	08.33	10.13
	14.34	16.23	17.57	20.35	22.16	00.09	02.58	22.08	20.12	18.20	15.30	14.07
10	10.15	08.40	07.00	06.04	04.12	02.23	02.53	04.41	06.21	07.53	08.37	10.16
	14.37	16.26	18.00	20.38	22.20	00.12	23.55	22.04	20.08	18.17	15.27	14.06
11	10.13	08.37	06.56	06.00	04.09	02.21	02.57	04.45	06.24	07.56	08.40	10.18
	14.40	16.30	18.03	20.41	22.24	00.15	23.51	22.00	20.04	18.13	15.24	14.04
12	10.10	08.33	06.52	05.57	04.05	02.19	03.00	04.48	06.27	07.59	08.44	10.20
	14.43	16.33	18.06	20.44	22.27	00.17	23.48	21.57	20.01	18.09	15.20	14.03
13	10.08	08.30	06.49	05.53	04.01	02.16	03.00	04.51	06.30	08.03	08.47	10.23
	14.47	16.37	18.09	20.48	22.31	00.20	23.45	21.53	19.57	18.06	15.17	14.02
14	10.05	08.26	06.45	05.49	03.58	02.14	03.04	04.55	06.34	08.06	08.51	10.25
	14.50	16.40	18.13	20.51	22.35	00.23	23.41	21.49	19.53	18.02	15.14	14.01
15	10.03	08.23	06.41	05.45	03.54	02.13	03.07	04.58	06.37	08.09	08.54	10.26
	14.53	16.44	18.16	20.54	22.38	00.25	23.38	21.45	19.49	17.58	15.10	14.00
16	10.00	08.19	06.37	05.42	03.50	02.11	03.11	05.02	06.40	08.12	08.58	10.28
	14.57	16.47	18.19	20.57	22.42	00.27	23.35	21.42	19.46	17.55	15.07	13.59
17	09.57	08.16	06.34	05.38	03.47	02.10	03.15	05.05	06.43	08.15	09.02	10.30
	15.00	16.50	18.22	21.01	22.46	00.29	23.31	21.38	19.42	17.51	15.04	13.58
18	09.54	08.12	06.30	05.34	03.43	02.09	03.18	05.08	06.46	08.19	09.05	10.31
	15.04	16.54	18.25	21.04	22.49	00.30	23.28	21.34	19.38	17.47	15.01	13.58
19	09.52	08.09	06.26	05.30	03.39	02.08	03.22	05.12	06.49	08.22	09.09	10.32
	15.07	16.57	18.28	21.07	22.53	00.31	23.24	21.30	19.34	17.44	14.58	13.58
20	09.49	08.05	06.23	05.27	03.36	02.08	03.26	05.15	06.52	08.25	09.12	10.33
	15.11	17.01	18.31	21.11	22.57	00.32	23.21	21.27	19.31	17.40	14.55	13.58
21	09.46	08.02	06.19	05.23	03.32	02.07	03.29	05.18	06.55	08.28	09.16	10.34
	15.14	17.04	18.35	21.14	23.01	00.33	23.17	21.23	19.27	17.37	14.52	13.58
22	09.43	07.58	06.15	05.19	03.29	02.08	03.33	05.21	06.58	08.32	09.19	10.35
	15.18	17.07	18.38	21.17	23.04	00.33	23.14	21.19	19.23	17.33	14.49	13.58
23	09.40	07.54	06.11	05.16	03.25	02.08	03.37	05.25	07.01	08.35	09.23	10.35
	15.21	17.11	18.41	21.21	23.08	00.33	23.10	21.15	19.20	17.29	14.46	13.59
24	09.37	07.51	06.08	05.12	03.22	02.09	03.40	05.28	07.04	08.38	09.26	10.35
	15.25	17.14	18.44	21.24	23.12	00.32	23.06	21.12	19.16	17.26	14.43	14.00
25	09.34	07.47	06.04	05.08	03.18	02.11	03.44	05.31	07.07	07.42	09.30	10.36
	15.29	17.18	18.47	21.27	23.15	00.31	23.03	21.08	19.12	16.22	14.40	14.01
26	09.30	07.43	06.00	05.04	03.14	02.12	03.48	05.34	07.10	07.45	09.33	10.35
	15.32	17.21	18.50	21.31	23.19	00.30	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.57	05.01	03.11	02.14	03.51	05.38	07.13	07.48	09.36	10.35
	15.36	17.24	18.53	21.34	23.23	00.29	22.56	21.00	19.05	16.15	14.34	14.03
28	09.24	07.36	05.53	04.57	03.08	02.16	03.55	05.41	07.16	07.52	09.40	10.35
	15.39	17.27	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.05
29	09.21		06.49	04.53	03.04	02.19	03.59	05.44	07.19	07.55	09.43	10.34
	15.43		20.00	21.41	23.30	00.25	22.48	20.53	18.57	16.08	14.29	14.06
30	09.18		06.45	04.49	03.01	02.21	04.02	05.47	07.22	07.58	09.46	10.33
	15.47		20.03	21.45	23.34	00.23	22.45	20.49	18.54	16.05	14.27	14.08
31	09.14		06.42		02.54		04.06	05.50		08.02		10.32
	15.50		20.06		23.38		22.41	20.46		16.01		14.10
Potential sun hours	155	232	362	456	585	658	630	517	395	301	187	116
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkangas tuulivoimapuisto, Ii

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Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207 WTG: 9 - VESTAS V162-6.0 HH199 6000 162.0 IOI hub: 199.0 m (TOT: 280.0 m) (32)

Assumptions for shadow calculations

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0,60	2,61	4,18	6,47	8,80	10,60	9,50	6,88	4,22	2,77	1,22	0,17

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
619	605	559	627	758	839	939	1 102	916	649	504	548	8 664

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31	09.11	07.33	06.38	04.46	02.50	02.24	04.09	05.53	07.25	08.05	09.50
	14.12	15.54	17.31	20.09	21.48	23.41	00.21	22.37	20.42	18.50	15.58	14.24
2	10.30	09.08	07.29	06.34	04.42	02.47	02.27	04.13	05.56	07.28	08.09	09.53
	14.15	15.57	17.34	20.12	21.52	23.45	00.18	22.34	20.38	18.46	15.54	14.21
3	10.28	09.04	07.25	06.30	04.38	02.44	02.30	04.16	06.00	07.31	08.12	09.56
	14.17	16.01	17.37	20.15	21.55	23.48	00.16	22.30	20.34	18.42	15.51	14.19
4	10.27	09.01	07.22	06.27	04.34	02.41	02.33	04.20	06.03	07.34	08.16	09.59
	14.20	16.05	17.40	20.19	21.59	23.52	00.13	22.26	20.30	18.39	15.47	14.17
5	10.25	08.58	07.18	06.23	04.31	02.38	02.36	04.24	06.06	07.37	08.19	10.02
	14.22	16.08	17.44	20.22	22.02	23.56	00.10	22.22	20.27	18.35	15.44	14.15
6	10.23	08.54	07.14	06.19	04.27	02.35	02.39	04.27	06.09	07.41	08.23	10.05
	14.25	16.12	17.47	20.25	22.06	23.59	00.07	22.19	20.23	18.31	15.40	14.13
7	10.21	08.51	07.11	06.15	04.23	02.32	02.42	04.31	06.12	07.44	08.26	10.08
	14.28	16.15	17.50	20.28	22.09	00.02	00.04	22.15	20.19	18.28	15.37	14.11
8	10.19	08.47	07.07	06.12	04.20	02.29	02.46	04.34	06.15	07.47	08.30	10.11
	14.31	16.19	17.53	20.31	22.13	00.06	00.01	22.11	20.15	18.24	15.33	14.09
9	10.17	08.44	07.03	06.08	04.16	02.26	02.49	04.38	06.18	07.50	08.33	10.13
	14.34	16.22	17.57	20.35	22.16	00.09	02.58	22.08	20.12	18.20	15.30	14.07
10	10.15	08.40	07.00	06.04	04.12	02.23	02.53	04.41	06.21	07.53	08.37	10.16
	14.37	16.26	18.00	20.38	22.20	00.12	23.55	22.04	20.08	18.17	15.27	14.05
11	10.13	08.37	06.56	06.00	04.09	02.21	02.56	04.44	06.24	07.56	08.40	10.18
	14.40	16.30	18.03	20.41	22.24	00.15	23.52	22.00	20.04	18.13	15.23	14.04
12	10.10	08.33	06.52	05.57	04.05	02.18	03.00	04.48	06.27	07.59	08.44	10.20
	14.43	16.33	18.06	20.44	22.27	00.18	23.48	21.57	20.01	18.09	15.20	14.03
13	10.08	08.30	06.48	05.53	04.01	02.16	03.00	04.51	06.30	08.03	08.47	10.23
	14.46	16.37	18.09	20.48	22.31	00.20	23.45	21.53	19.57	18.06	15.17	14.01
14	10.05	08.26	06.45	05.49	03.58	02.14	03.04	04.55	06.33	08.06	08.51	10.25
	14.50	16.40	18.13	20.51	22.35	00.23	23.41	21.49	19.53	18.02	15.14	14.00
15	10.03	08.23	06.41	05.45	03.54	02.12	03.07	04.58	06.36	08.09	08.54	10.26
	14.53	16.43	18.16	20.54	22.38	00.25	23.38	21.45	19.49	17.58	15.10	14.00
16	10.00	08.19	06.37	05.42	03.50	02.11	03.11	05.01	06.40	08.12	08.58	10.28
	14.57	16.47	18.19	20.57	22.42	00.27	23.35	21.42	19.46	17.55	15.07	13.59
17	09.57	08.16	06.34	05.38	03.47	02.09	03.15	05.05	06.43	08.15	09.01	10.30
	15.00	16.50	18.22	21.01	22.46	00.29	23.31	21.38	19.42	17.51	15.04	13.58
18	09.54	08.12	06.30	05.34	03.43	02.08	03.18	05.08	06.46	08.19	09.05	10.31
	15.03	16.54	18.25	21.04	22.49	00.30	23.28	21.34	19.38	17.47	15.01	13.58
19	09.52	08.09	06.26	05.30	03.39	02.08	03.22	05.11	06.49	08.22	09.09	10.32
	15.07	16.57	18.28	21.07	22.53	00.31	23.24	21.30	19.34	17.44	14.58	13.58
20	09.49	08.05	06.23	05.27	03.36	02.07	03.26	05.15	06.52	08.25	09.12	10.33
	15.11	17.01	18.31	21.11	22.57	00.32	23.21	21.27	19.31	17.40	14.55	13.58
21	09.46	08.01	06.19	05.23	03.32	02.07	03.29	05.18	06.55	08.28	09.16	10.34
	15.14	17.04	18.35	21.14	23.01	00.33	23.17	21.23	19.27	17.37	14.52	13.58
22	09.43	07.58	06.15	05.19	03.29	02.07	03.33	05.21	06.58	08.32	09.19	10.35
	15.18	17.07	18.38	21.17	23.04	00.33	23.14	21.19	19.23	17.33	14.49	13.58
23	09.40	07.54	06.11	05.15	03.25	02.08	03.37	05.25	07.01	08.35	09.23	10.35
	15.21	17.11	18.41	21.21	23.08	00.33	23.10	21.15	19.19	17.29	14.46	13.59
24	09.37	07.51	06.08	05.12	03.21	02.09	03.40	05.28	07.04	08.38	09.26	10.36
	15.25	17.14	18.44	21.24	23.12	00.32	23.06	21.12	19.16	17.26	14.43	14.00
25	09.34	07.47	06.04	05.08	03.18	02.10	03.44	05.31	07.07	07.42	09.30	10.36
	15.28	17.17	18.47	21.27	23.15	00.31	23.03	21.08	19.12	16.22	14.40	14.00
26	09.30	07.43	06.00	05.04	03.14	02.12	03.48	05.34	07.10	07.45	09.33	10.36
	15.32	17.21	18.50	21.31	23.19	00.30	22.59	21.04	19.08	16.19	14.37	14.02
27	09.27	07.40	05.56	05.00	03.11	02.14	03.51	05.37	07.13	07.48	09.36	10.35
	15.36	17.24	18.53	21.34	23.23	00.29	22.56	21.00	19.05	16.15	14.34	14.03
28	09.24	07.36	05.53	04.57	03.07	02.16	03.55	05.41	07.16	07.52	09.40	10.35
	15.39	17.27	18.57	21.38	23.27	00.27	22.52	20.57	19.01	16.12	14.32	14.04
29	09.21		06.49	04.53	03.04	02.18	03.58	05.44	07.19	07.55	09.43	10.34
	15.43		20.00	21.41	23.30	00.25	22.48	20.53	18.57	16.08	14.29	14.06
30	09.18		06.45	04.49	03.00	02.21	04.02	05.47	07.22	07.58	09.46	10.33
	15.47		20.03	21.45	23.34	00.23	22.45	20.49	18.53	16.05	14.26	14.08
31	09.14		06.42		02.54		04.06	05.50		08.02		10.32
	15.50		20.06		23.38		22.41	20.45		16.01		14.10
Potential sun hours	155	232	362	456	585	658	631	517	395	301	187	115
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkangas tuulivoimapaisto, li

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+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207 WTG: 10 - VESTAS V162-6.0 HH199 6000 162.0 IOI hub: 199,0 m (TOT: 280,0 m) (33)

Assumptions for shadow calculations

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0,60	2,61	4,18	6,47	8,80	10,60	9,50	6,88	4,22	2,77	1,22	0,17

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
619	605	559	627	758	839	939	1 102	916	649	504	548	8 664

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10.31 14.12	09.11 15.54	07.32 17.31	06.38 20.09	04.46 21.48	02.50 23.41	02.24 00.20	04.09 22.37	05.53 20.42	07.25 18.50	08.05 15.58	09.50 14.24
2	10.30 14.15	09.08 15.57	07.29 17.34	06.34 20.12	04.42 21.51	02.47 23.45	02.27 00.18	04.13 22.33	05.56 20.38	07.28 18.46	08.09 15.54	09.53 14.21
3	10.28 14.17	09.04 16.01	07.25 17.37	06.30 20.15	04.38 21.55	02.44 23.48	02.30 00.15	04.16 22.30	06.00 20.34	07.31 18.42	08.12 15.51	09.56 14.19
4	10.27 14.20	09.01 16.05	07.22 17.40	06.27 20.19	04.34 21.58	02.41 23.52	02.33 00.13	04.20 22.26	06.03 20.30	07.34 18.39	08.16 15.47	09.59 14.17
5	10.25 14.22	08.57 16.08	07.18 17.44	06.23 20.22	04.31 22.02	02.38 23.55	02.36 00.10	04.24 22.22	06.06 20.27	07.37 18.35	08.19 15.44	10.02 14.15
6	10.23 14.25	08.54 16.12	07.14 17.47	06.19 20.25	04.27 22.06	02.35 23.59	02.39 00.07	04.27 22.19	06.09 20.23	07.41 18.31	08.22 15.40	10.05 14.13
7	10.21 14.28	08.51 16.15	07.11 17.50	06.15 20.28	04.23 22.09	02.32 00.02	02.43 00.04	04.31 22.15	06.12 20.19	07.44 18.28	08.26 15.37	10.08 14.11
8	10.19 14.31	08.47 16.19	07.07 17.53	06.12 20.31	04.20 22.13	02.29 00.05	02.46 00.01	04.34 22.11	06.15 20.15	07.47 18.24	08.30 15.33	10.10 14.09
9	10.17 14.34	08.44 16.22	07.03 17.57	06.08 20.35	04.16 22.16	02.26 00.09	02.49 23.58	04.38 22.08	06.18 20.12	07.50 18.20	08.33 15.30	10.13 14.07
10	10.15 14.37	08.40 16.26	06.59 18.00	06.04 20.38	04.12 22.20	02.23 00.12	02.53 23.55	04.41 22.04	06.21 20.08	07.53 18.17	08.37 15.27	10.16 14.05
11	10.12 14.40	08.37 16.29	06.56 18.03	06.00 20.41	04.09 22.24	02.21 00.15	02.57 23.51	04.44 22.00	06.24 20.04	07.56 18.13	08.40 15.23	10.18 14.04
12	10.10 14.43	08.33 16.33	06.52 18.06	05.57 20.44	04.05 22.27	02.18 00.17	03.00 23.48	04.48 21.56	06.27 20.00	07.59 18.09	08.44 15.20	10.20 14.03
13	10.08 14.46	08.30 16.37	06.48 18.09	05.53 20.47	04.01 22.31	02.16 00.20	03.00 23.45	04.51 21.53	06.30 19.57	08.02 18.06	08.47 15.17	10.22 14.01
14	10.05 14.50	08.26 16.40	06.45 18.12	05.49 20.51	03.58 22.35	02.14 00.23	03.04 23.41	04.55 21.49	06.33 19.53	08.06 18.02	08.51 15.14	10.24 14.00
15	10.02 14.53	08.23 16.43	06.41 18.16	05.45 20.54	03.54 22.38	02.12 00.25	03.07 23.38	04.58 21.45	06.36 19.49	08.09 17.58	08.54 15.10	10.26 14.00
16	10.00 14.57	08.19 16.47	06.37 18.19	05.42 20.57	03.50 22.42	02.11 00.27	03.11 23.34	05.01 21.42	06.39 19.46	08.12 17.55	08.58 15.07	10.28 13.59
17	09.57 15.00	08.16 16.50	06.34 18.22	05.38 21.01	03.47 22.46	02.09 00.29	03.15 23.31	05.05 21.38	06.43 19.42	08.15 17.51	09.01 15.04	10.30 13.58
18	09.54 15.03	08.12 16.54	06.30 18.25	05.34 21.04	03.43 22.49	02.08 00.30	03.18 23.28	05.08 21.34	06.46 19.38	08.18 17.47	09.05 15.01	10.31 13.58
19	09.51 15.07	08.09 16.57	06.26 18.28	05.30 21.07	03.39 22.53	02.08 00.31	03.22 23.24	05.11 21.30	06.49 19.34	08.22 17.44	09.08 14.58	10.32 13.58
20	09.49 15.11	08.05 17.01	06.22 18.31	05.27 21.10	03.36 22.57	02.07 00.32	03.26 23.21	05.15 21.27	06.52 19.31	08.25 17.40	09.12 14.55	10.33 13.58
21	09.46 15.14	08.01 17.04	06.19 18.35	05.23 21.14	03.32 23.00	02.07 00.33	03.29 23.17	05.18 21.23	06.55 19.27	08.28 17.37	09.16 14.52	10.34 13.58
22	09.43 15.18	07.58 17.07	06.15 18.38	05.19 21.17	03.29 23.04	02.08 00.33	03.33 23.13	05.21 21.19	06.58 19.23	08.32 17.33	09.19 14.49	10.35 13.58
23	09.40 15.21	07.54 17.11	06.11 18.41	05.15 21.21	03.25 23.08	02.08 00.32	03.37 23.10	05.25 21.15	07.01 19.19	08.35 17.29	09.23 14.46	10.35 13.59
24	09.37 15.25	07.51 17.14	06.08 18.44	05.12 21.24	03.21 23.12	02.09 00.32	03.40 23.06	05.28 21.12	07.04 19.16	08.38 17.26	09.26 14.43	10.35 14.00
25	09.33 15.28	07.47 17.17	06.04 18.47	05.08 21.27	03.18 23.15	02.11 00.31	03.44 23.03	05.31 21.08	07.07 19.12	07.41 16.22	09.30 14.40	10.35 14.01
26	09.30 15.32	07.43 17.21	06.00 18.50	05.04 21.31	03.14 23.19	02.12 00.30	03.48 22.59	05.34 21.04	07.10 19.08	07.45 16.19	09.33 14.37	10.35 14.02
27	09.27 15.36	07.40 17.24	05.56 18.53	05.00 21.34	03.11 23.23	02.14 00.29	03.51 22.55	05.37 21.00	07.13 19.05	07.48 16.15	09.36 14.34	10.35 14.03
28	09.24 15.39	07.36 17.27	05.53 18.56	04.57 21.38	03.07 23.26	02.16 00.27	03.55 22.52	05.41 20.57	07.16 19.01	07.52 16.12	09.40 14.32	10.35 14.04
29	09.21 15.43	07.33 17.30	05.50 18.59	04.54 21.41	03.04 23.30	02.19 00.25	03.58 22.48	05.44 20.53	07.19 18.57	07.55 16.08	09.43 14.29	10.34 14.06
30	09.17 15.47	07.29 17.34	05.46 19.03	04.49 21.44	03.01 23.34	02.21 00.23	04.02 22.44	05.47 20.49	07.22 18.53	07.58 16.05	09.46 14.26	10.33 14.08
31	09.14 15.50	07.26 17.37	05.43 19.06	04.46 21.47	02.98 23.37	02.24 00.26	04.05 22.41	05.50 20.45	07.25 16.01	07.61 16.01	09.49 14.26	10.32 14.10
Potential sun hours	155	232	362	456	585	658	630	517	395	301	187	116
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

Project:
Kovasinkangas_20191009

Description:
Kovasinkankaan tuulivoimapuisto, II

Licensed user:
FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Henna-Riikka Rintamäki / henna-riikka.rintamaki@fcg.fi
Calculated:
30.12.2020 17.09/3.4.388

SHADOW - Calendar per WTG

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207 WTG: 11 - VESTAS V162-6.0 HH199 6000 162.0 IOI hub: 199,0 m (TOT: 280,0 m) (34)
Sunshine probability S (Average daily sunshine hours) [LULEÅ]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0,60 2,61 4,18 6,47 8,80 10,60 9,50 6,88 4,22 2,77 1,22 0,17

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
619 605 559 627 758 839 939 1102 916 649 504 548 8664
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December	
1	10.31 14.12	09.11 15.54	07.32 17.31	06.38 20.09	04.45 21.48	02.50 23.41	02.24 00.20	04.09 22.37	05.53 20.42	07.25 18.50	08.05 13.42-14.10/28	09.50 14.24	
2	10.30 14.15	09.07 15.57	14.22-14.29/7 17.34	07.29 20.12	06.34 21.51	04.42 23.45	02.47 00.18	02.27 22.33	04.13 20.38	05.56 18.46	08.09 13.43-14.10/27	09.53 14.21	
3	10.28 14.17	09.04 16.01	14.20-14.33/13 17.37	07.25 20.15	06.30 21.55	04.38 23.48	02.44 00.15	02.30 22.30	04.16 20.34	05.59 18.42	08.12 13.43-14.10/27	09.56 14.19	
4	10.27 14.20	09.01 16.04	14.17-14.35/18 17.21	07.21 20.19	06.26 21.58	04.34 23.52	02.41 00.13	02.33 22.26	04.20 20.30	06.03 18.39	08.15 13.44-14.09/25	09.59 14.17	
5	10.25 14.22	08.57 16.08	14.16-14.37/21 17.18	07.18 20.22	06.23 22.02	04.31 23.55	02.38 00.10	02.36 22.22	04.23 20.27	06.06 18.35	08.19 13.45-14.07/22	10.02 14.15	
6	10.23 14.25	08.54 16.12	14.15-14.38/23 17.47	07.14 20.25	06.19 22.06	04.27 23.59	02.35 00.07	02.39 22.19	04.27 20.23	06.09 18.31	08.22 13.47-14.07/20	10.05 14.13	
7	10.21 14.28	08.51 16.15	14.14-14.39/25 17.50	07.10 20.28	06.15 22.09	04.23 23.02	02.32 00.04	02.43 22.15	04.31 20.19	06.12 18.27	08.26 13.48-14.05/17	10.08 14.11	
8	10.19 14.31	08.47 16.19	14.13-14.39/26 17.53	07.07 20.31	06.11 22.13	04.20 23.05	02.29 00.01	02.46 22.11	04.34 20.15	06.15 18.24	08.29 13.50-14.03/13	10.10 14.09	
9	10.17 14.34	08.44 16.22	14.13-14.40/27 17.56	07.03 20.34	06.08 22.16	04.16 23.08	02.26 00.08	02.49 22.07	04.37 20.12	06.18 18.20	08.33 13.54-13.59/5	10.13 14.07	
10	10.15 14.37	08.40 16.26	14.12-14.41/29 18.00	06.59 20.38	06.04 22.20	04.12 23.02	02.23 00.12	02.53 23.54	04.41 22.04	06.21 18.16	07.53 15.27	10.16 14.05	
11	10.12 14.40	08.37 16.29	14.12-14.41/29 18.03	06.56 20.41	06.00 22.24	04.08 23.04	02.21 00.14	02.56 22.00	04.44 20.04	07.56 18.13	08.40 15.23	10.18 14.04	
12	10.10 14.43	08.33 16.33	14.12-14.42/30 18.06	06.52 20.44	05.56 22.27	04.05 23.07	02.18 00.17	03.00 23.48	04.48 21.56	07.59 18.00	08.44 15.20	10.20 14.03	
13	10.08 14.46	08.30 16.36	14.12-14.42/30 18.09	06.48 20.47	05.53 22.31	04.01 23.02	02.16 00.20	03.00 23.45	04.51 21.53	08.02 19.57	08.47 15.17	10.22 14.01	
14	10.05 14.50	08.26 16.40	14.12-14.42/30 18.12	06.45 20.51	05.49 22.34	03.57 23.41	02.14 00.22	03.04 23.41	04.55 21.49	08.06 18.02	08.51 15.13	10.24 14.00	
15	10.02 14.53	08.23 16.43	14.13-14.42/29 18.16	06.41 20.54	05.45 22.38	03.54 23.02	02.12 00.25	03.07 23.38	04.58 21.45	08.09 17.58	08.54 15.10	10.26 14.00	
16	10.00 14.56	08.19 16.47	14.13-14.41/28 18.19	06.37 20.57	05.42 22.42	03.50 23.07	02.11 00.27	03.11 23.34	05.01 21.41	06.39 17.55	08.12 15.07	10.28 13.59	
17	09.57 15.00	08.16 16.50	14.13-14.41/28 18.22	06.34 21.00	05.38 22.46	03.46 23.02	02.09 00.28	03.15 23.31	05.05 21.38	06.42 17.51	08.15 15.04	10.29 13.58	
18	09.54 15.03	08.12 16.54	14.14-14.40/26 18.25	06.30 21.04	05.34 22.49	03.43 23.00	02.08 00.30	03.18 23.27	05.08 21.34	06.45 17.47	08.18 15.01	10.31 13.58	
19	09.51 15.07	08.08 16.57	14.15-14.39/24 18.28	06.26 21.07	05.30 22.53	03.39 23.01	02.08 00.31	03.22 23.24	05.11 21.30	06.49 17.44	14.53-15.03/10 14.58	10.32 13.58	
20	09.48 15.10	08.05 17.01	14.16-14.38/22 18.31	06.22 21.10	05.27 22.57	03.36 23.02	02.07 00.32	03.26 23.20	05.15 21.26	08.25 19.31	14.50-15.06/16 14.55	10.33 13.58	
21	09.45 15.14	08.01 17.04	14.17-14.37/20 18.34	06.19 21.14	05.23 23.00	03.32 23.00	02.07 00.32	03.29 23.17	05.18 21.23	08.28 19.27	14.47-15.07/20 14.52	10.34 13.58	
22	09.43 15.18	07.58 17.07	14.20-14.34/14 18.38	06.15 21.17	05.19 23.04	03.28 23.03	02.08 00.33	03.33 23.13	05.21 21.19	06.58 19.23	14.45-15.08/23 14.49	10.35 13.58	
23	09.39 15.21	07.54 17.11	14.24-14.30/6 18.41	06.11 21.20	05.15 23.08	03.25 23.08	02.08 00.32	03.37 23.10	05.24 21.15	07.01 19.19	14.44-15.10/26 14.46	10.35 13.59	
24	09.36 15.25	07.51 17.14	06.08 18.44	05.12 21.24	05.12 23.12	03.21 23.12	02.09 00.32	03.40 23.06	05.28 21.12	07.04 19.16	14.44-15.10/26 14.43	10.35 14.00	
25	09.33 15.28	07.47 17.17	06.04 18.47	05.08 21.27	05.08 23.15	03.18 23.15	02.11 00.31	03.44 23.03	05.31 21.08	07.07 19.12	13.43-14.11/28 14.40	10.35 14.00	
26	09.30 15.32	07.43 17.21	06.00 18.50	05.04 21.31	05.04 23.19	03.14 23.00	02.12 00.30	03.48 22.59	05.34 21.04	07.10 19.08	13.42-14.11/29 14.37	10.35 14.02	
27	09.27 15.36	07.40 17.24	05.56 18.53	05.00 21.34	05.00 23.23	03.11 23.02	02.14 00.28	03.51 22.55	05.37 21.00	07.13 19.04	13.42-14.11/29 14.34	10.35 14.03	
28	09.24 15.39	07.36 17.27	05.53 18.56	04.57 21.37	04.57 23.26	03.07 23.26	02.16 00.27	03.55 22.52	05.41 20.57	07.16 19.01	13.41-14.11/30 14.32	10.35 14.04	
29	09.21 15.43	07.34 17.34	05.49 19.01	04.53 21.41	04.53 23.30	03.04 23.30	02.18 00.25	03.58 22.48	05.44 20.53	07.19 18.57	13.41-14.11/30 14.29	10.34 14.06	
30	09.17 15.46	07.32 17.37	06.45 20.00	04.49 21.44	04.49 23.34	03.00 23.34	02.21 00.23	04.02 22.44	05.47 20.49	07.22 18.53	13.41-14.11/30 14.26	10.33 14.08	
31	09.14 15.50	07.31 17.44	06.41 20.06	04.48 21.44	04.48 23.37	03.00 23.37	02.21 00.24	04.06 22.41	05.50 20.45	08.02 16.01	13.42-14.11/29 14.26	10.32 14.10	
	Potential sun hours Sum of minutes with flicker	155 0	232 505	362 0	456 0	585 0	658 0	630 0	517 0	395 0	301 326	187 184	116 0

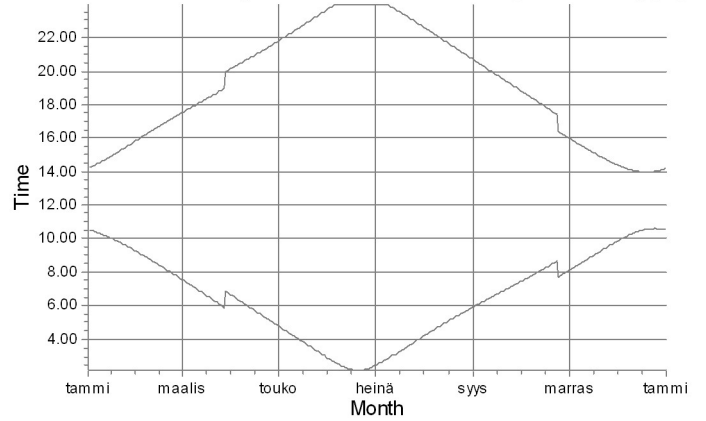
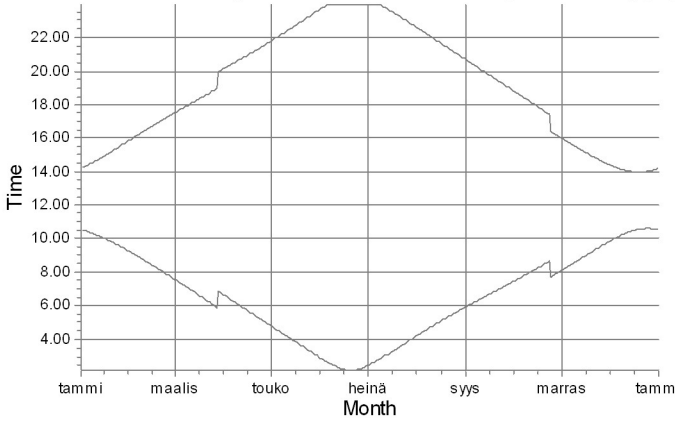
Table layout: For each day in each month the following matrix apply

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

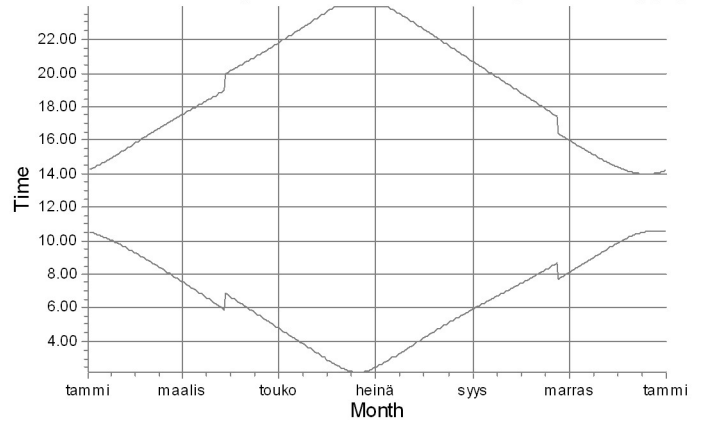
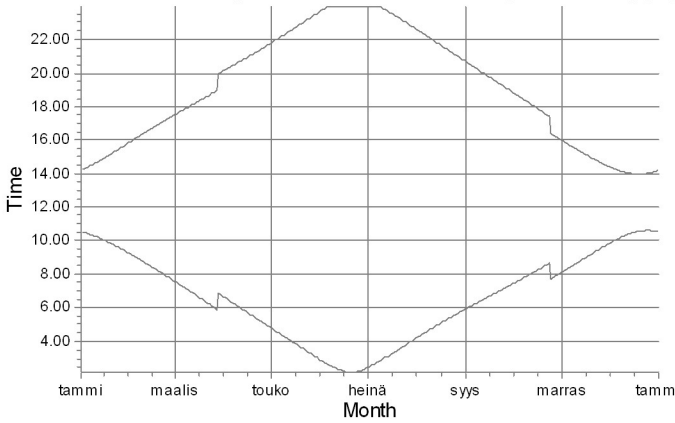
SHADOW - Calendar per WTG, graphical

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207

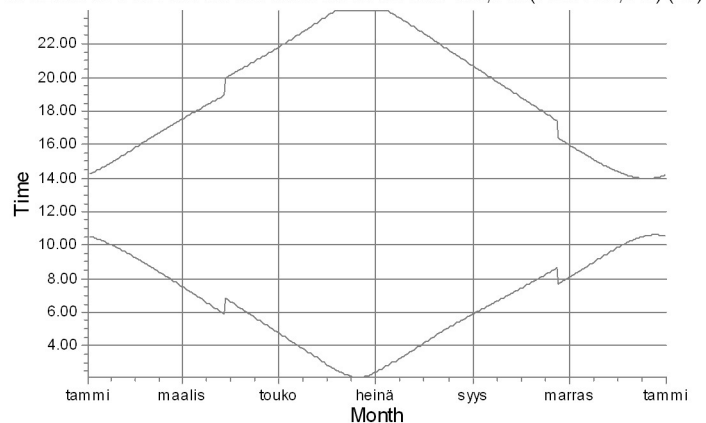
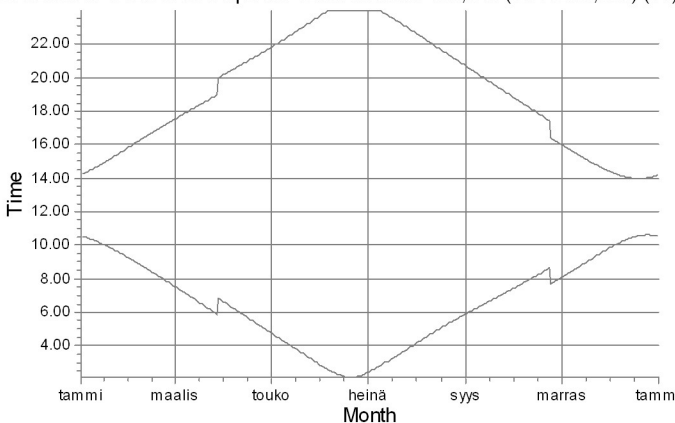
1: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (13) 2: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (14)



3: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (15) 4: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (16)



5: VESTAS V126-3.45 LTq 3450 126.0 !O! hub: 137,0 m (TOT: 200,0 m) (17) 6: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (29)

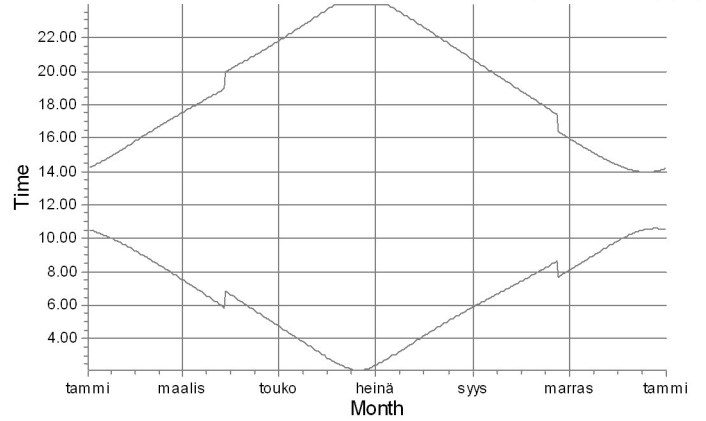
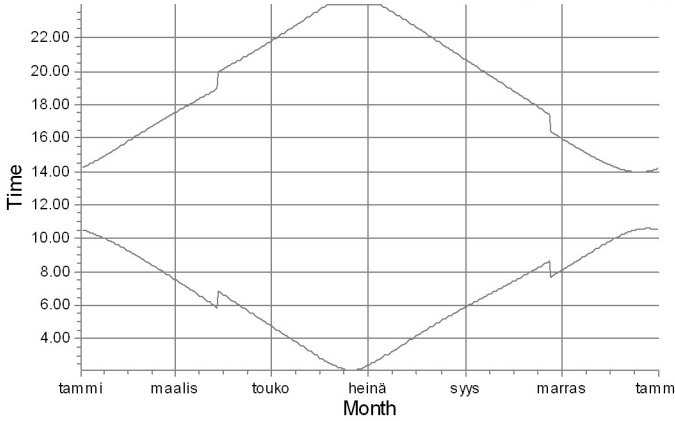


Shadow receptors

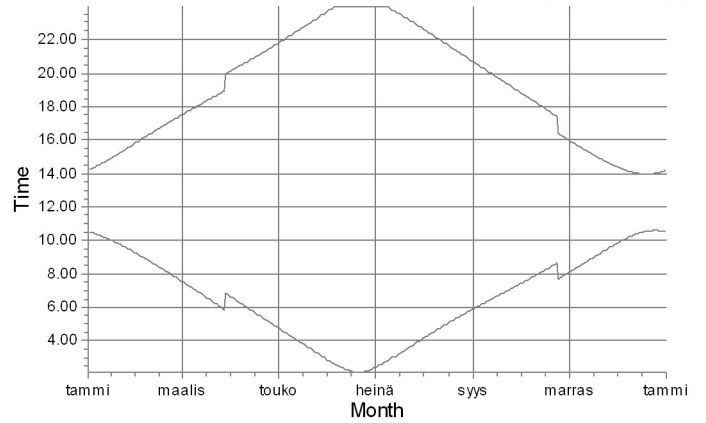
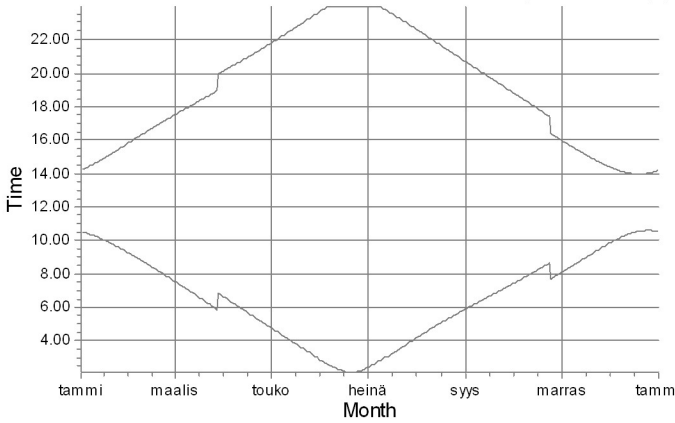
SHADOW - Calendar per WTG, graphical

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207

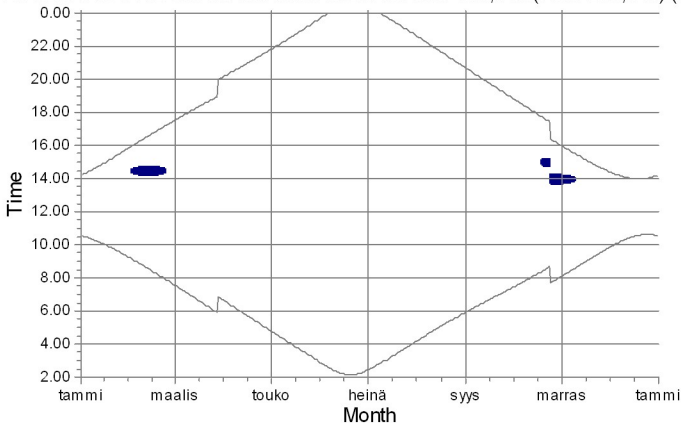
7: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (3) 8: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (31)




9: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (3) 10: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (33)



11: VESTAS V162-6.0 HH199 6000 162.0 !O! hub: 199,0 m (TOT: 280,0 m) (34)

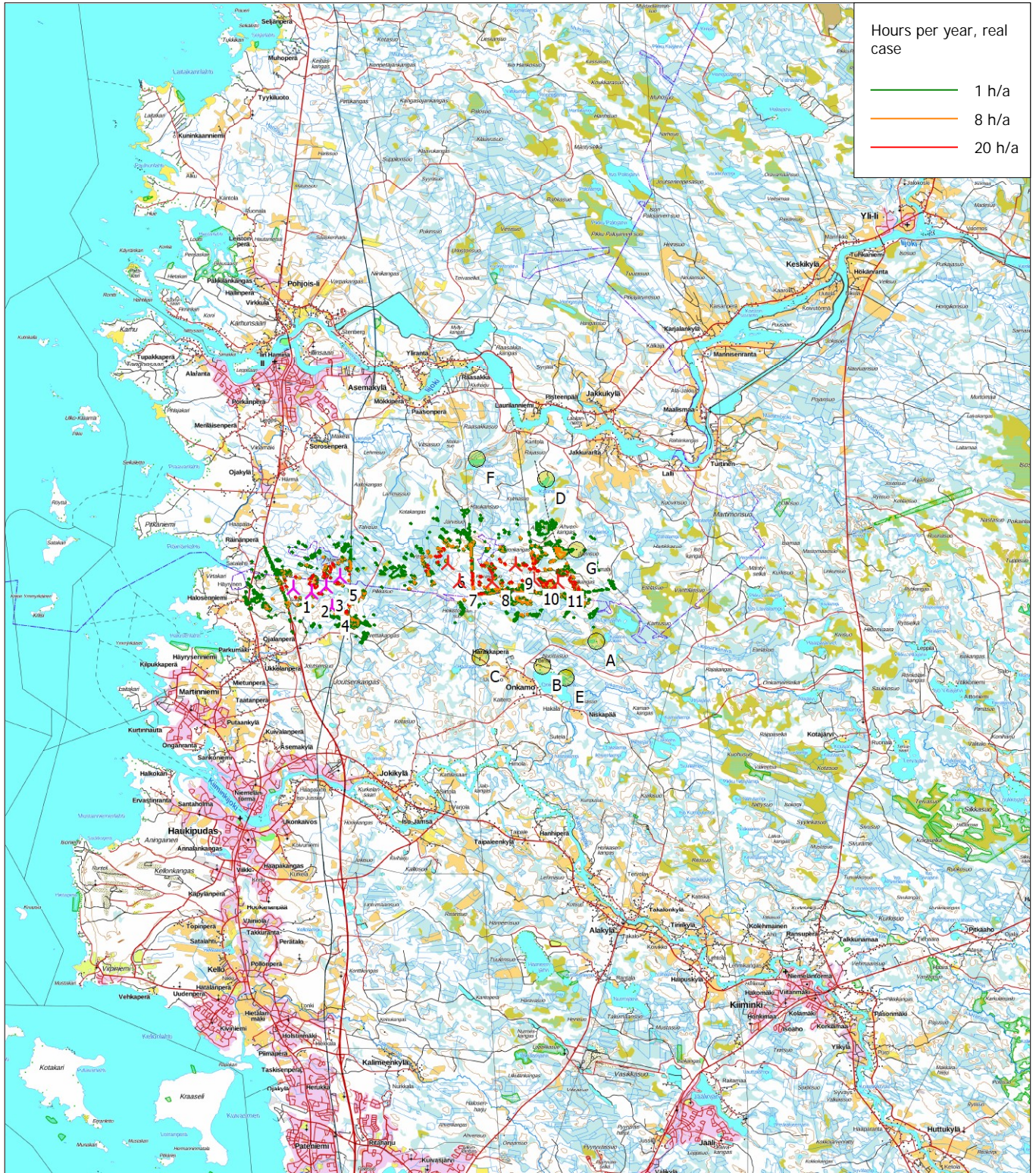


Shadow receptors

 G: Liikerakennus G (Impivaarantie kämpä)

SHADOW - Map

Calculation: Kovasinkangas V162-6,0MW x 6 x HH199 + Ketunmaankangas V126-3.45MW x 5 x HH137_Luke forest_20201207



Map: Maastokarttarasteri100K , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 432 420 North: 7 237 530
New WTG Shadow receptor
Flicker map level: Height Contours: CONTOURLINE_Kovasinkangas_20191009_4.wpo (4)