

ESCALA Wind Srl

# Parco Eolico ESCALA sito nel Comune di Escalaplano

**Analisi degli effetti di shadow - flickering**

Marzo 2023

Regione Autonoma  
della Sardegna



Comune di Escalaplano



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**Parco Eolico ESCALA sito nel Comune di Escalaplano**

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**Analisi degli effetti di shadow - flickering**

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## 1 Criteri generali di analisi e valutazione

Il presente elaborato, facente parte integrante dello Studio di impatto ambientale allegato al progetto del parco eolico “ESCALA”, proposto dalla Escala Wind S.r.l. (società di proprietà di Wind Power Development A/S, controllata da Vestas Wind Systems A/S), in territorio di Escalaplano (SU), esamina compiutamente il potenziale disturbo da ombreggiamento intermittente (*shadow flickering*) sui potenziali ricettori individuati nell’area interessata dal proposto impianto, entro una distanza indicativa di 1000 metri dagli aerogeneratori.

A tal fine, nel seguito, si farà riferimento alla ricognizione sugli edifici esistenti eseguita nell’ambito della definizione del layout di impianto e dell’analisi ambientale, i cui risultati sono riepilogati in opportune “schede fabbricati” all’interno di apposito report allegato al progetto del parco eolico.

Sotto il profilo metodologico, il documento è strutturato in una sezione introduttiva atta a descrivere la natura del fenomeno dell’ombreggiamento intermittente e le ipotesi alla base dei calcoli previsionali, eseguiti a mezzo di specifico software specialistico.

## 2 Descrizione del fenomeno

Un ostacolo solido opaco posto tra il sole e il terreno genera un’ombra. Generalmente se l’ostacolo è fermo, l’ombra si proietta al suolo seguendo le regole del movimento relativo del sole sull’orizzonte. Le dimensioni dell’ombra proiettata sono funzione inversa dell’angolo che i raggi del sole formano sull’orizzonte per cui si ha la massima dimensione (elongazione sul terreno) dell’ombra all’alba ed al tramonto con il minimo quando il sole raggiunge la massima altezza (mezzogiorno).

Anche gli aerogeneratori durante il giorno proiettano un’ombra che in parte è fissa (torre e navicella) e in parte è mobile (pale del rotore).

Se l’ombra del rotore in movimento si proietta sulle aperture di un fabbricato può venirsi a creare l’effetto di ombra intermittente o *shadow flickering* (sfarfallio dell’ombra); in talune circostanze, tale fenomeno di pulsazioni “luce – ombra” può potenzialmente essere all’origine di un disturbo alle normali attività che possono svolgersi all’interno dell’ambiente abitativo.

Il fenomeno si verifica durante il giorno in presenza di cielo sereno ed in assenza di ostacoli naturali, quali vegetazione, alberi, muri ecc., e con le turbine in movimento.

Per le ragioni anzidette, a distanze turbine-ricettore superiori a circa 300 metri solitamente il fenomeno di *shadow flickering* si manifesta all’alba o al tramonto, allorché le ombre proiettate sono sufficientemente lunghe. Per le stesse ragioni il tremolio dell’ombra è un fenomeno particolarmente avvertito nelle regioni del nord Europa (Germania, Danimarca, ecc.) piuttosto che alle latitudini del Mediterraneo.

L’intensità del *shadow flickering* è definita come la differenza in luminosità, in un determinato sito, in presenza ed assenza di un’ombra.

Di seguito si riassumono alcuni aspetti caratteristici del fenomeno:

- la pala delle turbine eoliche è stretta in corrispondenza dell’estremità più esterna ed assume progressivamente maggiore larghezza verso la giunzione con il mozzo. Quando una turbina è posizionata sufficientemente vicino ad un ricettore, cosicché la porzione più larga della pala oscura una porzione maggiore del campo visivo (o meglio del disco solare), l’intensità di *shadow flickering* aumenterà. A distanze maggiori l’intensità del fenomeno sarà minore in quanto le pale copriranno una porzione inferiore del disco solare;
- l’intensità del *shadow flickering* è più bassa quando l’ombra che intercetta un ricettore si origina dall’estremità esterna del rotore (minore spessore della pala). L’intensità aumenterà allorché l’ombra si muove lungo lo sviluppo della pala fino ad arrivare ad un massimo in corrispondenza del mozzo; a tal punto l’intensità diminuisce quando l’ombra si sposta verso l’estremità della pala opposta;
- bassi impatti da *shadow flickering* sono generalmente indicativi di grandi distanze tra turbine e ricettore e ombre incidenti originate dalle estremità del rotore;
- situazioni di precaria visibilità determineranno modeste intensità di *S. flickering*;
- a distanze ancora maggiori le ombre proiettate risulteranno “fuori-fuoco”. Ciò non è causa di un’intensità inferiore del *shadow flickering* ma contribuisce a rendere meno distinto il fenomeno;
- all’interno di un ambiente ben illuminato le ombre svaniscono. Conseguentemente l’accensione di luci in un ambiente riduce l’incidenza del *shadow flickering*;

- schermare una finestra (con tende o quant'altro) previene il fenomeno;
- schermare un edificio (ad esempio con alberature) può rappresentare una misura di mitigazione per prevenire il fenomeno.

La frequenza di pulsazione del tremolio dell'ombra è proporzionale alla velocità di rotazione del rotore. La tipica frequenza di passo fra le pale del rotore (tripala) è compresa tra 0.6 ed 1 Hz (velocità con cui le pale passano attraverso una posizione specifica).

Nel caso specifico, considerando un rotore del diametro indicativo di 162 metri con una velocità massima nominale di rotazione di circa 12.5 RPM si avrà una frequenza di passo pari a circa 0,6 Hz. Tali frequenze di oscillazione luminosa sono prive di rischi significativi per la salute.

Ricerche finalizzate alla definizione di relazioni cause-effetto tra fenomeni stroboscopici ed attacchi epilettici (Graham e Pamela Harding della *Aston University* e Arnold Wilkins della *University of Essex*) attestano che, al fine di escludere rischi sulla salute, le turbine eoliche dovrebbero ruotare a velocità superiori a 60 RPM (velocità di passo 5 volte superiori a quella degli aerogeneratori in progetto, superiori a 3 Hz). Peraltro, non può disconoscersi come il fenomeno del *shadow flickering* possa talvolta costituire, in particolari situazioni, un disturbo per i ricettori più esposti.

Per analizzare i risultati e quindi definire l'effettiva portata del disturbo, è dunque fondamentale conoscere l'esatta destinazione del fabbricato ricettore. Nel seguito saranno considerati potenziali ricettori i soli edifici che, sulla base delle informazioni disponibili e delle verifiche condotte in sito, potrebbero prudenzialmente ricondursi alla fattispecie di "ambienti abitativi".

### 3 Individuazione dei ricettori

Per le finalità del presente studio, con l'intento di meglio inquadrare i criteri di individuazione dei potenziali edifici sensibili (o ricettori) del proposto impianto eolico, si ritiene opportuno richiamare i contenuti della D.G.R. RAS 59/90 del 2020 e s.m.i. (*Individuazione delle aree non idonee all'installazione di impianti energetici alimentati da fonti energetiche rinnovabili*) e segnatamente al punto 4.3.3 "Distanze di rispetto dagli insediamenti rurali".

*"Al fine di limitare gli impatti visivi, acustici e di ombreggiamento, ogni singolo aerogeneratore dovrà rispettare una distanza pari a:*

- *300 metri da corpi aziendali ad utilizzazione agro-pastorale in cui sia accertata la presenza continuativa di personale in orario diurno (h. 6.00 – 22.00);*
- *500 metri da corpi aziendali ad utilizzazione agro-pastorale in cui sia accertata la presenza continuativa di personale in orario notturno (h. 22.00 – 6.00), o case rurali ad utilizzazione residenziale di carattere stagionale;*
- *700 metri da nuclei e case sparse nell'agro, destinati ad uso residenziale, così come definiti all'art. 82 delle NTA del PPR."*

Secondo tale impostazione, pertanto, possono individuarsi le seguenti categorie di edifici:

*Cat.1 – Case rurali ad utilizzazione residenziale (Categoria catastale A) e/o corpi di fabbrica con tipologia costruttiva equiparabile;*

*Cat. 2a – corpi aziendali ad utilizzazione agro-pastorale in cui sia accertata la presenza continuativa di personale in orario notturno;*

*Cat. 2b – corpi aziendali ad utilizzazione agro-pastorale in cui sia accertata la presenza continuativa di personale in orario diurno;*

*Cat. 3 – fabbricati ad utilizzazione agro-pastorale con presenza discontinua di personale;*

*Cat. 4 – fabbricati di supporto alle attività agricole (ricoveri, depositi, stalle);*

*Cat. 5 – ruderi/fabbricati in abbandono;*

*Cat. 6 – impianti minieolici esistenti.*



Muovendo da tale classificazione, al fine di procedere all'individuazione di potenziali ricettori nelle aree più direttamente interessate dalle installazioni eoliche, ricomprese entro una distanza massima di 1000m<sup>1</sup> dalle postazioni di macchina, si è proceduto ad una individuazione complessiva dei fabbricati con l'ausilio della cartografia ufficiale di riferimento (Carta Tecnica Regionale in scala 1:10.000). Successivamente è stata verificata l'effettiva esistenza e consistenza dall'esame di foto aeree e satellitari nonché attraverso specifici sopralluoghi e riscontri sul campo. In tal modo sono state acquisite le necessarie informazioni preliminari sulle caratteristiche tipologico-costruttive e le condizioni di utilizzo degli edifici. A valle di tali riscontri, è stata inoltre accertata la categoria catastale di appartenenza degli edifici, laddove disponibile.

L'Elaborato IT-VesEsc-CLP-GEN-TR-05 (*Report dei fabbricati censiti*) riporta l'individuazione dei fabbricati in accordo con la metodologia precedentemente indicata.

Nel presente Report sono contenuti lo stralcio della ripresa aerea zenitale, la categoria catastale di appartenenza ed una fotografia prospettica degli edifici.

Il censimento ha condotto all'individuazione di n. 55 edifici, o complessi di fabbricati agricoli; tra questi è stata riscontrata la prevalente presenza di corpi edilizi a servizio di attività del settore terziario come: magazzini e locali di deposito o immobili speciali a destinazione produttiva o terziaria. La frequentazione di tali edifici è saltuaria e, in prossimità dell'area di impianto, principalmente legata alle esigenze di conduzione dei fondi agricoli.

È stata inoltre verificata la presenza di 3 edifici con categoria 1 precedentemente individuata, riferibili a "Case rurali ad utilizzazione residenziale (Categoria catastale A) e/o corpi di fabbrica con tipologia costruttiva equiparabile". Rispetto a tali fabbricati, così selezionati e identificati con le sigle F19, F26, e F49, in accordo con le indicazioni della D.G.R. RAS 59/90 del 2020, il posizionamento degli aerogeneratori ha assicurato una distanza minima di 500m. Il fabbricato F26, pur non appartenendo alla Categoria catastale A - ed essendo attualmente censito esclusivamente al catasto terreni - è stato inserito prudenzialmente tra gli edifici assimilabili a case rurali a utilizzazione residenziale in seguito alla ricognizione sul campo.

Gli ulteriori edifici individuati al momento della ricognizione dei fabbricati entro i 1000 metri dagli aerogeneratori in progetto, non sono accatastati come Fabbricati quindi la loro destinazione catastale riportata nel "Report dei fabbricati censiti" è quella del "Catasto Terreni".

Ai fini dell'individuazione dei ricettori di interesse per le finalità del presente Studio, in accordo con gli enunciati criteri della DGR 59/90 del 2020, sono stati ricondotti alla Categoria 1:

- gli edifici F19 e F49, catastalmente classificati come A4 (Abitazioni di tipo popolare) e A3 (Abitazioni di tipo economico) rispettivamente, assumendo prudenzialmente la presenza continuativa di persone in periodo diurno e notturno;
- Un fabbricato non appartenente alla categoria catastale "A" (F26 - non presente al catasto fabbricati) che, in ragione della tipologia costruttiva e per informazioni acquisite sul territorio, si è prudenzialmente ritenuto assimilabile ad ambiente abitativo.

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<sup>1</sup> La distanza di 1000m dagli aerogeneratori, ai fini dell'individuazione dei ricettori, è pari al doppio di quella indicata dalla norma UNI/TS 11143-7 per descrivere l'"area di influenza" di un parco eolico.

## 4 Ipotesi alla base del calcolo e soglie di riferimento

L'analisi dell'effetto di shadow flickering è stata condotta con l'utilizzo del modulo SHADOW del software WindPro 3.4. Il programma esegue una simulazione completa del percorso del sole durante un intero anno.

I calcoli possono essere eseguiti secondo due scenari: lo scenario peggiore (*worst case*) e il caso reale (*real case*).

Nello scenario *worst case* nessuno, tra i fattori di influenza indicati al capitolo 2 è contemplato nei calcoli del modello di simulazione. In situazioni di cielo coperto o calma di vento, o in caso di direzione del vento tale da porre il piano del rotore in posizione parallela rispetto alla linea sole-ricettore, la WTG non produrrà ombra intermittente, ma il suo contributo teorico è comunque computato dal *software*.

Conseguentemente, nello scenario peggiore, è altamente verosimile che i ricettori considerati saranno soggetti ad un impatto da *shadow flickering* significativamente inferiore a quello ipotizzato dal modello.

Nello scenario *real case*, il software può tenere conto delle reali **condizioni di funzionamento degli aerogeneratori** (in termini di ore di funzionamento attese per ogni settore angolare di provenienza del vento) nonché delle condizioni di **Eliofania**, ossia di durata media del soleggiamento della specifica zona di studio.

Peraltro, in entrambi gli scenari di calcolo, se la simulazione contempla l'effetto dell'orografia sulla propagazione dell'ombra, la stessa ignora l'azione schermante "sito-specifica" esercitata dai manufatti e dalle alberature. In altre parole, il calcolo è sempre conservativo e rappresenta quindi il massimo rischio potenziale di disturbo.

In definitiva, affinché il fenomeno dell'ombra intermittente possa costituire un disturbo per i soggetti più sensibili dovrebbero verificarsi simultaneamente le seguenti circostanze:

- il vento deve soffiare ad una velocità superiore a 3 m/s (velocità di *cut-in* del rotore);
- presenza di luminosità solare diretta;
- l'osservatore deve risultare sufficientemente vicino alla sorgente di *shadow flickering*;
- il ricettore deve essere effettivamente esposto al campo di luce tremolante;
- l'illuminazione dell'ambiente residenziale deve essere bassa;
- il contrasto tra luci ed ombre deve essere alto;
- non devono essere presenti schermature che ostacolano la propagazione dell'ombra (come tendaggi o alberature);
- gli individui potenzialmente soggetti ad un impatto da *shadow flickering* dovrebbero permanere esposti alla luce tremolante per un tempo sufficiente ad avvertire fastidio.

Per le finalità del presente studio, in assenza di una specifica disciplina normativa nazionale o regionale, si è fatto riferimento alle linee guida elaborate dal Gruppo Federale tedesco di Controllo delle Emissioni (*Bund-/Länder-Arbeitsgemeinschaft für Immissionsschutz - LAI*) – aggiornamento 2020.

Per la valutazione degli effetti del tremolio dell'ombra, peraltro, lo stesso legislatore tedesco non ha finora emanato, né risulta che sia in procinto di emanare, norme giuridicamente vincolanti.

Secondo le richiamate linee guida, affinché il fenomeno di ombreggiamento sia significativo dovrebbero essere simultaneamente verificate le seguenti circostanze

- L'angolo del sole sopra l'orizzonte deve essere almeno 3°;
- l'ingombro della pala della turbina eolica deve coprire almeno il 20% del disco solare.

Il massimo ombreggiamento su un edificio secondo tali linee-guida è stabilito in:

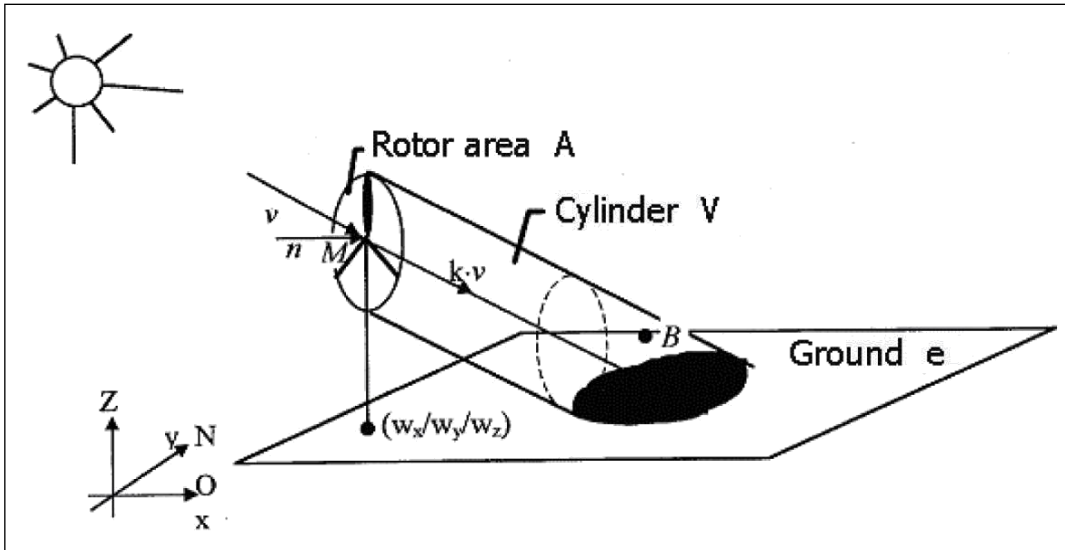
- 30 ore di ombreggiamento annuale;
- 30 minuti di ombreggiamento giornaliero.

In tali archi temporali (30 ore/anno e 30 minuti/giorno), trattandosi di un disturbo effettivamente avvertito dagli occupanti l'edificio, dovrebbero risultare simultaneamente verificate le seguenti condizioni:

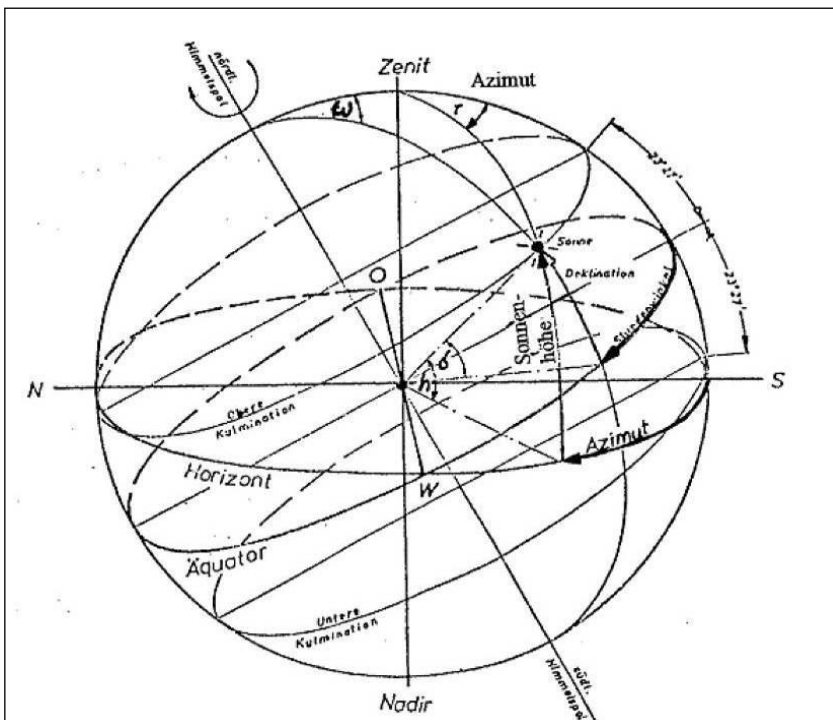
- gli ambienti esposti all'ombreggiamento sono occupati;
- gli occupanti sono svegli.

Considerata l'esigua probabilità che si verifichino contemporaneamente tutte le condizioni precedentemente illustrate per l'intera durata del fenomeno, ne deriva che il risultato del calcolo rappresenta comunque una stima prudente dell'impatto.

La Figura 4.1 e la Figura 4.2 mostrano i parametri necessari al modello utilizzato dal modulo SHADOW per valutare l'impatto del tremolio dell'ombra.



**Figura 4.1: Rappresentazione schematica della proiezione dell'ombra del rotore.**



**Figura 4.2: Schema dei moti terrestri e parametri di calcolo.**



## 5 Lo scenario peggiore (*worst case*)

Questi calcoli sono basati sullo scenario più conservativo (ombra massima astronomica, ossia basata sulla posizione del sole rispetto alle WTG). Se il cielo è coperto o c'è calma di vento, o la direzione del vento è tale da porre il piano del rotore in posizione parallela rispetto alla linea sole-edificio, la WTG non produrrà ombra, ma la sua influenza apparirà comunque nei calcoli. In altre parole, il calcolo descrive lo scenario peggiore possibile, e rappresenta quindi il massimo rischio potenziale di impatto. Per ciascun ricettore il software produce un calendario che indica i giorni ed i periodi di tempo in cui l'ombra sarà presente.

## 6 Lo scenario reale (*real case*)

Oltre al calcolo che contempla le ore di "ombra massima astronomica" (detta anche ombra peggiore), il software WINDPRO consente di configurare i parametri statistici per calcolare l'"ombra meteorologica probabile" (detta anche ombra reale). In particolare, possono essere configurati due parametri statistici:

1. Statistica delle ore di funzionamento. È il periodo in cui le turbine saranno operative per ciascuna direzione di provenienza del vento nel corso dell'anno.
2. Statistica dell'eliofania. È la percentuale di ore di sole durante il dì (dall'alba al tramonto). Questa varia notevolmente da luogo a luogo, e si rende opportuno utilizzare, pertanto, una statistica proveniente da stazioni di misura vicine al sito.

WindPRO combina ZVI ed il calcolo dell'ombra in modo da escludere il contributo delle turbine non visibili dai recettori. Questo vale anche per la mappa dell'ombra, in cui saranno incluse solo le WTG visibili da ciascun punto di griglia.

Ai fini del calcolo del tremolio dell'ombra il software di simulazione considera i seguenti parametri:

- diametro del sole,  $D$  (1.390.000 km);
- distanza Terra-Sole,  $d$  (150.000.000 km);
- angolo di attacco ( $3^\circ$ );
- coordinate geografiche e altitudine delle turbine in progetto;
- altezza al mozzo (125 m) e diametro del rotore (162 m);
- coordinate dei recettori;
- recettori considerati in modalità "serra", assumendo che vengano interessati dal fenomeno di shadow-flickering indipendentemente dall'orientamento delle finestre (ipotesi conservativa);
- modello digitale del terreno;
- eliofania del sito;
- statistica delle ore di funzionamento degli aerogeneratori in funzione delle frequenze di provenienza del vento su 12 quadranti convenzionali;
- modello di calcolo della simulazione, che tiene conto sia dell'orbita terrestre rispetto al Sole (rivoluzione), sia della rotazione rispetto al proprio asse.

## 7 Risultati

Il risultato dei calcoli è reso disponibile dal programma di simulazione (*Windpro*) sotto diversi formati:

- Tabellare, (calendario per ciascun ricettore) nel quale per ogni giorno dell'anno sono indicate le ore di luce e l'intervallo di tempo di esposizione all'ombra con l'orario in cui si verifica il fenomeno;
- Grafico, (per ciascun ricettore) nel quale vengono rappresentati i periodi dell'anno in cui si verifica il fenomeno, l'orario e le turbine responsabili dell'ombra;
- grafico globale, con la rappresentazione di isolinee rappresentanti l'incidenza dell'ombra espressa in ore/anno.

Con riferimento allo Scenario di progetto, le isolinee d'ombra sono state rappresentate su specifica tavola grafica, in scala adeguata alla dimensione territoriale da rappresentare, per facilitarne la lettura. La tavola è stata realizzata, pertanto, su base cartografica in scala 1:10.000 (Elaborato IT-VesEsc-CLP-OMB-DW-01).

I risultati forniti dal modello di calcolo consentono di valutare approssimativamente sia l'impatto puntuale sul singolo ricettore, sia l'impatto distribuito sul territorio (movimento e persistenza dell'ombra).

Nello specifico, all'interno degli allegati report di calcolo sono indicati, per il singolo ricettore, i valori totali di interferenza da *shadow flickering* (espressi in h/anno), il numero di giorni in cui si verifica l'interferenza ed infine la durata massima per singolo giorno.

I risultati numerici delle simulazioni modellistiche, condotti con riferimento a ciascuno scenario di calcolo (*worst e real case*), sono riportati in Appendice.

## 8 Analisi e post-elaborazione dei risultati

Le risultanze del calcolo modellistico atto a stimare i valori totali di potenziale interferenza da *shadow flickering* in corrispondenza dei ricettori nello scenario di progetto sono riportate in *Tabella 8.1*.

*Tabella 8.1: Risultati dei calcoli di ombreggiamento intermittente presso i ricettori considerati*

ID	RICETTORE	WTG SF	WTG Più prossimo	Dist. Min. WTG	h/anno SF Worst Case	h/giorno SF Worst Case	h/anno SF Real Case
1	F19	AG08, AG07, AG06	AG12	553	79:55:00	1:07	<b>38:08:00</b>
2	F26	AG10	AG11	569	14:13:00	0:29	<b>4:59:00</b>
3	F49	AG03	AG10	768	14:32:00	0:31	<b>6:16:00</b>

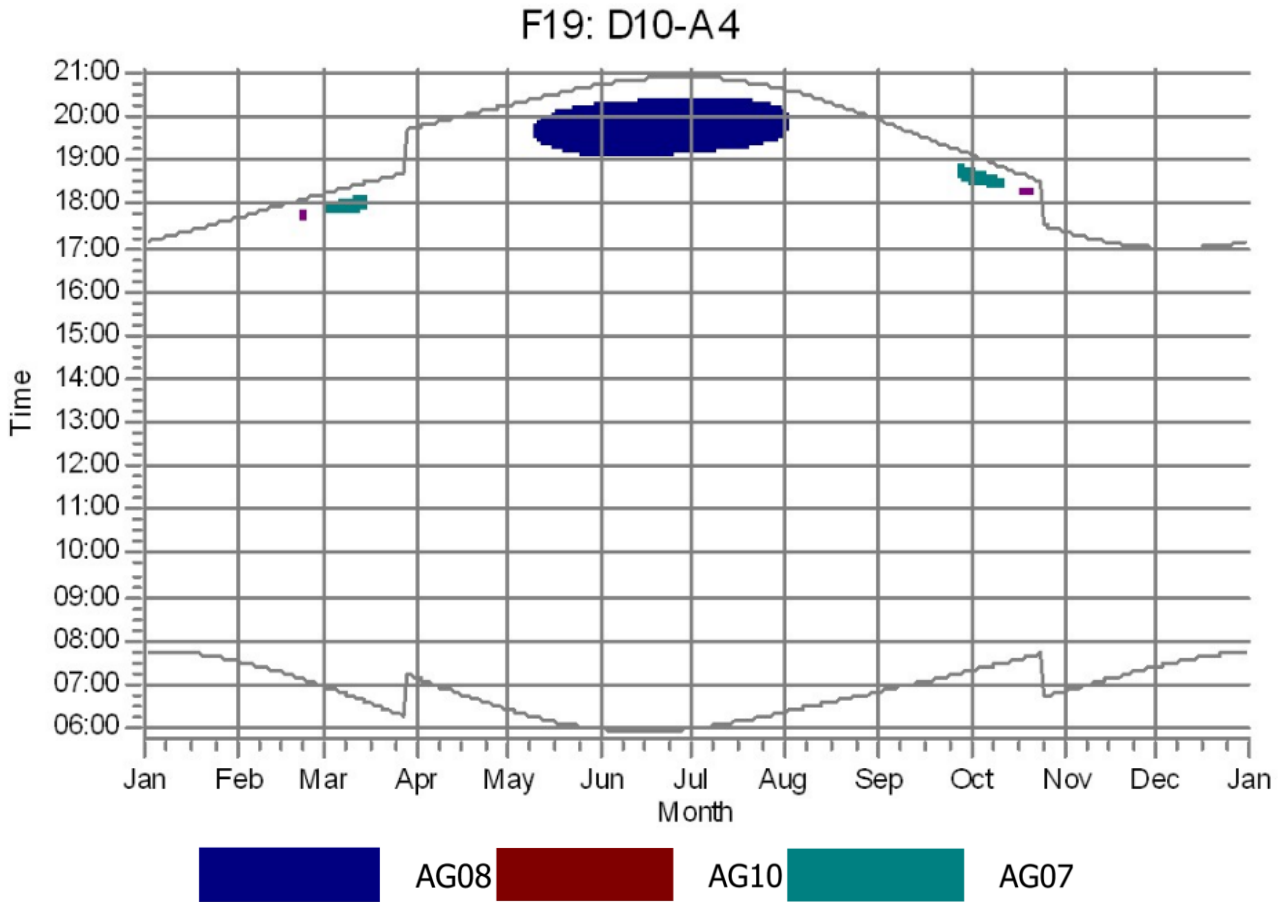
Come si può osservare dall'esame della Tabella 6.1, l'incidenza dell'ombreggiamento intermittente presso i ricettori considerati nello "scenario reale" è sempre al disotto del valore guida di 30 h/anno (fabbricati F26 e F49) o di poco superiore (F19).

In riferimento a fabbricato potenzialmente più esposto al fenomeno (F19), il calendario dell'ombra riportato in Figura 8.1 mostra come il contributo principale all'ombreggiamento sia riferibile all'aerogeneratore AG08, ubicato a circa 560 metri a nordovest di questo, potendosi ritenere trascurabili i contributi degli aerogeneratori AG07 e AG06.

D'altro canto, le riprese fotografiche di seguito illustrate (Figura 8.2, Figura 8.3 e Figura 8.4) mostrano in tutta evidenza come la porzione dello stabile F19 esposta all'ombreggiamento dell'aerogeneratore AG08 non sia destinata a funzioni residenziali, trattandosi di locali di supporto alle pratiche agricole.

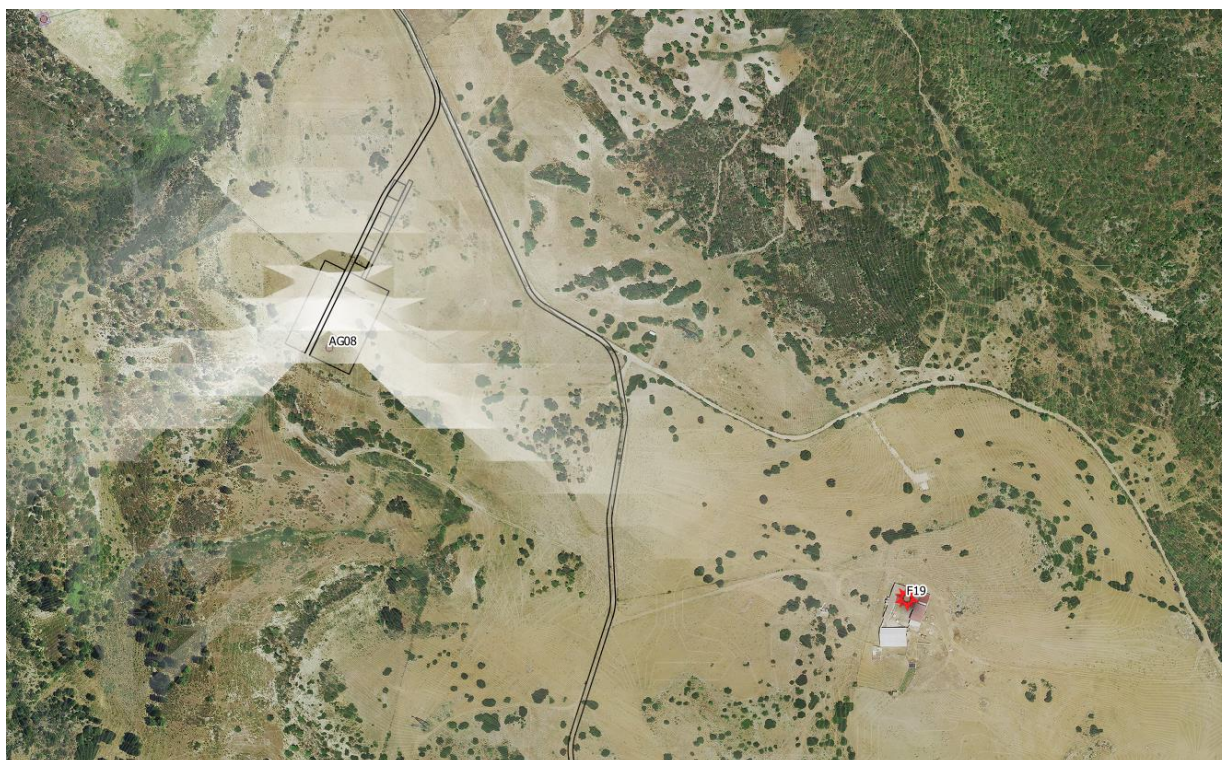
In ragione di quanto precede, avuto riguardo della conservatività delle stime<sup>2</sup>, del modesto superamento della soglia guida e della saltuaria presenza di persone nei locali, è ragionevole affermare che l'effettivo potenziale disturbo da *shadow flickering* risulterà estremamente più contenuto di quello prospettato dal software di simulazione, tale da potersi ricondurre ai predetti "valori guida" e da non arrecare apprezzabili disturbi agli occupanti l'edificio più esposto.

<sup>2</sup> Si ricorda che la soglia di 30 h/anno fa riferimento alle ore di disturbo effettivo, il che presuppone che gli occupanti l'edificio siano effettivamente presenti nei locali interessati dal fenomeno e la circostanza che gli stessi siano svegli.



**Figura 8.1 – Calendario dell’ombra relativo al fabbricato F19**





**Figura 8.2 - Posizionamento del fabbricato F19 rispetto all'aerogeneratore AG08, all'origine del principale contributo al fenomeno di shadow-flickering sull'edificio (con tratto bianco le isole di ombra intermittente)**



**Figura 8.3 – Edificio F19 ed isolinee d'ombra proiettate dall'aerogeneratore AG05 (vista zenitale). Si noti come l'ombra, proveniente esclusivamente dal lato ovest, investe una porzione del fabbricato ragionevolmente funzionale all'esercizio di attività produttive, trovandosi la porzione residenziale sul lato est (cfr. Figura 8.4)**





**Figura 8.4 – Ripresa da nordovest del fabbricato F19. Si noti come il prospetto esposto all’ombreggiamento da parte dell’aerogeneratore AG08 (evidenziato in rosso) si riferisca ad una porzione dello stabile non destinata a funzioni residenziali**

## 9 Conclusioni

Il documento ha esaminato compiutamente il potenziale disturbo da ombreggiamento intermittente (*shadow flickering*) in corrispondenza dei più prossimi fabbricati presenti nell’area interessata dal proposto parco eolico. L’individuazione dei ricettori ha fatto riferimento alla ricognizione sugli edifici esistenti eseguita nell’ambito della definizione del layout di impianto e dell’analisi ambientale, i cui risultati sono riepilogati in opportune “schede fabbricati” all’interno di apposito report allegato al progetto.

Ai fini dei calcoli di esposizione all’ombra intermittente - avuto riguardo dei criteri enunciati dalla DGR 59/90 del 2020 - sono stati individuati come ricettori n. 3 fabbricati, ubicati entro una distanza di 1000 m dalle postazioni eoliche in progetto.

Per le finalità del presente studio, in assenza di una specifica disciplina normativa nazionale o regionale, si è fatto riferimento alle linee guida elaborate dal Gruppo Federale tedesco di Controllo delle Emissioni (*Bund-/Länder-Arbeitsgemeinschaft für Immissionsschutz - LAI*) – aggiornamento 2020.

L’incidenza dell’ombreggiamento intermittente presso i ricettori considerati nello “scenario reale” è sempre risultata al disotto del valore guida di 30 h/anno (fabbricati F26 e F49) o di poco superiore (F19).

In riferimento a fabbricato potenzialmente più esposto al fenomeno (F19), contraddistinto da un’incidenza di circa 38 h/anno di SF, le verifiche condotte in sito hanno evidenziato come le porzioni dello stabile esposte all’ombreggiamento ad opera degli aerogeneratori in progetto non siano destinate a funzioni residenziali, trattandosi di locali di supporto alle pratiche agricole.

In ragione di quanto precede, avuto riguardo della conservatività delle stime, del modesto superamento della soglia guida e della saltuaria presenza di persone nei locali, è ragionevole affermare che l’effettivo potenziale disturbo da *shadow flickering* risulterà estremamente più contenuto di quello prospettato dal software di simulazione, tale da potersi ricondurre ai predetti “valori guida” e da non arrecare apprezzabili disturbi agli occupanti l’edificio più esposto.

## Allegato: Report di calcolo



Project:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

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Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

## SHADOW - Main Result

Calculation: Real\_case\_2023\_03\_17

### 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) [CAGLIARI / ELMA S]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4,40	5,05	5,88	7,00	8,45	9,88	10,82	10,03	8,08	6,09	5,07	4,27

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
93	283	496	514	286	79	35	35	214	1.318	3.577	570	7.500

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\_Progetto\_Vestas\_Escalaplano

Obstacles used in calculation

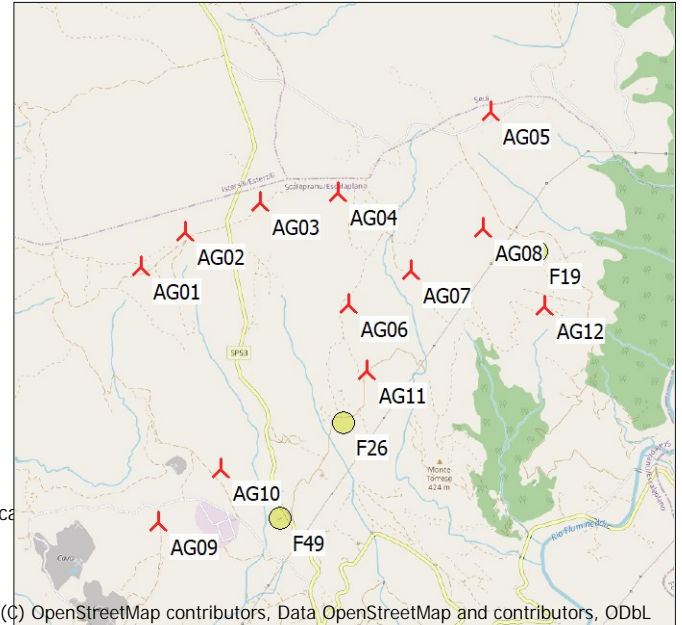
Eye height for map: 1,5 m

Grid resolution: 1,0 m

All coordinates are in

Italian Gauss-Boaga west-ROMA40 (IT-peninsular <±4m)

### WTGs



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Scale 1:75.000

▲ New WTG

● Shadow receptor

	Easting	Northing	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
AG01	1.528.883	4.392.340	604,6	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG02	1.529.321	4.392.679	604,3	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG03	1.530.063	4.392.975	588,9	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG04	1.530.839	4.393.081	575,7	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG05	1.532.347	4.393.885	661,4	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG06	1.530.947	4.391.972	522,0	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG07	1.531.560	4.392.311	529,3	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG08	1.532.280	4.392.734	618,0	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG09	1.529.063	4.389.808	441,8	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG10	1.529.685	4.390.338	469,2	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG11	1.531.132	4.391.319	490,1	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG12	1.532.896	4.391.958	580,0	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0

### Shadow receptor-Input

No.	Name	Easting	Northing	Z	Width	Height	Elevation	Slope of	Direction mode	Eye height
				[m]	[m]	[m]	a.g.l. [m]	window [°]		(ZVI) a.g.l. [m]
F19	D10-A4	1.532.812	4.392.504	618,0	1,2	1,4	1,2	90,0	"Green house mode"	2,6
F26	pascolo	1.530.904	4.390.798	464,2	1,2	1,4	1,2	90,0	"Green house mode"	2,6
F49	D03-A03	1.530.275	4.389.846	440,0	1,2	1,4	1,2	90,0	"Green house mode"	2,6

### Calculation Results

Shadow receptor

Shadow, expected values

No.	Name	Shadow hours per year [h/year]
F19	D10-A4	38:08
F26	pascolo	4:59
F49	D03-A03	6:16

Project:

Progetto\_Vestas\_Escalaplano

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Calculated:

17/03/2023 17:07/3.4.415

## SHADOW - Main Result

Calculation: Real\_case\_2023\_03\_17

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

No.	Name	Worst case [h/year]	Expected [h/year]
AG01	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (65)	0:00	0:00
AG02	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (69)	0:00	0:00
AG03	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (66)	0:00	0:00
AG04	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (67)	0:00	0:00
AG05	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (68)	0:00	0:00
AG06	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (75)	0:03	0:01
AG07	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (70)	3:34	1:24
AG08	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (71)	76:18	36:42
AG09	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (74)	14:32	6:16
AG10	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (72)	14:13	4:59
AG11	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (73)	0:00	0:00
AG12	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (76)	0:00	0:00

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

### SHADOW - Calendar

Calculation: Real\_case\_2023\_03\_17Shadow receptor: F19 - D10-A4

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4,40	5,05	5,88	7,00	8,45	9,88	10,82	10,03	8,08	6,09	5,07	4,27

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
93	283	496	514	286	79	35	35	214	1.318	3.577	570	7.500

	January	February	March	April	May	June			
1	07:44	07:32	06:58	07:09	06:25	05:58	19:11 (AG08)		
	17:09	17:42	18:14	19:46	20:16	20:44	62 20:13 (AG08)		
2	07:44	07:31	06:56	07:07	06:24	05:57	19:12 (AG08)		
	17:10	17:43	18:15	19:47	20:17	20:45	61 20:13 (AG08)		
3	07:44	07:30	06:55	17:54 (AG07)	07:06	06:22	05:57	19:12 (AG08)	
	17:10	17:44	18:16	1 17:55 (AG07)	19:48	20:18	20:46	62 20:14 (AG08)	
4	07:44	07:29	06:53	17:54 (AG07)	07:04	06:21	05:56	19:11 (AG08)	
	17:11	17:45	18:17	3 17:57 (AG07)	19:49	20:19	20:46	63 20:14 (AG08)	
5	07:44	07:28	06:52	17:53 (AG07)	07:02	06:20	05:56	19:11 (AG08)	
	17:12	17:47	18:18	4 17:57 (AG07)	19:50	20:20	20:47	64 20:15 (AG08)	
6	07:44	07:27	06:50	17:53 (AG07)	07:01	06:19	05:56	19:11 (AG08)	
	17:13	17:48	18:20	6 17:59 (AG07)	19:51	20:21	20:48	64 20:15 (AG08)	
7	07:44	07:26	06:49	17:52 (AG07)	06:59	06:18	05:56	19:12 (AG08)	
	17:14	17:49	18:21	8 18:00 (AG07)	19:52	20:22	20:48	64 20:16 (AG08)	
8	07:44	07:25	06:47	17:52 (AG07)	06:58	06:17	05:55	19:12 (AG08)	
	17:15	17:50	18:22	8 18:00 (AG07)	19:53	20:23	20:49	64 20:16 (AG08)	
9	07:44	07:24	06:45	17:52 (AG07)	06:56	06:16	05:55	19:11 (AG08)	
	17:16	17:51	18:23	10 18:02 (AG07)	19:54	20:24	20:49	65 20:16 (AG08)	
10	07:44	07:23	06:44	17:52 (AG07)	06:55	06:14	05:55	19:11 (AG08)	
	17:17	17:52	18:24	11 18:03 (AG07)	19:55	20:25	20:50	65 20:16 (AG08)	
11	07:44	07:21	06:42	17:53 (AG07)	06:53	06:13	19:37 (AG08)	05:55	19:11 (AG08)
	17:18	17:54	18:25	11 18:04 (AG07)	19:56	20:26	8 19:45 (AG08)	20:50	66 20:17 (AG08)
12	07:43	07:20	06:41	17:54 (AG07)	06:52	06:12	19:32 (AG08)	05:55	19:12 (AG08)
	17:19	17:55	18:26	11 18:05 (AG07)	19:57	20:27	19 19:51 (AG08)	20:51	65 20:17 (AG08)
13	07:43	07:19	06:39	17:56 (AG07)	06:50	06:11	19:28 (AG08)	05:55	19:12 (AG08)
	17:20	17:56	18:27	11 18:07 (AG07)	19:58	20:28	26 19:54 (AG08)	20:51	65 20:17 (AG08)
14	07:43	07:18	06:38	17:57 (AG07)	06:49	06:10	19:26 (AG08)	05:55	19:12 (AG08)
	17:21	17:57	18:28	10 18:07 (AG07)	19:59	20:29	30 19:56 (AG08)	20:52	66 20:18 (AG08)
15	07:43	07:17	06:36	17:59 (AG07)	06:47	06:09	19:24 (AG08)	05:55	19:12 (AG08)
	17:22	17:58	18:29	9 18:08 (AG07)	20:00	20:30	34 19:58 (AG08)	20:52	66 20:18 (AG08)
16	07:42	07:15	06:34	17:54 (AG07)	06:46	06:09	19:22 (AG08)	05:55	19:12 (AG08)
	17:23	17:59	18:30	20:01	20:31	37 19:59 (AG08)	20:53	66 20:18 (AG08)	
17	07:42	07:14	06:33	17:54 (AG07)	06:44	06:08	19:20 (AG08)	05:55	19:12 (AG08)
	17:24	18:01	18:31	20:02	20:32	41 20:01 (AG08)	20:53	66 20:18 (AG08)	
18	07:41	07:13	06:31	17:54 (AG07)	06:43	06:07	19:20 (AG08)	05:55	19:12 (AG08)
	17:25	18:02	18:32	20:03	20:33	43 20:03 (AG08)	20:53	67 20:19 (AG08)	
19	07:41	07:12	06:30	17:54 (AG07)	06:41	06:06	19:19 (AG08)	05:55	19:13 (AG08)
	17:27	18:03	18:33	20:04	20:33	45 20:04 (AG08)	20:54	67 20:20 (AG08)	
20	07:40	07:10	06:28	17:54 (AG07)	06:40	06:05	19:17 (AG08)	05:55	19:13 (AG08)
	17:28	18:04	18:34	20:05	20:34	48 20:05 (AG08)	20:54	67 20:20 (AG08)	
21	07:40	07:09	06:26	17:54 (AG07)	06:38	06:04	19:16 (AG08)	05:55	19:13 (AG08)
	17:29	18:05	18:35	20:06	20:35	49 20:05 (AG08)	20:54	67 20:20 (AG08)	
22	07:39	07:08	17:44 (AG06)	06:25	06:37	06:04	19:16 (AG08)	05:55	19:13 (AG08)
	17:30	18:06	1 17:45 (AG06)	18:36	20:07	20:36	51 20:07 (AG08)	20:54	67 20:20 (AG08)
23	07:39	07:06	06:23	17:54 (AG07)	06:36	06:03	19:15 (AG08)	05:56	19:13 (AG08)
	17:31	18:07	18:37	20:08	20:37	52 20:07 (AG08)	20:54	67 20:20 (AG08)	
24	07:38	07:05	06:22	17:54 (AG07)	06:34	06:02	19:14 (AG08)	05:56	19:14 (AG08)
	17:32	18:09	18:38	20:09	20:38	54 20:08 (AG08)	20:55	67 20:21 (AG08)	
25	07:37	07:03	06:20	17:54 (AG07)	06:33	06:01	19:14 (AG08)	05:56	19:14 (AG08)
	17:33	18:10	18:39	20:10	20:39	55 20:09 (AG08)	20:55	66 20:20 (AG08)	
26	07:37	07:02	06:18	17:54 (AG07)	06:31	06:01	19:13 (AG08)	05:56	19:14 (AG08)
	17:35	18:11	18:40	20:11	20:39	56 20:09 (AG08)	20:55	66 20:20 (AG08)	
27	07:36	07:00	06:17	17:54 (AG07)	06:30	06:00	19:13 (AG08)	05:57	19:15 (AG08)
	17:36	18:12	18:41	20:12	20:40	58 20:11 (AG08)	20:55	66 20:21 (AG08)	
28	07:35	06:59	06:15	17:54 (AG07)	06:29	06:00	19:13 (AG08)	05:57	19:15 (AG08)
	17:37	18:13	18:42	20:13	20:41	58 20:11 (AG08)	20:55	66 20:21 (AG08)	
29	07:34		07:14	17:54 (AG07)	06:27	05:59	19:13 (AG08)	05:57	19:15 (AG08)
	17:38		19:43	20:14	20:42	59 20:12 (AG08)	20:55	66 20:21 (AG08)	
30	07:34		07:12	17:54 (AG07)	06:26	05:59	19:12 (AG08)	05:58	19:16 (AG08)
	17:39		19:44	20:15	20:43	60 20:12 (AG08)	20:55	65 20:21 (AG08)	
31	07:33		07:10	17:54 (AG07)	06:25	05:58	19:12 (AG08)		
	17:41		19:45	20:43	20:43	61 20:13 (AG08)			
Potential sun hours	301	299	370	397	445		448		
Total, worst case			1	103		944		1958	
Sun reduction			0,47	0,49		0,59		0,66	
Oper. time red.			0,86	0,86		0,86		0,86	
Wind dir. red.			0,83	0,86		0,83		0,83	
Total reduction			0,34	0,36		0,42		0,47	
Total, real			0	37		397		925	

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: Real\_case\_2023\_03\_17Shadow receptor: F19 - D10-A4

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4,40	5,05	5,88	7,00	8,45	9,88	10,82	10,03	8,08	6,09	5,07	4,27

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
93	283	496	514	286	79	35	35	214	1.318	3.577	570	7.500

	July	August	September	October	November	December
1	05:58 20:55 65	19:16 (AG08) 06:21 20:21 (AG08) 20:37	19:44 (AG08) 06:50 20:00 (AG08) 19:56	07:18 19:07 11	18:34 (AG07) 18:45 (AG07) 17:22	06:50 07:24 16:59
2	05:59 20:55 66	19:16 (AG08) 06:22 20:22 (AG08) 20:36	19:44 (AG08) 06:51 20:00 (AG08) 19:54	07:19 19:05 11	18:32 (AG07) 18:43 (AG07) 17:21	06:52 07:25 16:59
3	05:59 20:55 65	19:16 (AG08) 06:23 20:21 (AG08) 20:35	19:44 (AG08) 06:52 20:00 (AG08) 19:53	07:20 19:04 11	18:31 (AG07) 18:42 (AG07) 17:20	06:53 07:26 16:59
4	06:00 20:54 65	19:17 (AG08) 06:24 20:22 (AG08) 20:34	19:44 (AG08) 06:53 20:00 (AG08) 19:51	07:21 19:02 10	18:30 (AG07) 18:40 (AG07) 17:19	06:54 07:27 16:59
5	06:00 20:54 64	19:17 (AG08) 06:25 20:21 (AG08) 20:33	19:44 (AG08) 06:54 20:00 (AG08) 19:49	07:22 19:01 10	18:29 (AG07) 18:39 (AG07) 17:18	06:55 07:28 16:59
6	06:01 20:54 64	19:18 (AG08) 06:26 20:22 (AG08) 20:32	19:44 (AG08) 06:55 20:00 (AG08) 19:48	07:23 18:59 8	18:29 (AG07) 18:37 (AG07) 17:17	06:56 07:29 16:59
7	06:02 20:54 64	19:18 (AG08) 06:27 20:22 (AG08) 20:30	19:44 (AG08) 06:56 20:00 (AG08) 19:46	07:24 18:57 7	18:28 (AG07) 18:35 (AG07) 17:16	06:57 07:30 16:59
8	06:02 20:53 63	19:18 (AG08) 06:28 20:21 (AG08) 20:29	19:44 (AG08) 06:57 20:00 (AG08) 19:45	07:25 18:56 6	18:28 (AG07) 18:34 (AG07) 17:15	06:58 07:31 16:59
9	06:03 20:53 63	19:19 (AG08) 06:29 20:22 (AG08) 20:28	19:44 (AG08) 06:58 20:00 (AG08) 19:43	07:26 18:54 4	18:28 (AG07) 18:32 (AG07) 17:14	07:00 07:31 16:59
10	06:03 20:53 62	19:19 (AG08) 06:29 20:21 (AG08) 20:27	19:44 (AG08) 06:58 20:00 (AG08) 19:41	07:27 18:53 3	18:28 (AG07) 18:31 (AG07) 17:13	07:01 07:32 16:59
11	06:04 20:52 62	19:19 (AG08) 06:30 20:21 (AG08) 20:26	19:44 (AG08) 06:59 20:00 (AG08) 19:40	07:28 18:51 1	18:28 (AG07) 18:29 (AG07) 17:12	07:02 07:33 16:59
12	06:05 20:52 61	19:20 (AG08) 06:31 20:21 (AG08) 20:24	19:44 (AG08) 07:00 20:00 (AG08) 19:38	07:29 18:50 1	18:29 (AG07) 18:50 17:11	07:03 07:34 16:59
13	06:05 20:51 60	19:20 (AG08) 06:32 20:20 (AG08) 20:23	19:44 (AG08) 07:01 20:00 (AG08) 19:36	07:30 18:48 1	18:29 (AG07) 18:48 17:10	07:04 07:35 16:59
14	06:06 20:51 59	19:21 (AG08) 06:33 20:20 (AG08) 20:22	19:44 (AG08) 07:02 20:00 (AG08) 19:35	07:31 18:47 1	18:29 (AG07) 18:47 17:09	07:05 07:36 16:59
15	06:07 20:50 58	19:22 (AG08) 06:34 20:20 (AG08) 20:20	19:44 (AG08) 07:03 20:00 (AG08) 19:33	07:32 18:45 1	18:29 (AG07) 18:45 17:08	07:06 07:37 16:59
16	06:08 20:50 57	19:23 (AG08) 06:35 20:20 (AG08) 20:19	19:44 (AG08) 07:04 20:00 (AG08) 19:32	07:33 18:44 1	18:29 (AG07) 18:44 17:07	07:07 07:38 16:59
17	06:08 20:49 57	19:23 (AG08) 06:35 20:19 (AG08) 20:18	19:44 (AG08) 07:05 20:00 (AG08) 19:30	07:34 18:42 1	18:29 (AG07) 18:42 17:07	07:09 07:39 16:59
18	06:09 20:49 56	19:23 (AG08) 06:37 20:19 (AG08) 20:16	19:44 (AG08) 07:06 20:00 (AG08) 19:28	07:35 18:41 1	18:17 (AG06) 18:18 (AG06) 17:06	07:10 07:38 16:59
19	06:10 20:48 54	19:24 (AG08) 06:38 20:18 (AG08) 20:15	19:44 (AG08) 07:07 20:00 (AG08) 19:27	07:36 18:39 1	18:17 (AG06) 18:16 (AG06) 17:05	07:11 07:39 16:59
20	06:11 20:47 53	19:25 (AG08) 06:40 20:18 (AG08) 20:14	19:44 (AG08) 07:08 20:00 (AG08) 19:25	07:37 18:38 1	18:15 (AG06) 18:16 (AG06) 17:05	07:12 07:40 16:59
21	06:12 20:47 52	19:25 (AG08) 06:40 20:17 (AG08) 20:12	19:44 (AG08) 07:09 20:00 (AG08) 19:23	07:38 18:37 1	18:15 (AG06) 18:16 (AG06) 17:05	07:13 07:41 16:59
22	06:12 20:46 50	19:26 (AG08) 06:41 20:16 (AG08) 20:11	19:44 (AG08) 07:10 20:00 (AG08) 19:22	07:39 18:35 1	18:15 (AG06) 18:16 (AG06) 17:05	07:14 07:42 16:59
23	06:13 20:45 48	19:27 (AG08) 06:42 20:15 (AG08) 20:09	19:44 (AG08) 07:11 20:00 (AG08) 19:20	07:41 18:34 1	18:15 (AG06) 18:16 (AG06) 17:05	07:15 07:43 16:59
24	06:14 20:44 46	19:29 (AG08) 06:43 20:15 (AG08) 20:08	19:44 (AG08) 07:12 20:00 (AG08) 19:18	07:42 18:32 1	18:15 (AG06) 18:16 (AG06) 17:05	07:16 07:44 16:59
25	06:15 20:43 44	19:30 (AG08) 06:44 20:14 (AG08) 20:06	19:44 (AG08) 07:12 20:00 (AG08) 19:17	07:43 18:31 1	18:15 (AG06) 18:16 (AG06) 17:05	07:17 07:45 16:59
26	06:16 20:43 42	19:31 (AG08) 06:45 20:13 (AG08) 20:05	19:44 (AG08) 07:13 20:00 (AG08) 19:15	07:44 18:30 1	18:15 (AG06) 18:16 (AG06) 17:05	07:18 07:46 16:59
27	06:17 20:42 39	19:32 (AG08) 06:45 20:11 (AG08) 20:03	19:44 (AG08) 07:14 20:00 (AG08) 19:14	07:45 18:28 1	18:15 (AG06) 18:16 (AG06) 17:05	07:19 07:47 16:59
28	06:18 20:41 36	19:33 (AG08) 06:46 20:09 (AG08) 20:02	19:44 (AG08) 07:15 20:00 (AG08) 19:12	07:46 18:27 8	18:15 (AG06) 18:16 (AG06) 17:05	07:20 07:48 16:59
29	06:18 20:40 33	19:35 (AG08) 06:47 20:08 (AG08) 20:00	19:44 (AG08) 07:16 20:00 (AG08) 19:10	07:47 18:26 10	18:15 (AG06) 18:16 (AG06) 17:05	07:21 07:49 16:59
30	06:19 20:39 29	19:37 (AG08) 06:48 20:06 (AG08) 19:59	19:44 (AG08) 07:17 20:00 (AG08) 19:09	07:48 18:25 11	18:15 (AG06) 18:16 (AG06) 17:05	07:22 07:50 16:59
31	06:20 20:38 23	19:40 (AG08) 06:49 20:03 (AG08) 19:57	19:44 (AG08) 07:18 20:00 (AG08) 19:08	07:49 18:24 12	18:15 (AG06) 18:16 (AG06) 17:05	07:23 07:51 16:59
Potential sun hours	455	425	374	347	301	292
Total, worst case	1660	16	29	84		
Sun reduction	0,74	0,73	0,65	0,54		
Oper. time red.	0,86	0,86	0,86	0,86		
Wind dir. red.	0,83	0,83	0,86	0,86		
Total reduction	0,53	0,52	0,48	0,40		
Total, real	873	8	14	34		

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

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

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.
Via Santa Margherita 4
IT-09124 Cagliari
+39 070 658297
Giuseppe Frongia / direttore@iatprogetti.it
Calculated:
17/03/2023 17:07/3.4.415

SHADOW - Calendar

Calculation: Real\_case\_2023\_03\_17Shadow receptor: F26 - pascolo

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Table with 12 columns (Jan-Dec) and 1 row of values: 4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

Operational time

Table with 13 columns (N, NNE, ENE, E, ESE, SSE, S, SSW, WSW, W, WNW, NNW, Sum) and 1 row of values: 93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

Main shadow calculation table with columns for months (January-December) and rows for each day (1-31) showing sun rise/set times and reduction factors.

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

Matrix with 4 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)



Project:

Progetto\_Vestas\_Escalaplano

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Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar

Calculation: Real\_case\_2023\_03\_17Shadow receptor: F49 - D03-A03

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December				
1	07:44	07:32	06:58	07:09	18:51 (AG09)	06:25	05:58	05:59	06:21	06:50	07:18	06:51	07:24			
	17:09	17:42	18:14	19:46	26	19:17 (AG09)	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00		
2	07:44	07:31	06:56	07:07	18:52 (AG09)	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25			
	17:10	17:43	18:15	19:47	24	19:16 (AG09)	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59		
3	07:44	07:30	06:55	07:06	18:53 (AG09)	06:23	05:57	06:00	06:23	06:52	07:20	06:53	07:26			
	17:11	17:44	18:16	19:48	22	19:15 (AG09)	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59		
4	07:44	07:29	06:53	07:04	18:55 (AG09)	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27			
	17:11	17:46	18:18	19:49	17	19:12 (AG09)	20:19	20:46	20:54	20:34	19:51	19:02	17:19	16:59		
5	07:44	07:28	06:52	07:03	18:57 (AG09)	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28			
	17:12	17:47	18:19	19:50	13	19:10 (AG09)	20:20	20:47	20:54	20:33	19:49	19:01	17:18	16:59		
6	07:44	07:27	06:50	07:01	19:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29			
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59	07:30			
7	07:44	07:26	06:49	06:59	18:18	05:56	06:02	06:27	06:56	18:53 (AG09)	07:24	06:57	07:30			
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:30	19:46	11	19:04 (AG09)	18:58	17:16	16:59		
8	07:44	07:25	06:47	06:58	18:17	05:55	06:02	06:28	06:57	18:50 (AG09)	07:25	06:58	07:31			
	17:15	17:50	18:22	19:53	20:23	20:49	20:53	20:29	19:45	17	19:07 (AG09)	18:56	17:15	16:59		
9	07:44	07:24	06:46	06:56	18:16	05:55	06:03	06:29	06:58	18:48 (AG09)	07:26	07:00	07:31			
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	21	19:09 (AG09)	18:54	17:14	16:59		
10	07:44	07:23	06:44	06:55	18:15	05:55	06:04	06:30	06:59	18:46 (AG09)	07:27	07:01	07:32			
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:41	24	19:10 (AG09)	18:53	17:13	16:59		
11	07:44	07:22	06:42	06:53	18:14	05:55	06:04	06:31	07:00	18:44 (AG09)	07:28	07:02	07:33			
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	26	19:10 (AG09)	18:51	17:12	16:59		
12	07:44	07:20	06:41	06:52	18:13	05:55	06:05	06:32	07:00	18:42 (AG09)	07:29	07:03	07:34			
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	28	19:10 (AG09)	18:50	17:11	16:59		
13	07:43	07:19	06:39	06:50	18:12	05:55	06:06	06:32	07:01	18:42 (AG09)	07:30	07:04	07:35			
	17:20	17:56	18:27	19:58	20:28	20:51	20:51	20:23	19:37	28	19:10 (AG09)	18:48	17:10	16:59		
14	07:43	07:18	06:38	06:49	18:11	05:55	06:06	06:33	07:02	18:41 (AG09)	07:31	07:05	07:35			
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	30	19:11 (AG09)	18:47	17:09	16:59		
15	07:43	07:17	06:36	06:47	18:10	05:55	06:07	06:34	07:03	18:40 (AG09)	07:32	07:06	07:36			
	17:22	17:58	18:29	20:00	20:30	20:52	20:50	20:20	19:33	31	19:11 (AG09)	18:45	17:08	17:00		
16	07:42	07:16	06:35	06:46	18:09	05:55	06:08	06:35	07:04	18:40 (AG09)	07:33	07:08	07:37			
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	30	19:10 (AG09)	18:44	17:08	17:00		
17	07:42	07:14	06:33	06:44	18:08	05:55	06:09	06:36	07:05	18:40 (AG09)	07:34	07:09	07:38			
	17:25	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	28	19:08 (AG09)	18:42	17:07	17:00		
18	07:41	07:13	06:31	06:43	18:07	05:55	06:09	06:37	07:06	18:39 (AG09)	07:35	07:10	07:38			
	17:26	18:02	18:32	9	18:12 (AG09)	20:03	20:33	20:53	20:49	20:16	19:28	28	19:07 (AG09)	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	18:06	05:55	06:10	06:38	07:07	18:39 (AG09)	07:36	07:11	07:39			
	17:27	18:03	18:33	14	18:13 (AG09)	20:04	20:33	20:54	20:48	20:15	19:27	26	19:05 (AG09)	18:40	17:05	17:01
20	07:40	07:10	06:28	06:40	18:05	05:55	06:11	06:39	07:08	18:40 (AG09)	07:37	07:12	07:39			
	17:28	18:04	18:34	16	18:13 (AG09)	20:05	20:34	20:54	20:47	20:14	19:25	24	19:04 (AG09)	18:38	17:05	17:01
21	07:40	07:09	06:27	06:40	18:04	05:55	06:12	06:40	07:09	18:39 (AG09)	07:39	07:13	07:40			
	17:29	18:05	18:35	19	18:15 (AG09)	20:06	20:35	20:54	20:47	20:12	19:23	22	19:01 (AG09)	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	18:03	05:55	06:13	06:41	07:10	18:40 (AG09)	07:40	07:14	07:40			
	17:30	18:06	18:36	21	18:15 (AG09)	20:07	20:36	20:54	20:46	20:11	19:22	20	19:00 (AG09)	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	18:02	05:56	06:13	06:42	07:11	18:41 (AG09)	07:41	07:15	07:41			
	17:31	18:08	18:37	23	18:17 (AG09)	20:08	20:37	20:54	20:45	20:09	19:20	17	18:58 (AG09)	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	18:01	05:56	06:14	06:43	07:12	18:42 (AG09)	07:42	07:16	07:41			
	17:32	18:09	18:38	26	18:18 (AG09)	20:09	20:38	20:55	20:44	20:08	19:19	14	18:56 (AG09)	18:33	17:02	17:03
25	07:37	07:03	06:20	06:33	18:00	05:56	06:15	06:44	07:13	18:44 (AG09)	07:43	07:18	07:42			
	17:34	18:10	18:39	27	18:18 (AG09)	20:10	20:39	20:55	20:44	20:06	19:17	11	18:55 (AG09)	18:31	17:02	17:04
26	07:37	07:02	06:19	06:32	17:59	05:57	06:16	06:45	07:14	18:48 (AG09)	07:44	07:19	07:42			
	17:35	18:11	18:40	29	18:20 (AG09)	20:11	20:40	20:55	20:43	20:05	19:15	5	18:53 (AG09)	18:30	17:01	17:04
27	07:36	07:01	06:17	06:30	17:58	05:57	06:17	06:46	07:14	18:49 (AG09)	07:45	07:20	07:43			
	17:36	18:12	18:41	29	18:20 (AG09)	20:12	20:40	20:55	20:42	20:03	19:14	17:29	17:01	17:05		
28	07:35	06:59	06:15	06:29	17:50	05:57	06:18	06:47	07:15	18:50 (AG09)	07:46	07:21	07:43			
	17:37	18:13	18:42	30	18:20 (AG09)	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06		
29	07:34	07:14	06:28	06:37	18:11	05:58	06:19	06:47	07:16	18:51 (AG09)	07:47	07:22	07:43			
	17:38	18:12	18:41	29	19:20 (AG09)	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06		
30	07:34	07:12	06:26	06:35	18:10	05:58	06:20	06:48	07:17	18:52 (AG09)	07:48	07:23	07:43			
	17:40	18:14	18:43	29	19:19 (AG09)	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07		
31	07:33	07:11	06:25	06:34	18:09	05:58	06:20	06:49	07:18	18:53 (AG09)	07:49	07:24	07:44			
	17:41	18:15	18:44	28	19:19 (AG09)	20:16	20:43	20:58	20:38	19:57	19:08	17:24	17:00	17:08		
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292				
Total, worst case			329	102					441							
Sun reduction			0,49	0,53					0,65							
Oper. time red.			0,86	0,86					0,86							
Wind dir. red.			0,88	0,88					0,88							
Total reduction			0,37	0,40					0,49							
Total, real			122	40					214							

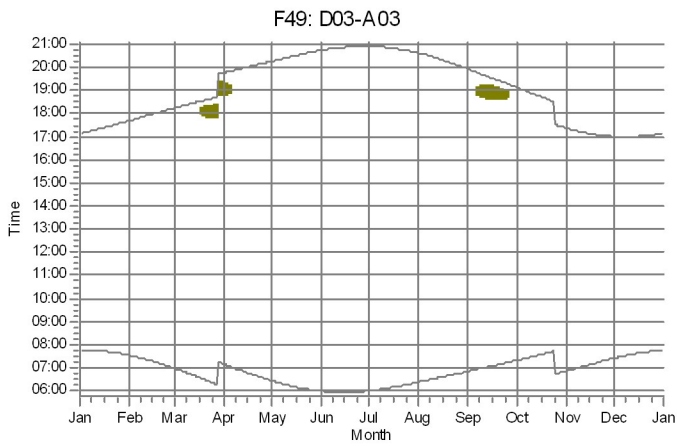
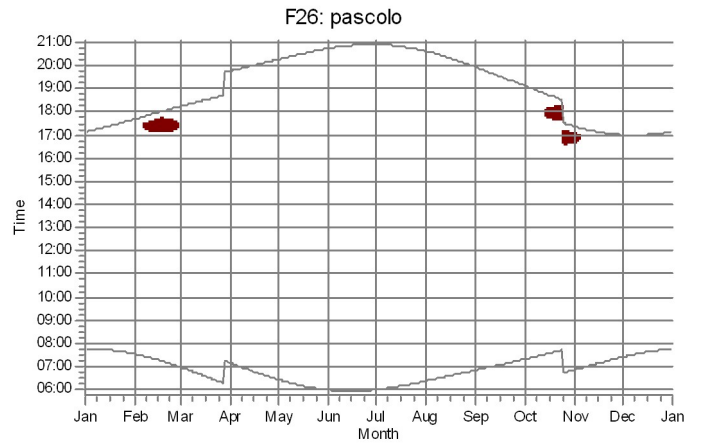
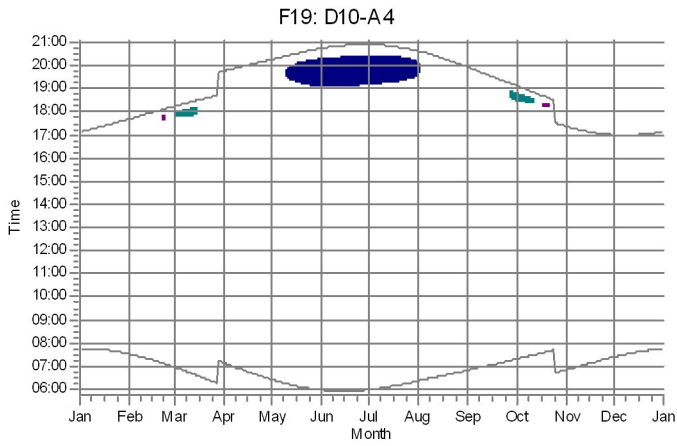
Table layout: For each day in each month the following matrix apply

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, graphical

Calculation: Real\_case\_2023\_03\_17



### WTGs

	AG07: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (70)
	AG08: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (71)
	AG10: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (72)

	AG09: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (74)
	AG06: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (75)

Project:

Progetto\_Vestas\_Escalaplano

Licensed user:

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Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG01 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (65) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44	07:32	06:58	07:09	06:25	05:58	05:59	06:21	06:50	07:18	06:51	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59
3	07:44	07:30	06:55	07:06	06:23	05:57	06:00	06:23	06:52	07:20	06:53	07:26
	17:11	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:46	18:18	19:49	20:19	20:46	20:55	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:03	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:19	19:50	20:20	20:47	20:54	20:33	19:50	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	07:00	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:31	19:46	18:58	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:59	07:31
	17:15	17:50	18:22	19:53	20:23	20:49	20:54	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:32
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:55	17:14	16:59
10	07:44	07:23	06:44	06:55	06:15	05:55	06:04	06:30	06:59	07:27	07:01	07:32
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:42	18:53	17:13	16:59
11	07:44	07:22	06:43	06:53	06:14	05:55	06:04	06:31	07:00	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:51	20:52	20:26	19:40	18:51	17:12	16:59
12	07:44	07:20	06:41	06:52	06:13	05:55	06:05	06:32	07:01	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:12	05:55	06:06	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:52	20:23	19:37	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:11	05:55	06:06	06:33	07:02	07:31	07:05	07:36
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:10	05:55	06:07	06:34	07:03	07:32	07:07	07:36
	17:22	17:59	18:29	20:00	20:30	20:52	20:51	20:21	19:33	18:45	17:08	17:00
16	07:42	07:16	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:08	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:09	06:36	07:05	07:34	07:09	07:38
	17:25	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:42	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:26	18:02	18:32	20:03	20:33	20:53	20:49	20:17	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:34	20:54	20:48	20:15	19:27	18:40	17:05	17:01
20	07:41	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:38	07:12	07:39
	17:28	18:04	18:34	20:05	20:35	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:27	06:39	06:04	05:55	06:12	06:40	07:09	07:39	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:24	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:13	06:41	07:10	07:40	07:14	07:41
	17:30	18:07	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:16	07:41
	17:31	18:08	18:37	20:08	20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:17	07:42
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:19	18:33	17:02	17:03
25	07:38	07:04	06:20	06:33	06:02	05:56	06:15	06:44	07:13	06:43	07:18	07:42
	17:34	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:19	06:32	06:01	05:57	06:16	06:45	07:14	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:46	07:15	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:04	19:14	17:29	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:47	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06
29	07:35		07:14	06:28	05:59	05:58	06:19	06:48	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:20	06:48	07:17	06:48	07:23	07:44
	17:40		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:11		05:58		06:20	06:49		06:50		07:44
	17:41		19:45		20:44		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

Via Santa Margherita 4

IT-09124 Cagliari

+39 070 658297

Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG02 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (69) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA SJ

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44	07:32	06:58	07:09	06:25	05:58	05:59	06:21	06:50	07:18	06:51	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59
3	07:44	07:30	06:55	07:06	06:23	05:57	05:59	06:23	06:52	07:20	06:53	07:26
	17:11	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:46	18:18	19:49	20:19	20:46	20:55	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:03	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:19	19:50	20:20	20:47	20:54	20:33	19:50	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	06:59	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:31	19:46	18:58	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:59	07:31
	17:15	17:50	18:22	19:53	20:23	20:49	20:54	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:32
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:59
10	07:44	07:23	06:44	06:55	06:15	05:55	06:04	06:30	06:59	07:27	07:01	07:32
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:42	18:53	17:13	16:59
11	07:44	07:22	06:43	06:53	06:14	05:55	06:04	06:31	07:00	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:51	20:52	20:26	19:40	18:51	17:12	16:59
12	07:44	07:20	06:41	06:52	06:13	05:55	06:05	06:32	07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:12	05:55	06:06	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:52	20:23	19:37	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:11	05:55	06:06	06:33	07:02	07:31	07:05	07:36
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:10	05:55	06:07	06:34	07:03	07:32	07:07	07:36
	17:22	17:58	18:29	20:00	20:30	20:52	20:51	20:21	19:33	18:45	17:08	17:00
16	07:42	07:16	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:08	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:09	06:36	07:05	07:34	07:09	07:38
	17:25	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:42	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:26	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:34	20:54	20:48	20:15	19:27	18:40	17:05	17:01
20	07:41	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:38	07:12	07:39
	17:28	18:04	18:34	20:05	20:35	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:27	06:38	06:04	05:55	06:12	06:40	07:09	07:39	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:24	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:13	06:41	07:10	07:40	07:14	07:41
	17:30	18:07	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41
	17:31	18:08	18:37	20:08	20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:17	07:42
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:19	18:33	17:02	17:03
25	07:38	07:04	06:20	06:33	06:02	05:56	06:15	06:44	07:13	06:43	07:18	07:42
	17:34	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:19	06:32	06:01	05:57	06:16	06:45	07:14	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:46	07:15	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:29	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:47	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06
29	07:35		07:14	06:28	05:59	05:58	06:19	06:47	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:20	06:48	07:17	06:48	07:23	07:44
	17:40		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:11		05:58		06:20	06:49		06:50		07:44
	17:41		19:45		20:44		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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: Real\_case\_2023\_03\_17WTG: AG03 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (66)  
 Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA SJ

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

#### Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44	07:32	06:58	07:09	06:25	05:58	05:58	06:21	06:50	07:18	06:51	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59
3	07:44	07:30	06:55	07:06	06:23	05:57	05:59	06:23	06:52	07:20	06:53	07:26
	17:11	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:45	18:18	19:49	20:19	20:46	20:55	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:03	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:19	19:50	20:20	20:47	20:54	20:33	19:50	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	06:59	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:31	19:46	18:58	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:59	07:31
	17:15	17:50	18:22	19:53	20:23	20:49	20:54	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:31
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:59
10	07:44	07:23	06:44	06:55	06:15	05:55	06:04	06:30	06:59	07:27	07:01	07:32
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:41	18:53	17:13	16:59
11	07:44	07:22	06:43	06:53	06:14	05:55	06:04	06:31	07:00	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	18:51	17:12	16:59
12	07:44	07:20	06:41	06:52	06:13	05:55	06:05	06:31	07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:12	05:55	06:06	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:52	20:23	19:37	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:11	05:55	06:06	06:33	07:02	07:31	07:05	07:35
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:10	05:55	06:07	06:34	07:03	07:32	07:06	07:36
	17:22	17:58	18:29	20:00	20:30	20:52	20:51	20:21	19:33	18:45	17:08	16:59
16	07:42	07:16	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:08	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:09	06:36	07:05	07:34	07:09	07:38
	17:24	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:42	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:26	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:34	20:54	20:48	20:15	19:27	18:40	17:05	17:01
20	07:41	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:37	07:12	07:39
	17:28	18:04	18:34	20:05	20:34	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:27	06:38	06:04	05:55	06:12	06:40	07:09	07:39	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:23	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:13	06:41	07:10	07:40	07:14	07:41
	17:30	18:06	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41
	17:31	18:08	18:37	20:08	20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:17	07:42
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:19	18:33	17:02	17:03
25	07:38	07:03	06:20	06:33	06:02	05:56	06:15	06:44	07:13	06:43	07:18	07:42
	17:34	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:19	06:32	06:01	05:56	06:16	06:45	07:14	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:46	07:14	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:29	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:47	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06
29	07:34		07:14	06:28	05:59	05:58	06:19	06:47	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:19	06:48	07:17	06:48	07:23	07:44
	17:39		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:11		05:58		06:20	06:49		06:49		07:44
	17:41		19:45		20:44		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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:

Progetto\_Vestas\_Escalaplano

Licensed user:

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+39 070 658297  
Giuseppe Frongia / direttore@iatprogetti.it  
Calculated:  
17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG04 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (67)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

| January | February | March | April | May | June | July | August | September | October | November | December

Table with 12 columns (months) and 31 rows (days). Each cell contains a time range (Sun rise - Sun set) in hh:mm format. The last row shows 'Potential sun hours' and 'Sum of minutes with flicker' for each month.

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



Project:

Progetto\_Vestas\_Escalaplano

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Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG05 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (68) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

| January | February | March | April | May | June | July | August | September | October | November | December

1	07:44	07:32	06:58	07:09	06:25	05:58	05:58	06:21	06:50	07:18	06:51	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	16:59
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:05	17:21	16:59
3	07:44	07:30	06:55	07:06	06:22	05:57	05:59	06:23	06:52	07:20	06:53	07:26
	17:10	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:56	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:45	18:17	19:49	20:19	20:46	20:54	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:02	06:20	05:56	06:00	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:18	19:50	20:20	20:47	20:54	20:33	19:49	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	06:59	06:18	05:55	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:30	19:46	18:57	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:58	07:31
	17:15	17:50	18:22	19:53	20:23	20:49	20:53	20:29	19:45	18:56	17:15	16:58
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:31
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:58
10	07:44	07:23	06:44	06:55	06:14	05:55	06:03	06:29	06:58	07:27	07:01	07:32
	17:17	17:52	18:24	19:55	20:25	20:50	20:53	20:27	19:41	18:53	17:13	16:59
11	07:44	07:22	06:42	06:53	06:13	05:55	06:04	06:30	06:59	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	18:51	17:12	16:59
12	07:44	07:20	06:41	06:52	06:12	05:55	06:05	06:31	07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:11	05:55	06:05	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:51	20:23	19:36	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:10	05:55	06:06	06:33	07:02	07:31	07:05	07:35
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:09	05:55	06:07	06:34	07:03	07:32	07:06	07:36
	17:22	17:58	18:29	20:00	20:30	20:52	20:50	20:20	19:33	18:45	17:08	16:59
16	07:42	07:15	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37
	17:23	17:59	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:07	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:08	06:36	07:05	07:34	07:09	07:38
	17:24	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:41	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:25	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:33	20:54	20:48	20:15	19:27	18:39	17:05	17:01
20	07:40	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:37	07:12	07:39
	17:28	18:04	18:34	20:05	20:34	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:27	06:38	06:04	05:55	06:12	06:40	07:09	07:38	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:23	18:37	17:04	17:01
22	07:39	07:08	06:25	06:37	06:04	05:55	06:12	06:41	07:10	07:40	07:14	07:40
	17:30	18:06	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41
	17:31	18:07	18:37	20:08	20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:02
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:16	07:41
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:18	18:32	17:02	17:03
25	07:37	07:03	06:20	06:33	06:01	05:56	06:15	06:44	07:12	06:43	07:18	07:42
	17:33	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:18	06:31	06:01	05:56	06:16	06:45	07:13	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:45	07:14	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:28	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:46	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:00	17:06
29	07:34		07:14	06:27	05:59	05:57	06:18	06:47	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:19	06:48	07:17	06:48	07:23	07:43
	17:39		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:10		05:58		06:20	06:49		06:49		07:44
	17:41		19:45		20:43		20:38	19:57		17:23		17:08

Potential sun hours | 301 | 299 | 370 | 397 | 445 | 448 | 455 | 425 | 374 | 347 | 301 | 292  
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:

Progetto\_Vestas\_Escalaplano

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Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG06 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (75) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA SJ

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

#### Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December	
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	05:58 20:55	06:21 20:37	06:50 19:56	07:18 19:07	06:51 17:22	07:24 17:00	
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	05:59 20:55	06:22 20:36	06:51 19:54	07:19 19:06	06:52 17:21	07:25 16:59	
3	07:44 17:11	07:30 17:44	06:55 18:16	07:06 19:48	06:23 20:18	05:57 20:46	05:59 20:55	06:23 20:35	06:52 19:53	07:20 19:04	06:53 17:20	07:26 16:59	
4	07:44 17:11	07:29 17:45	06:53 18:17	07:04 19:49	06:21 20:19	05:57 20:46	06:00 20:54	06:24 20:34	06:53 19:51	07:21 19:02	06:54 17:19	07:27 16:59	
5	07:44 17:12	07:28 17:47	06:52 18:17	07:03 19:50	06:20 20:20	05:56 20:47	06:00 20:54	06:25 20:33	06:54 19:49	07:22 19:01	06:55 17:18	07:28 16:59	
6	07:44 17:13	07:27 17:48	06:50 18:20	07:01 19:51	06:19 20:21	05:56 20:48	06:01 20:54	06:26 20:32	06:55 19:48	07:23 18:59	06:56 17:17	07:29 16:59	
7	07:44 17:14	07:26 17:49	06:49 18:21	06:59 19:52	06:18 20:22	05:56 20:48	06:02 20:54	06:27 20:30	06:56 19:46	07:24 18:58	06:57 17:16	07:30 16:59	
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9	07:44 17:16	07:24 17:51	06:46 18:23	06:56 19:54	06:16 20:24	05:55 20:49	06:03 20:53	06:29 20:28	06:58 19:43	07:26 18:54	07:00 17:14	07:31 16:59	
10	07:44 17:17	07:23 17:53	06:44 18:24	06:55 19:55	06:15 20:25	05:55 20:50	06:04 20:53	06:30 20:27	06:59 19:41	07:27 18:53	07:01 17:13	07:32 16:59	
11	07:44 17:18	07:22 17:54	06:42 18:25	06:53 19:56	06:14 20:26	05:55 20:50	06:04 20:52	06:31 20:26	06:59 19:40	07:28 18:51	07:02 17:12	07:33 16:59	
12	07:44 17:19	07:20 17:55	06:41 18:26	06:52 19:57	06:12 20:27	05:55 20:51	06:05 20:52	06:31 20:24	07:00 19:38	07:29 18:50	07:03 17:11	07:34 16:59	
13	07:43 17:20	07:19 17:56	06:39 18:27	06:50 19:58	06:11 20:28	05:55 20:51	06:06 20:52	06:32 20:23	07:01 19:37	07:30 18:48	07:04 17:10	07:35 16:59	
14	07:43 17:21	07:18 17:57	06:38 18:28	06:49 19:59	06:11 20:29	05:55 20:52	06:06 20:51	06:33 20:22	07:02 19:35	07:31 18:47	07:05 17:09	07:35 16:59	
15	07:43 17:22	07:17 17:58	06:36 18:29	06:47 20:00	06:10 20:30	05:55 20:52	06:07 20:50	06:34 20:20	07:03 19:33	07:32 18:45	07:06 17:08	07:36 16:59	
16	07:42 17:23	07:16 18:00	06:35 18:30	06:46 20:01	06:09 20:31	05:55 20:53	06:08 20:50	06:35 20:19	07:04 19:32	07:33 18:44	07:08 17:08	07:37 17:00	
17	07:42 17:24	07:14 18:01	06:33 18:31	06:44 20:02	06:08 20:32	05:55 20:53	06:09 20:49	06:36 20:18	07:05 19:30	07:34 18:42	07:09 17:07	07:38 17:00	
18	07:41 17:26	07:13 18:02	06:31 18:32	06:43 20:03	06:07 20:33	05:55 20:53	06:09 20:49	06:37 20:16	07:06 19:28	07:35 18:41	18:17-18:18/1	07:10 17:06	07:38 17:00
19	07:41 17:27	07:12 18:03	06:30 18:33	06:41 20:04	06:06 20:34	05:55 20:54	06:10 20:48	06:38 20:15	07:07 19:27	07:36 18:39	07:11 17:05	07:39 17:01	
20	07:40 17:28	07:10 18:04	06:28 18:34	06:40 20:05	06:05 20:34	05:55 20:54	06:11 20:47	06:39 20:14	07:08 19:25	07:37 18:38	18:15-18:16/1	07:12 17:05	07:39 17:01
21	07:40 17:29	07:09 18:05	06:27 18:35	06:38 20:06	06:04 20:35	05:55 20:54	06:12 20:47	06:40 20:12	07:09 19:23	07:38 18:37	07:13 17:04	07:40 17:02	
22	07:39 17:30	07:08 18:06	07:08 18:36	17:44-17:45/1	06:25 20:07	06:37 20:36	06:04 20:54	05:55 20:46	06:13 20:11	07:10 19:22	07:40 18:35	07:14 17:03	07:40 17:02
23	07:39 17:31	07:06 18:08	06:23 18:37	06:36 20:08	06:03 20:37	05:56 20:55	06:13 20:45	06:42 20:09	07:11 19:20	07:41 18:34	07:15 17:03	07:41 17:03	
24	07:38 17:32	07:05 18:09	06:22 18:38	06:34 20:09	06:02 20:38	05:56 20:55	06:14 20:44	06:43 20:08	07:12 19:19	07:42 18:33	07:16 17:02	07:41 17:03	
25	07:37 17:34	07:03 18:10	06:20 18:39	06:33 20:10	06:02 20:39	05:56 20:55	06:15 20:44	06:44 20:06	07:13 19:17	07:43 17:31	07:18 17:02	07:42 17:04	
26	07:37 17:35	07:02 18:11	06:19 18:40	06:32 20:11	06:01 20:40	05:56 20:55	06:16 20:43	06:45 20:05	07:13 19:15	07:44 17:30	07:19 17:01	07:42 17:04	
27	07:36 17:36	07:01 18:12	06:17 18:41	06:30 20:12	06:00 20:40	05:57 20:55	06:17 20:42	06:46 20:03	07:14 19:14	06:45 17:29	07:20 17:01	07:43 17:05	
28	07:35 17:37	06:59 18:13	06:15 18:42	06:29 20:13	06:00 20:41	05:57 20:55	06:18 20:41	06:46 20:02	07:15 19:12	06:46 17:27	07:21 17:01	07:43 17:06	
29	07:34 17:38	07:34 18:13	07:14 19:43	06:28 20:14	05:59 20:42	05:58 20:55	06:19 20:40	06:47 20:00	07:16 19:10	06:47 17:26	07:22 17:00	07:43 17:06	
30	07:34 17:39	07:34 18:13	07:12 19:44	06:26 20:15	05:59 20:43	05:58 20:55	06:19 20:39	06:48 19:59	07:17 19:09	06:48 17:25	07:23 17:00	07:44 17:07	
31	07:33 17:41	07:33 18:13	07:11 19:45	07:11 20:43	05:58 20:43	05:58 20:55	06:20 20:38	06:49 19:57	06:49 17:24	06:49 17:24	07:44 17:07	07:44 17:08	
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292	
Sum of minutes with flicker	0	1	0	0	0	0	0	0	0	2	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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

Via Santa Margherita 4

IT-09124 Cagliari

+39 070 658297

Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG07 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (70) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

#### Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December	
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	05:58 20:55	06:21 20:37	06:50 19:56	07:18 19:07	18:34-18:45/11	06:51 17:22	07:24 17:00
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	05:59 20:55	06:22 20:36	06:51 19:54	07:19 19:05	18:32-18:43/11	06:52 17:21	07:25 16:59
3	07:44 17:11	07:30 17:44	06:55 18:16	17:54-17:55/1	07:06 19:48	06:23 20:18	05:57 20:46	05:59 20:35	06:23 19:53	07:20 19:04	18:31-18:42/11	06:53 17:20	07:26 16:59
4	07:44 17:11	07:29 17:45	06:53 18:17	17:54-17:57/3	07:04 19:49	06:21 20:19	05:56 20:46	06:00 20:54	06:53 20:34	07:21 19:02	18:30-18:40/10	06:54 17:19	07:27 16:59
5	07:44 17:12	07:28 17:47	06:52 18:19	17:53-17:57/4	07:03 19:50	06:20 20:20	05:56 20:47	06:00 20:54	06:54 20:33	07:22 19:01	18:29-18:39/10	06:55 17:18	07:28 16:59
6	07:44 17:13	07:27 17:48	06:50 18:20	17:53-17:59/6	07:01 19:51	06:19 20:21	05:56 20:48	06:01 20:54	06:55 20:32	07:23 18:59	18:29-18:37/8	06:56 17:17	07:29 16:59
7	07:44 17:14	07:26 17:49	06:49 18:21	17:52-18:00/8	06:59 19:52	06:18 20:22	05:56 20:48	06:02 20:54	06:56 20:30	07:24 18:58	18:28-18:35/7	06:57 17:16	07:30 16:59
8	07:44 17:15	07:25 17:50	06:47 18:22	17:52-18:00/8	06:58 19:53	06:17 20:23	05:55 20:49	06:02 20:53	06:57 20:29	07:25 18:56	18:28-18:34/6	06:58 17:15	07:31 16:59
9	07:44 17:16	07:24 17:51	06:46 18:23	17:52-18:02/10	06:56 19:54	06:16 20:24	05:55 20:49	06:03 20:53	06:58 20:28	07:26 18:54	18:28-18:32/4	07:00 17:14	07:31 16:59
10	07:44 17:17	07:23 17:53	06:44 18:24	17:52-18:03/11	06:55 19:55	06:15 20:25	05:55 20:50	06:03 20:53	06:30 20:27	07:27 18:53	18:28-18:31/3	07:01 17:13	07:32 16:59
11	07:44 17:18	07:22 17:54	06:42 18:25	17:53-18:04/11	06:53 19:56	06:13 20:26	05:55 20:50	06:04 20:52	06:30 20:26	07:28 18:51	18:28-18:29/1	07:02 17:12	07:33 16:59
12	07:44 17:19	07:20 17:55	06:41 18:26	17:54-18:05/11	06:52 19:57	06:12 20:27	05:55 20:51	06:05 20:52	06:31 20:24	07:29 18:50		07:03 17:11	07:34 16:59
13	07:43 17:20	07:19 17:56	06:39 18:27	17:56-18:07/11	06:50 19:58	06:11 20:28	05:55 20:51	06:06 20:51	06:32 20:23	07:01 19:37		07:04 17:10	07:35 16:59
14	07:43 17:21	07:18 17:57	06:38 18:28	17:57-18:07/10	06:49 19:59	06:10 20:29	05:55 20:52	06:06 20:51	06:33 20:22	07:02 19:35		07:05 17:09	07:35 16:59
15	07:43 17:22	07:17 17:58	06:36 18:29	17:59-18:08/9	06:47 20:00	06:10 20:30	05:55 20:52	06:07 20:50	06:34 20:20	07:03 19:33		07:06 17:08	07:36 16:59
16	07:42 17:23	07:15 18:00	06:35 18:30		06:46 20:01	06:09 20:31	05:55 20:53	06:08 20:50	06:35 20:19	07:04 19:32		07:08 17:07	07:37 17:00
17	07:42 17:24	07:14 18:01	06:33 18:31		06:44 20:02	06:08 20:32	05:55 20:53	06:08 20:49	06:36 20:18	07:05 19:30		07:09 17:07	07:38 17:00
18	07:41 17:26	07:13 18:02	06:31 18:32		06:43 20:03	06:07 20:33	05:55 20:53	06:09 20:49	06:37 20:16	07:06 19:28		07:10 17:06	07:38 17:00
19	07:41 17:27	07:12 18:03	06:30 18:33		06:41 20:04	06:06 20:33	05:55 20:54	06:10 20:48	06:38 20:15	07:07 19:27		07:11 17:05	07:39 17:01
20	07:40 17:28	07:10 18:04	06:28 18:34		06:40 20:05	06:05 20:34	05:55 20:54	06:11 20:47	06:39 20:14	07:08 19:25		07:12 17:05	07:39 17:01
21	07:40 17:29	07:09 18:05	06:27 18:35		06:38 20:06	06:04 20:35	05:55 20:54	06:12 20:47	06:40 20:12	07:09 19:23		07:13 17:04	07:40 17:02
22	07:39 17:30	07:08 18:06	06:25 18:36		06:37 20:07	06:04 20:36	05:55 20:54	06:12 20:46	06:41 20:11	07:10 19:22		07:14 17:03	07:40 17:02
23	07:39 17:31	07:06 18:08	06:23 18:37		06:36 20:08	06:03 20:37	05:56 20:54	06:13 20:45	06:42 20:09	07:11 19:20		07:15 17:03	07:41 17:03
24	07:38 17:32	07:05 18:09	06:22 18:38		06:34 20:09	06:02 20:38	05:56 20:55	06:14 20:44	06:43 20:08	07:12 19:18		07:16 17:02	07:41 17:03
25	07:37 17:34	07:03 18:10	06:20 18:39		06:33 20:10	06:02 20:39	05:56 20:55	06:15 20:44	06:44 20:06	07:13 19:17		07:18 17:02	07:42 17:04
26	07:37 17:35	07:02 18:11	06:18 18:40		06:31 20:11	06:01 20:40	05:56 20:55	06:16 20:43	06:45 20:05	07:13 19:15		07:19 17:01	07:42 17:04
27	07:36 17:36	07:01 18:12	06:17 18:41		06:30 20:12	06:00 20:40	05:57 20:55	06:17 20:42	06:46 20:03	07:14 19:14		07:20 17:01	07:43 17:05
28	07:35 17:37	06:59 18:13	06:15 18:42		06:29 20:13	06:00 20:41	05:57 20:55	06:18 20:41	06:46 20:02	18:42-18:50/8	06:46 17:27	07:21 17:00	07:43 17:06
29	07:34 17:38		07:14 19:43		06:28 20:14	05:59 20:42	05:58 20:55	06:19 20:40	06:47 20:00	18:38-18:48/10	06:47 17:26	07:22 17:00	07:43 17:06
30	07:34 17:39		07:12 19:44		06:26 20:15	05:59 20:43	05:58 20:55	06:19 20:39	06:48 19:59	18:36-18:47/11	06:48 17:25	07:23 17:00	07:43 17:07
31	07:33 17:41		07:10 19:45			05:58 20:43		06:20 20:38	06:49 19:57		06:49 17:24		07:44 17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292	0
Sum of minutes with flicker	0	0	103	0	0	0	0	0	29	82	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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

Via Santa Margherita 4

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+39 070 658297

Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG08 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (71) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

#### Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December	
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	19:11-20:13/62 20:55	05:58 20:37	19:16-20:21/65 20:37	06:21 19:56	19:44-20:00/16 19:07	06:50 17:22	07:24 16:59
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	19:12-20:13/61 20:55	05:59 20:36	19:16-20:22/66 20:36	06:22 19:54	06:22 19:05	06:51 17:21	07:25 16:59
3	07:44 17:10	07:29 17:44	06:53 18:16	07:04 19:48	06:21 20:18	05:56 20:46	19:11-20:14/63 20:55	06:00 20:35	19:17-20:22/65 20:35	06:24 19:53	06:24 19:04	06:54 17:20	07:27 16:59
4	07:44 17:11	07:28 17:45	06:52 18:17	07:02 19:49	06:20 20:19	05:56 20:46	19:11-20:15/64 20:54	06:00 20:34	19:17-20:21/64 20:34	06:25 19:51	06:25 19:02	06:55 17:19	07:28 16:59
5	07:44 17:12	07:27 17:47	06:50 18:18	07:01 19:50	06:19 20:20	05:56 20:47	19:11-20:15/64 20:54	06:01 20:33	19:18-20:22/64 20:33	06:26 19:49	06:26 19:01	06:56 17:18	07:29 16:59
6	07:44 17:13	07:26 17:48	06:49 18:20	06:59 19:51	06:18 20:21	05:56 20:48	19:12-20:16/64 20:54	06:02 20:32	19:18-20:22/64 20:32	06:27 19:48	06:27 18:59	06:57 17:17	07:30 16:59
7	07:44 17:14	07:25 17:49	06:47 18:21	06:58 19:52	06:17 20:22	05:55 20:48	19:12-20:16/64 20:54	06:02 20:30	19:18-20:21/63 20:30	06:28 19:46	06:28 18:57	06:58 17:16	07:30 16:59
8	07:44 17:15	07:25 17:50	06:47 18:22	06:58 19:53	06:17 20:23	05:55 20:49	19:12-20:16/64 20:53	06:02 20:29	19:18-20:21/63 20:29	06:29 19:45	06:29 18:56	06:59 17:15	07:31 16:59
9	07:44 17:16	07:24 17:51	06:46 18:23	06:56 19:54	06:16 20:24	05:55 20:49	19:11-20:16/65 20:53	06:03 20:28	19:19-20:22/63 20:28	06:29 19:43	06:29 18:54	07:00 17:14	07:31 16:59
10	07:44 17:17	07:23 17:52	06:44 18:24	06:55 19:55	06:14 20:25	05:55 20:50	19:11-20:16/65 20:53	06:03 20:27	19:19-20:21/62 20:27	06:30 19:41	06:30 18:57	07:01 17:13	07:32 16:59
11	07:44 17:18	07:22 17:54	06:42 18:25	06:53 19:56	06:13 20:26	05:55 20:50	19:11-20:17/66 20:52	06:04 20:26	19:19-20:21/62 20:26	06:30 19:40	06:30 18:51	07:02 17:12	07:33 16:59
12	07:44 17:19	07:20 17:55	06:41 18:26	06:52 19:57	06:12 20:27	05:55 20:51	19:12-20:17/65 20:52	06:05 20:24	19:20-20:21/61 20:24	06:31 19:38	06:31 18:59	07:03 17:11	07:34 16:59
13	07:43 17:20	07:19 17:56	06:39 18:27	06:50 19:58	06:11 20:28	05:55 20:51	19:12-20:17/65 20:51	06:05 20:23	19:20-20:20/60 20:23	06:32 19:36	06:32 18:48	07:04 17:10	07:35 16:59
14	07:43 17:21	07:18 17:57	06:38 18:28	06:49 19:59	06:10 20:29	05:55 20:52	19:12-20:18/66 20:52	06:06 20:22	19:21-20:20/59 20:22	06:33 19:35	06:33 18:47	07:05 17:09	07:35 16:59
15	07:43 17:22	07:17 17:58	06:36 18:29	06:47 20:00	06:09 20:30	05:55 20:52	19:12-20:18/66 20:52	06:07 20:20	19:22-20:20/58 20:20	06:34 19:33	06:34 18:45	07:06 17:08	07:36 16:59
16	07:42 17:23	07:15 18:00	06:35 18:30	06:46 20:01	06:09 20:31	05:55 20:53	19:12-20:18/66 20:53	06:08 20:19	19:23-20:20/57 20:19	06:35 19:32	06:35 18:44	07:07 17:07	07:37 17:00
17	07:42 17:24	07:14 18:01	06:33 18:31	06:44 20:02	06:08 20:32	05:55 20:53	19:12-20:18/66 20:53	06:08 20:18	19:22-20:19/57 20:18	06:36 19:30	06:36 18:42	07:08 17:07	07:37 17:00
18	07:41 17:25	07:13 18:02	06:31 18:32	06:43 20:03	06:07 20:33	05:55 20:53	19:12-20:19/67 20:53	06:09 20:16	19:23-20:19/56 20:16	06:37 19:28	06:37 18:41	07:09 17:06	07:38 17:00
19	07:41 17:27	07:12 18:03	06:30 18:33	06:41 20:04	06:06 20:33	05:55 20:54	19:13-20:20/67 20:54	06:10 20:15	19:24-20:18/54 20:15	06:38 19:27	06:38 18:39	07:11 17:05	07:39 17:01
20	07:40 17:28	07:10 18:04	06:28 18:34	06:40 20:05	06:05 20:34	05:55 20:54	19:13-20:20/67 20:54	06:11 20:14	19:25-20:18/53 20:14	06:39 19:25	06:39 18:38	07:12 17:05	07:39 17:01
21	07:40 17:29	07:09 18:05	06:27 18:35	06:38 20:06	06:04 20:35	05:55 20:54	19:13-20:20/67 20:54	06:12 20:12	19:25-20:17/52 20:12	06:40 19:23	06:40 18:37	07:13 17:04	07:40 17:02
22	07:39 17:30	07:08 18:06	06:25 18:36	06:37 20:07	06:04 20:36	05:55 20:54	19:13-20:20/67 20:54	06:12 20:11	19:26-20:16/50 20:11	06:41 19:22	06:41 18:35	07:14 17:03	07:40 17:02
23	07:39 17:31	07:06 18:07	06:23 18:37	06:36 20:08	06:03 20:37	05:56 20:54	19:13-20:20/67 20:54	06:13 20:09	19:27-20:15/48 20:09	06:42 19:20	06:42 18:34	07:15 17:03	07:41 17:03
24	07:38 17:32	07:05 18:09	06:22 18:38	06:34 20:09	06:02 20:38	05:56 20:55	19:14-20:21/67 20:55	06:14 20:08	19:29-20:15/46 20:08	06:43 19:18	06:43 18:32	07:16 17:02	07:41 17:03
25	07:37 17:33	07:03 18:10	06:20 18:39	06:33 20:10	06:01 20:39	05:56 20:55	19:14-20:20/66 20:55	06:15 20:06	19:30-20:14/44 20:06	06:44 19:17	06:44 17:31	07:18 17:02	07:42 17:04
26	07:37 17:35	07:02 18:11	06:18 18:40	06:31 20:11	06:01 20:40	05:56 20:55	19:14-20:20/66 20:55	06:16 20:05	19:31-20:13/42 20:05	06:45 19:15	06:45 17:30	07:19 17:01	07:42 17:04
27	07:36 17:36	07:01 18:12	06:17 18:41	06:30 20:12	06:00 20:40	05:57 20:55	19:15-20:21/66 20:55	06:17 20:03	19:32-20:11/39 20:03	06:45 19:14	06:45 17:29	07:20 17:01	07:43 17:05
28	07:35 17:37	06:59 18:13	06:15 18:42	06:29 20:13	06:00 20:41	05:57 20:55	19:15-20:21/66 20:55	06:18 20:02	19:33-20:09/36 20:02	06:46 19:12	06:46 17:27	07:21 17:00	07:43 17:06
29	07:34 17:38	07:07 18:14	06:14 19:43	06:27 20:14	06:00 20:42	05:58 20:55	19:15-20:21/66 20:55	06:18 20:00	19:35-20:08/33 20:00	06:47 19:10	06:47 17:26	07:22 17:00	07:43 17:06
30	07:34 17:39	07:06 18:15	06:13 19:44	06:26 20:15	06:00 20:43	05:58 20:55	19:16-20:21/65 20:55	06:19 20:39	19:37-20:06/29 19:59	06:48 19:09	06:48 17:25	07:23 17:00	07:43 17:07
31	07:33 17:41	07:05 18:16	06:12 19:45	06:25 20:16	06:00 20:44	05:58 20:55	19:17-20:21/65 20:55	06:20 19:57	19:40-20:03/23 19:57	06:49 19:09	06:49 17:24	07:24 17:01	07:44 17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292	0
Sum of minutes with flicker	0	0	0	0	944	1958	1660	16	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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

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Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG09 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (74) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA SJ]

Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

#### Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	18:51-19:17/26	06:25 20:16	05:58 20:44	05:59 20:55	06:21 20:37	06:50 19:56	07:18 19:07	06:51 17:23
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	18:52-19:16/24	06:24 20:17	05:57 20:45	05:59 20:55	06:22 20:36	06:51 19:54	07:19 19:06	06:52 17:21
3	07:44 17:11	07:30 17:44	06:55 18:16	07:06 19:48	18:53-19:15/22	06:23 20:18	05:57 20:46	06:00 20:55	06:23 20:35	06:52 19:53	07:20 19:04	06:53 17:20
4	07:44 17:12	07:29 17:46	06:53 18:18	07:04 19:49	18:55-19:12/17	06:21 20:19	05:57 20:46	06:00 20:54	06:24 20:34	06:53 19:51	07:21 19:02	06:54 17:19
5	07:44 17:12	07:28 17:47	06:52 18:19	07:03 19:50	18:57-19:10/13	06:20 20:20	05:56 20:47	06:01 20:54	06:25 20:33	06:54 19:50	07:22 19:01	06:55 17:18
6	07:44 17:13	07:27 17:48	06:50 18:20	07:01 19:51		06:19 20:21	05:56 20:48	06:01 20:54	06:26 20:32	06:55 19:48	07:23 18:59	06:56 17:17
7	07:44 17:14	07:26 17:49	06:49 18:21	07:00 19:52		06:18 20:22	05:56 20:48	06:02 20:54	06:27 20:31	06:56 19:46	18:53-19:04/11	07:24 18:58
8	07:44 17:15	07:25 17:50	06:47 18:22	06:58 19:53		06:17 20:23	05:56 20:49	06:02 20:54	06:28 20:29	06:57 19:45	18:50-19:07/17	07:25 18:56
9	07:44 17:16	07:24 17:52	06:46 18:23	06:56 19:54		06:16 20:24	05:55 20:49	06:03 20:53	06:29 20:28	06:58 19:43	18:48-19:09/21	07:26 18:55
10	07:44 17:17	07:23 17:53	06:44 18:24	06:55 19:55		06:15 20:25	05:55 20:50	06:04 20:53	06:30 20:27	06:59 19:42	18:46-19:10/24	07:27 18:53
11	07:44 17:18	07:22 17:54	06:43 18:25	06:53 19:56		06:14 20:26	05:55 20:50	06:04 20:52	06:31 20:26	07:00 19:40	18:44-19:10/26	07:28 18:51
12	07:44 17:19	07:20 17:55	06:41 18:26	06:52 19:57		06:13 20:27	05:55 20:51	06:05 20:52	06:32 20:24	07:01 19:38	18:42-19:10/28	07:29 18:50
13	07:43 17:20	07:19 17:56	06:39 18:27	06:50 19:58		06:12 20:28	05:55 20:51	06:06 20:52	06:33 20:23	07:01 19:37	18:42-19:10/28	07:30 18:48
14	07:43 17:21	07:18 17:57	06:38 18:28	06:49 19:59		06:11 20:29	05:55 20:52	06:06 20:51	06:33 20:22	07:02 19:35	18:41-19:11/30	07:31 18:47
15	07:43 17:22	07:17 17:59	06:36 18:29	06:47 20:00		06:10 20:30	05:55 20:52	06:07 20:51	06:34 20:21	07:03 19:33	18:40-19:11/31	07:32 18:45
16	07:42 17:23	07:16 18:00	06:35 18:30	06:46 20:01		06:09 20:31	05:55 20:53	06:08 20:50	06:35 20:19	07:04 19:32	18:40-19:10/30	07:33 18:44
17	07:42 17:25	07:14 18:01	06:33 18:31	06:44 20:02		06:08 20:32	05:55 20:53	06:09 20:49	06:36 20:18	07:05 19:30	18:40-19:08/28	07:34 18:42
18	07:42 17:26	07:13 18:02	06:31 18:32	18:03-18:12/9	06:43 20:03	06:07 20:33	05:55 20:53	06:09 20:49	06:37 20:16	07:06 19:28	18:39-19:07/28	07:35 18:41
19	07:41 17:27	07:12 18:03	06:30 18:33	17:59-18:13/14	06:41 20:04	06:06 20:34	05:55 20:54	06:10 20:48	06:38 20:15	07:07 19:27	18:39-19:05/26	07:36 18:40
20	07:41 17:28	07:10 18:04	06:28 18:34	17:57-18:13/16	06:40 20:05	06:05 20:34	05:55 20:54	06:11 20:47	06:39 20:14	07:08 19:25	18:40-19:04/24	07:38 18:38
21	07:40 17:29	07:09 18:05	06:27 18:35	17:56-18:15/19	06:39 20:06	06:05 20:35	05:55 20:54	06:12 20:47	06:40 20:12	07:09 19:24	18:39-19:01/22	07:39 18:37
22	07:39 17:30	07:08 18:07	06:25 18:36	17:54-18:15/21	06:37 20:07	06:04 20:36	05:56 20:54	06:13 20:46	06:41 20:11	07:10 19:22	18:40-19:00/20	07:40 18:35
23	07:39 17:31	07:06 18:08	06:23 18:37	17:54-18:17/23	06:36 20:08	06:03 20:37	05:56 20:55	06:13 20:45	06:42 20:09	07:11 19:20	18:41-18:58/17	07:41 18:34
24	07:38 17:33	07:05 18:09	06:22 18:38	17:52-18:18/26	06:34 20:09	06:02 20:38	05:56 20:55	06:14 20:44	06:43 20:08	07:12 19:19	18:42-18:56/14	07:42 18:33
25	07:37 17:34	07:03 18:10	06:20 18:39	17:51-18:18/27	06:33 20:10	06:02 20:39	05:56 20:55	06:15 20:44	06:44 20:06	07:13 19:17	18:44-18:55/11	06:43 17:31
26	07:37 17:35	07:02 18:11	06:19 18:40	17:51-18:20/29	06:32 20:11	06:01 20:40	05:57 20:55	06:16 20:43	06:45 20:05	07:14 19:15	18:48-18:53/5	06:44 17:30
27	07:36 17:36	07:01 18:12	06:17 18:41	17:51-18:20/29	06:30 20:12	06:00 20:40	05:57 20:55	06:17 20:42	06:46 20:03	07:15 19:14		06:45 17:29
28	07:35 17:37	06:59 18:13	06:15 18:42	17:50-18:20/30	06:29 20:13	06:00 20:41	05:57 20:55	06:18 20:41	06:47 20:02	07:15 19:12		06:46 17:27
29	07:34 17:38		07:14 19:43	18:51-19:20/29	06:28 20:14	05:59 20:42	05:58 20:55	06:19 20:40	06:48 20:00	07:16 19:10		06:47 17:26
30	07:34 17:40		07:12 19:44	18:50-19:19/29	06:26 20:15	05:59 20:43	05:58 20:55	06:20 20:39	06:48 19:59	07:17 19:09		06:48 17:25
31	07:33 17:41		07:11 19:45	18:51-19:19/28		05:58 20:43		06:20 20:38	06:49 19:57			06:49 17:24
Potential sun hours	301	299	370	397	445	448	455	425	374	441	347	301
Sum of minutes with flicker	0	0	329	102	0	0	0	0	0	441	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:

Progetto\_Vestas\_Escalaplano

Licensed user:

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Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG10 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (72) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

#### Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	05:59 20:55	06:21 20:37	06:50 19:56	07:18 19:07	06:51 17:22	16:45-17:00/15 17:00
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	05:59 20:55	06:22 20:36	06:51 19:54	07:19 19:06	06:52 17:21	16:47-16:58/11 16:59
3	07:44 17:11	07:30 17:44	06:55 18:16	07:06 19:48	06:23 20:18	05:57 20:46	06:00 20:55	06:23 20:35	06:52 19:53	07:20 19:04	06:53 17:20	16:49-16:57/8 16:59
4	07:44 17:12	07:29 17:46	06:53 18:18	07:04 19:49	06:21 20:19	05:57 20:46	06:00 20:54	06:24 20:34	06:53 19:51	07:21 19:02	06:54 17:19	16:52-16:56/4 16:59
5	07:44 17:12	07:28 17:47	06:52 18:19	07:03 19:50	06:20 20:20	05:56 20:47	06:01 20:54	06:25 20:33	06:54 19:50	07:22 19:01	06:55 17:18	16:59 16:59
6	07:44 17:13	07:27 17:48	06:50 18:20	07:01 19:51	06:19 20:21	05:56 20:48	06:01 20:54	06:26 20:32	06:55 19:48	07:23 18:59	06:56 17:17	16:59 16:59
7	07:44 17:14	07:26 17:49	06:49 18:21	06:59 19:52	06:18 20:22	05:56 20:48	06:02 20:54	06:27 20:30	06:56 19:46	07:24 18:58	06:57 17:16	16:59 16:59
8	07:44 17:15	07:25 17:50	06:47 18:22	06:58 19:53	06:17 20:23	05:55 20:49	06:02 20:53	06:28 20:29	06:57 19:45	07:25 18:56	06:58 17:15	16:59 16:59
9	07:44 17:16	07:24 17:51	06:46 18:23	06:56 19:54	06:16 20:24	05:55 20:49	06:03 20:53	06:29 20:28	06:58 19:43	07:26 18:54	07:00 17:14	16:59 16:59
10	07:44 17:17	07:23 17:53	06:44 18:24	06:55 19:55	06:15 20:25	05:55 20:50	06:04 20:53	06:30 20:27	06:59 19:41	07:27 18:53	07:01 17:13	16:59 16:59
11	07:44 17:18	07:22 17:54	06:43 18:25	06:53 19:56	06:14 20:26	05:55 20:50	06:04 20:52	06:31 20:26	07:00 19:40	07:28 18:51	07:02 17:12	16:59 16:59
12	07:44 17:19	07:20 17:55	06:41 18:26	06:52 19:57	06:13 20:27	05:55 20:51	06:05 20:52	06:32 20:24	07:00 19:38	07:29 18:50	07:03 17:11	16:59 16:59
13	07:43 17:20	07:19 17:56	06:39 18:27	06:50 19:58	06:12 20:28	05:55 20:51	06:06 20:52	06:32 20:23	07:01 19:37	07:30 18:48	07:04 17:10	16:59 16:59
14	07:43 17:21	07:18 17:57	06:38 18:28	06:49 19:59	06:11 20:29	05:55 20:52	06:06 20:51	06:33 20:22	07:02 19:35	07:31 18:47	07:05 17:09	16:59 16:59
15	07:43 17:22	07:17 17:59	06:36 18:29	06:47 20:00	06:10 20:30	05:55 20:52	06:07 20:51	06:34 20:20	07:03 19:33	07:32 18:45	17:52-18:02/10 17:08	16:59 16:59
16	07:42 17:23	07:16 18:00	06:35 18:30	06:46 20:01	06:09 20:31	05:55 20:53	06:08 20:50	06:35 20:19	07:04 19:32	07:33 18:44	17:49-18:05/16 17:08	16:59 16:59
17	07:42 17:25	07:14 18:01	06:33 18:31	06:44 20:02	06:08 20:32	05:55 20:53	06:09 20:49	06:36 20:18	07:05 19:30	07:34 18:42	17:47-18:06/19 17:07	16:59 16:59
18	07:41 17:26	07:13 18:02	06:31 18:32	06:43 20:03	06:07 20:33	05:55 20:53	06:09 20:49	06:37 20:16	07:06 19:28	07:35 18:41	17:45-18:07/22 17:06	16:59 16:59
19	07:41 17:27	07:12 18:03	06:30 18:33	06:41 20:04	06:06 20:34	05:55 20:54	06:10 20:48	06:38 20:15	07:07 19:27	07:36 18:40	17:43-18:08/25 17:05	16:59 16:59
20	07:41 17:28	07:10 18:04	06:28 18:34	06:40 20:05	06:05 20:34	05:55 20:54	06:11 20:47	06:39 20:14	07:08 19:25	07:37 18:38	17:43-18:10/27 17:05	16:59 16:59
21	07:40 17:29	07:09 18:05	06:27 18:35	06:38 20:06	06:05 20:35	05:55 20:54	06:12 20:47	06:40 20:12	07:09 19:23	07:39 18:37	17:42-18:10/28 17:04	16:59 16:59
22	07:39 17:30	07:08 18:07	06:25 18:36	06:37 20:07	06:04 20:36	05:56 20:54	06:13 20:46	06:41 20:11	07:10 19:22	07:40 18:35	17:42-18:10/28 17:03	16:59 16:59
23	07:39 17:31	07:06 18:08	06:23 18:37	06:36 20:08	06:03 20:37	05:56 20:55	06:13 20:45	06:42 20:09	07:11 19:20	07:41 18:34	17:41-18:10/29 17:03	16:59 16:59
24	07:38 17:33	07:05 18:09	06:22 18:38	06:34 20:09	06:02 20:38	05:56 20:55	06:14 20:44	06:43 20:08	07:12 19:19	07:42 18:33	17:41-18:10/29 17:02	16:59 16:59
25	07:37 17:34	07:03 18:10	06:20 18:39	06:33 20:10	06:02 20:39	05:56 20:55	06:15 20:44	06:44 20:06	07:13 19:17	06:43 17:31	16:41-17:08/27 17:02	16:59 16:59
26	07:37 17:35	07:02 18:11	06:19 18:40	06:32 20:11	06:01 20:40	05:57 20:55	06:16 20:43	06:45 20:05	07:14 19:15	06:44 17:30	16:40-17:07/27 17:01	16:59 16:59
27	07:36 17:36	07:01 18:12	06:17 18:41	06:30 20:12	06:00 20:40	05:57 20:55	06:17 20:42	06:46 20:03	07:14 19:14	06:45 17:29	16:41-17:06/25 17:01	16:59 16:59
28	07:35 17:37	06:59 18:13	06:15 18:42	06:29 20:13	06:00 20:41	05:57 20:55	06:18 20:41	06:47 20:02	07:15 19:12	06:46 17:27	16:42-17:05/23 17:01	16:59 16:59
29	07:34 17:38	07:00 18:00	06:14 18:40	06:28 20:14	05:59 20:42	05:58 20:55	06:19 20:40	06:47 20:00	07:16 19:10	06:47 17:26	16:42-17:03/21 17:00	16:59 16:59
30	07:34 17:40	07:00 18:00	06:14 18:40	06:28 20:14	05:59 20:42	05:58 20:55	06:20 20:39	06:48 19:59	07:17 19:09	06:48 17:25	16:43-17:02/19 17:00	16:59 16:59
31	07:33 17:41	07:00 18:00	06:14 18:40	06:28 20:14	05:59 20:42	05:58 20:55	06:20 20:38	06:49 19:57	07:18 17:24	06:49 17:24	16:43-17:00/17 17:00	16:59 16:59
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
Sum of minutes with flicker	0	423	0	0	0	0	0	0	0	392	38	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:

Progetto\_Vestas\_Escalaplano

Licensed user:

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Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG11 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (73) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44	07:32	06:58	07:09	06:25	05:58	05:58	06:21	06:50	07:18	06:51	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:05	17:21	16:59
3	07:44	07:30	06:55	07:06	06:23	05:57	05:59	06:23	06:52	07:20	06:53	07:26
	17:11	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:45	18:17	19:49	20:19	20:46	20:54	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:03	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:19	19:50	20:20	20:47	20:54	20:33	19:49	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	06:59	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:30	19:46	18:58	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:58	07:31
	17:15	17:50	18:22	19:53	20:23	20:49	20:53	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:31
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:59
10	07:44	07:23	06:44	06:55	06:15	05:55	06:04	06:30	06:59	07:27	07:01	07:32
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:41	18:53	17:13	16:59
11	07:44	07:22	06:42	06:53	06:14	05:55	06:04	06:31	06:59	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	18:51	17:12	16:59
12	07:44	07:20	06:41	06:52	06:12	05:55	06:05	06:31	07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:11	05:55	06:06	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:51	20:23	19:37	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:11	05:55	06:06	06:33	07:02	07:31	07:05	07:35
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:10	05:55	06:07	06:34	07:03	07:32	07:06	07:36
	17:22	17:58	18:29	20:00	20:30	20:52	20:50	20:20	19:33	18:45	17:08	16:59
16	07:42	07:15	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:08	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:09	06:36	07:05	07:34	07:09	07:38
	17:24	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:41	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:26	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:33	20:54	20:48	20:15	19:27	18:39	17:05	17:01
20	07:40	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:37	07:12	07:39
	17:28	18:04	18:34	20:05	20:34	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:27	06:38	06:04	05:55	06:12	06:40	07:09	07:38	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:23	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:13	06:41	07:10	07:40	07:14	07:40
	17:30	18:06	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41
	17:31	18:08	18:37	20:08	20:37	20:54	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:16	07:41
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:18	18:33	17:02	17:03
25	07:37	07:03	06:20	06:33	06:02	05:56	06:15	06:44	07:13	06:43	07:18	07:42
	17:34	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:19	06:32	06:01	05:56	06:16	06:45	07:13	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:46	07:14	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:29	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:46	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06
29	07:34		07:14	06:28	05:59	05:58	06:19	06:47	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:19	06:48	07:17	06:48	07:23	07:43
	17:39		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:10		05:58		06:20	06:49		06:49		07:44
	17:41		19:45		20:43		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

Via Santa Margherita 4

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+39 070 658297

Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

17/03/2023 17:07/3.4.415

### SHADOW - Calendar per WTG

Calculation: Real\_case\_2023\_03\_17WTG: AG12 - VESTAS V162-6.0 6000 162.0 IO! hub: 125,0 m (TOT: 206,0 m) (76) Sunshine probability S (Average daily sunshine hours) [CAGLIARI / ELMA S]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
4,40 5,05 5,88 7,00 8,45 9,88 10,82 10,03 8,08 6,09 5,07 4,27

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
93 283 496 514 286 79 35 35 214 1.318 3.577 570 7.500

| January | February | March | April | May | June | July | August | September | October | November | December

1	07:44	07:32	06:58	07:09	06:25	05:58	05:58	06:21	06:50	07:18	06:50	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	16:59
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:05	17:21	16:59
3	07:44	07:30	06:55	07:06	06:22	05:57	05:59	06:23	06:52	07:20	06:53	07:26
	17:10	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:56	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:45	18:17	19:49	20:19	20:46	20:54	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:02	06:20	05:56	06:00	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:18	19:50	20:20	20:47	20:54	20:33	19:49	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:47	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	06:59	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:30	19:46	18:57	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:58	07:30
	17:15	17:50	18:22	19:53	20:23	20:49	20:53	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:45	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:31
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:59
10	07:44	07:23	06:44	06:55	06:14	05:55	06:03	06:29	06:58	07:27	07:01	07:32
	17:17	17:52	18:24	19:55	20:25	20:50	20:53	20:27	19:41	18:53	17:13	16:59
11	07:44	07:21	06:42	06:53	06:13	05:55	06:04	06:30	06:59	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	18:51	17:12	16:59
12	07:43	07:20	06:41	06:52	06:12	05:55	06:05	06:31	07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:11	05:55	06:05	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:51	20:23	19:36	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:10	05:55	06:06	06:33	07:02	07:31	07:05	07:35
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:09	05:55	06:07	06:34	07:03	07:32	07:06	07:36
	17:22	17:58	18:29	20:00	20:30	20:52	20:50	20:20	19:33	18:45	17:08	16:59
16	07:42	07:15	06:34	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:07	07:37
	17:23	17:59	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:07	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:08	06:36	07:05	07:34	07:09	07:37
	17:24	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:41	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:25	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:33	20:54	20:48	20:15	19:27	18:39	17:05	17:01
20	07:40	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:37	07:12	07:39
	17:28	18:04	18:34	20:05	20:34	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:26	06:38	06:04	05:55	06:12	06:40	07:09	07:38	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:23	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:12	06:41	07:10	07:39	07:14	07:40
	17:30	18:06	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41
	17:31	18:07	18:37	20:08	20:37	20:54	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:16	07:41
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:18	18:32	17:02	17:03
25	07:37	07:03	06:20	06:33	06:01	05:56	06:15	06:44	07:12	06:43	07:17	07:42
	17:33	18:10	18:39	20:10	20:39	20:55	20:43	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:18	06:31	06:01	05:56	06:16	06:45	07:13	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:39	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:00	06:17	06:30	06:00	05:57	06:17	06:45	07:14	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:28	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:46	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:00	17:06
29	07:34		07:14	06:27	05:59	05:58	06:18	06:47	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:19	06:48	07:17	06:48	07:23	07:43
	17:39		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:10		05:58		06:20	06:49		06:49		07:44
	17:41		19:45		20:43		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

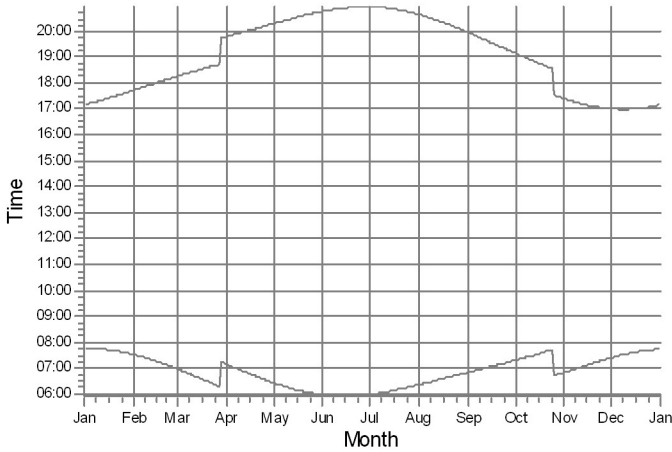
Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) 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

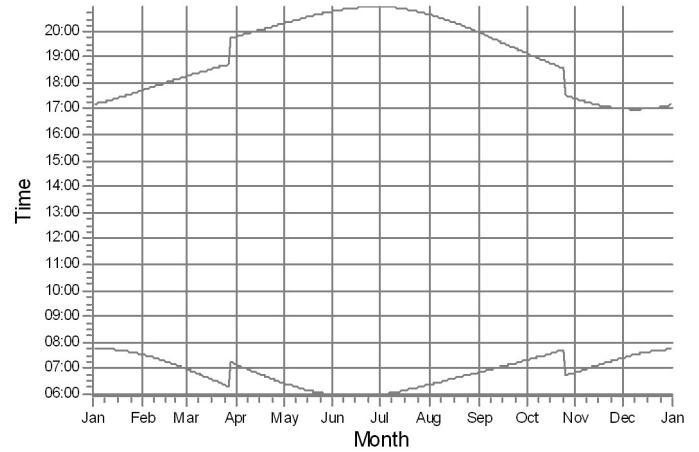
## SHADOW - Calendar per WTG, graphical

Calculation: Real\_case\_2023\_03\_17

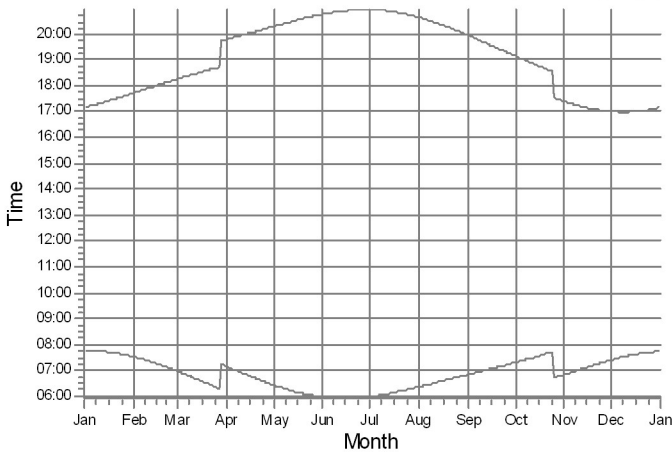
AG01: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (6€



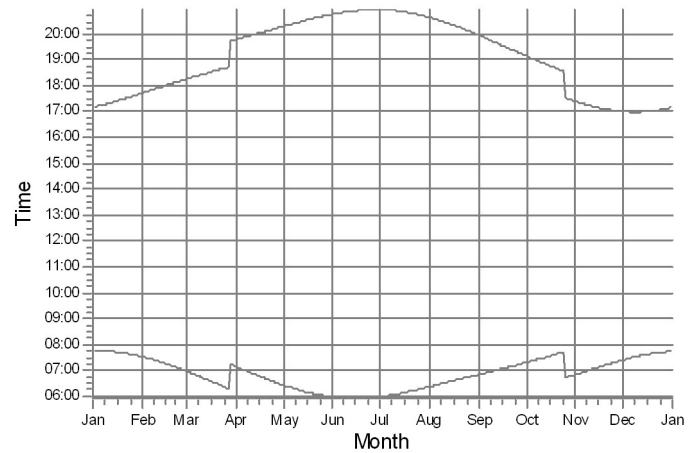
AG02: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (6€



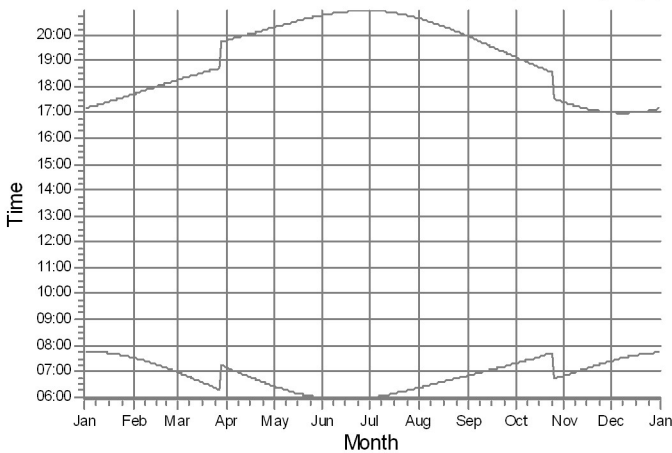
AG03: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (6€



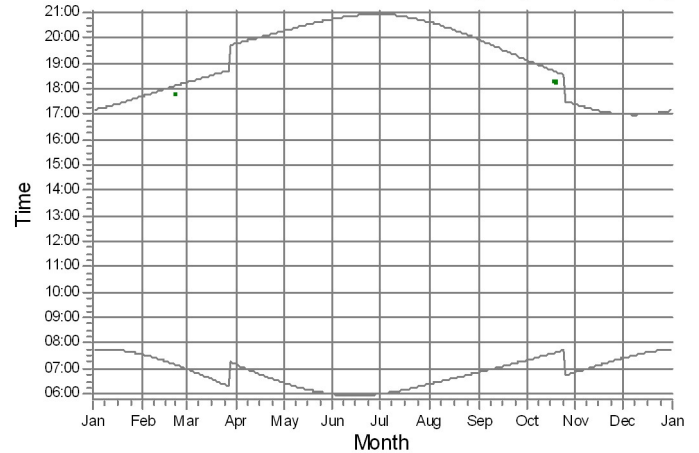
AG04: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (67



AG05: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (6€



AG06: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (75



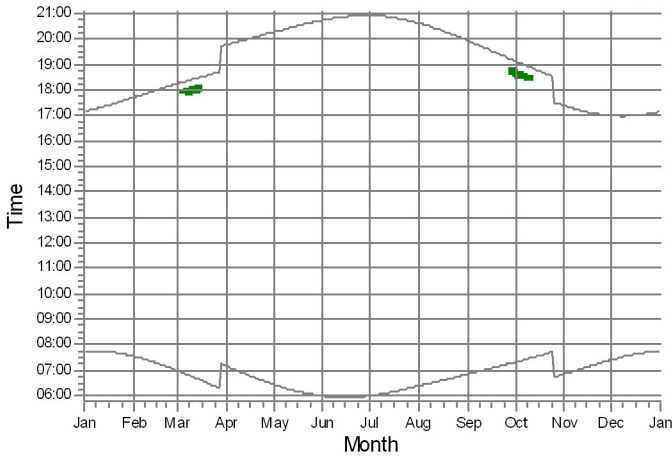
Shadow receptors

 F19: D10-A4

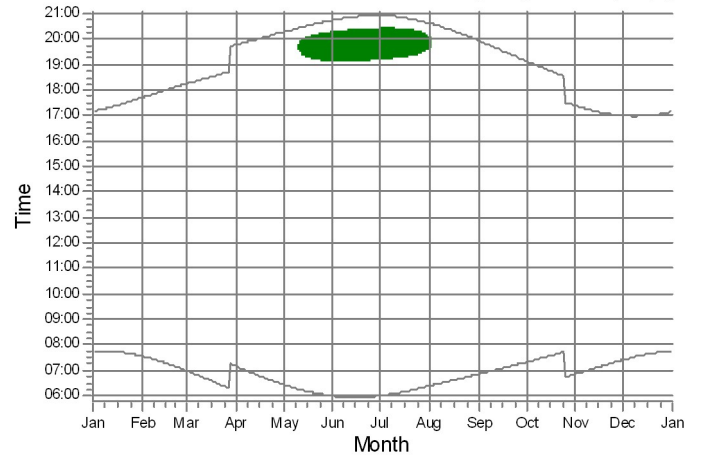
## SHADOW - Calendar per WTG, graphical

Calculation: Real\_case\_2023\_03\_17

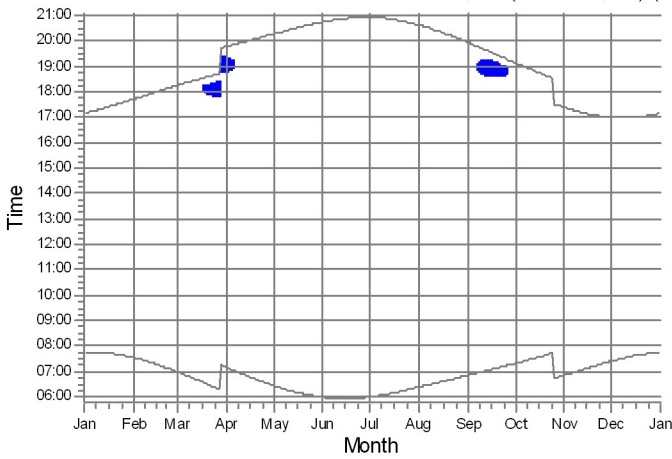
AG07: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (70)



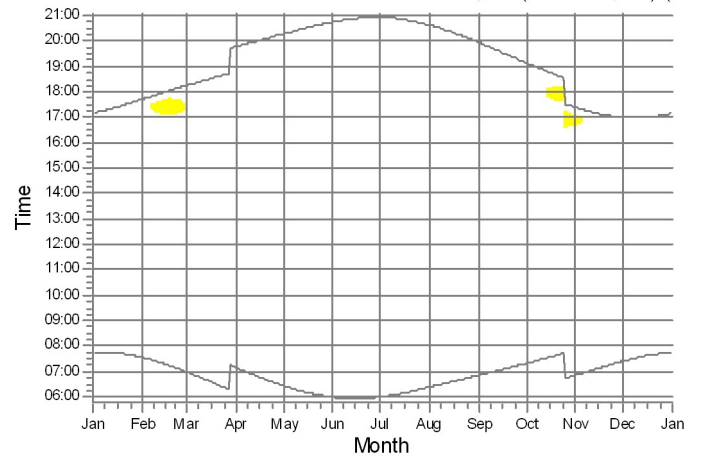
AG08: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (71)



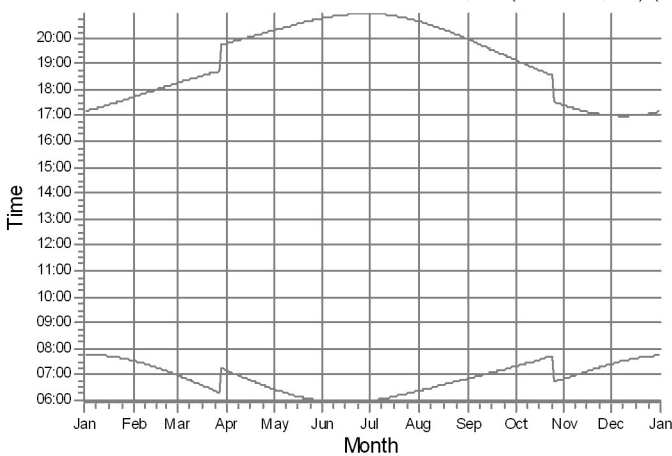
AG09: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (72)



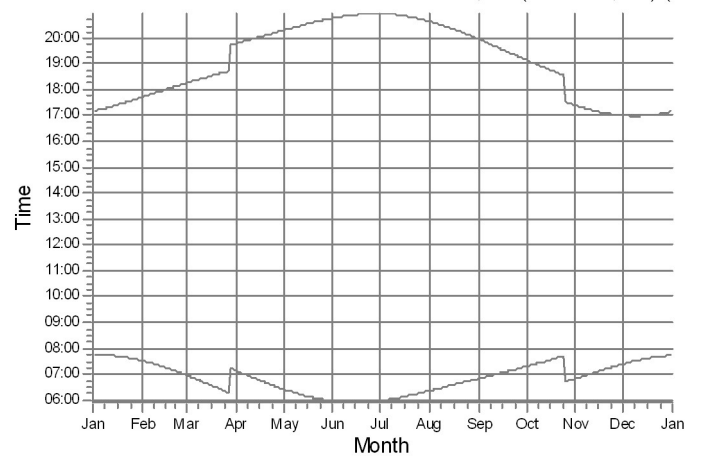
AG10: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (73)



AG11: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (74)



AG12: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (75)



Shadow receptors

- F19: D10-A4
- F26: pascolo
- F49: D03-A03

Project:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

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Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

20/03/2023 10:00/3.4.415

## SHADOW - Main Result

Calculation: Progetto\_layout\_2023\_03\_17

### 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

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

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\_Progetto\_Vestas\_Escalaplano

Obstacles used in calculation

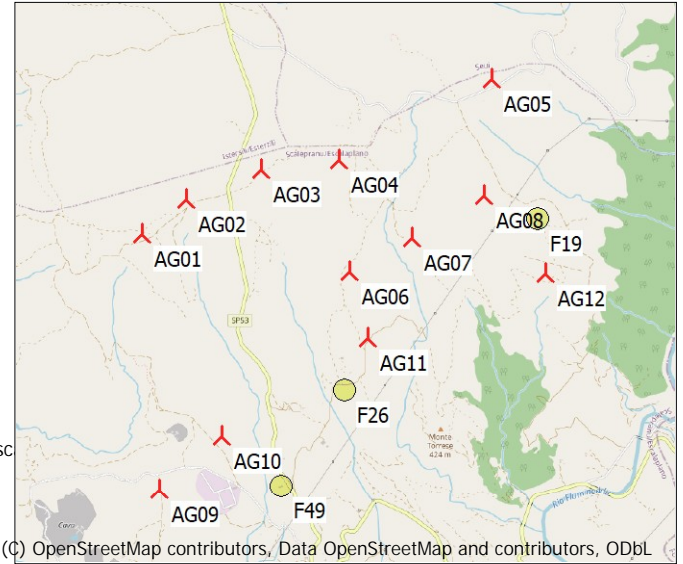
Eye height for map: 1,5 m

Grid resolution: 1,0 m

All coordinates are in

Italian Gauss-Boaga west-ROMA40 (IT-peninsular <±4m)

### WTGs



(C) OpenStreetMap contributors, Data OpenStreetMap and contributors, ODbL

Scale 1:75.000

▲ New WTG

● Shadow receptor

	Easting	Northing	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
			[m]									
AG01	1.528.883	4.392.340	604,6	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG02	1.529.321	4.392.679	604,3	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG03	1.530.063	4.392.975	588,9	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG04	1.530.839	4.393.081	575,7	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG05	1.532.347	4.393.885	661,4	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG06	1.530.947	4.391.972	522,0	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG07	1.531.560	4.392.311	529,3	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG08	1.532.280	4.392.734	618,0	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG09	1.529.063	4.389.808	441,8	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG10	1.529.685	4.390.338	469,2	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG11	1.531.132	4.391.319	490,1	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0
AG12	1.532.896	4.391.958	580,0	VESTAS V162-6.0 6000 162.0...	Yes	VESTAS	V162-6.0-6.000	6.000	162,0	125,0	2.044	0,0

### Shadow receptor-Input

No.	Name	Easting	Northing	Z	Width	Height	Elevation	Slope of	Direction mode	Eye height
				[m]	[m]	[m]	a.g.l. [m]	window [°]		(ZVI) a.g.l. [m]
F19	D10-A4	1.532.812	4.392.504	618,0	1,2	1,4	1,2	90,0	"Green house mode"	2,6
F26	pascolo	1.530.904	4.390.798	464,2	1,2	1,4	1,2	90,0	"Green house mode"	2,6
F49	D03-A03	1.530.275	4.389.846	440,0	1,2	1,4	1,2	90,0	"Green house mode"	2,6

### Calculation Results

#### Shadow receptor

Shadow, worst case

No.	Name	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
F19	D10-A4	79:55	113	1:07
F26	pascolo	14:13	42	0:29
F49	D03-A03	14:32	39	0:31

Project:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

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+39 070 658297

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Calculated:

20/03/2023 10:00/3.4.415

## SHADOW - Main Result

Calculation: Progetto\_layout\_2023\_03\_17

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

No.	Name	Worst case [h/year]
AG01	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (65)	0:00
AG02	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (69)	0:00
AG03	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (66)	0:00
AG04	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (67)	0:00
AG05	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (68)	0:00
AG06	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (75)	0:03
AG07	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (70)	3:34
AG08	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (71)	76:18
AG09	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (74)	14:32
AG10	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (72)	14:13
AG11	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (73)	0:00
AG12	VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (76)	0:00

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

## SHADOW - Calendar

Calculation: Progetto\_layout\_2023\_03\_17Shadow receptor: F19 - D10-A4

### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June			
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	19:11 (AG08) 62 20:13 (AG08)		
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	19:12 (AG08) 61 20:13 (AG08)		
3	07:44 17:10	07:30 17:44	06:55 18:16	17:54 (AG07) 17:55 (AG07)	07:06 19:48	06:22 20:18	05:57 20:46	19:12 (AG08) 62 20:14 (AG08)	
4	07:44 17:11	07:29 17:45	06:53 18:17	17:54 (AG07) 17:57 (AG07)	07:04 19:49	06:21 20:19	05:56 20:46	19:11 (AG08) 63 20:14 (AG08)	
5	07:44 17:12	07:28 17:47	06:52 18:18	17:53 (AG07) 17:57 (AG07)	07:02 19:50	06:20 20:20	05:56 20:47	19:11 (AG08) 64 20:15 (AG08)	
6	07:44 17:13	07:27 17:48	06:50 18:20	17:53 (AG07) 17:59 (AG07)	07:01 19:51	06:19 20:21	05:56 20:48	19:11 (AG08) 64 20:15 (AG08)	
7	07:44 17:14	07:26 17:49	06:49 18:21	17:52 (AG07) 18:00 (AG07)	06:59 19:52	06:18 20:22	05:56 20:48	19:12 (AG08) 64 20:16 (AG08)	
8	07:44 17:15	07:25 17:50	06:47 18:22	17:52 (AG07) 18:00 (AG07)	06:58 19:53	06:17 20:23	05:55 20:49	19:12 (AG08) 64 20:16 (AG08)	
9	07:44 17:16	07:24 17:51	06:45 18:23	17:52 (AG07) 18:02 (AG07)	06:56 19:54	06:16 20:24	05:55 20:49	19:11 (AG08) 65 20:16 (AG08)	
10	07:44 17:17	07:23 17:52	06:44 18:24	17:52 (AG07) 18:03 (AG07)	06:55 19:55	06:14 20:25	05:55 20:50	19:11 (AG08) 65 20:16 (AG08)	
11	07:44 17:18	07:21 17:54	06:42 18:25	17:53 (AG07) 18:04 (AG07)	06:53 19:56	06:13 20:26	19:37 (AG08) 05:55	19:11 (AG08) 66 20:17 (AG08)	
12	07:43 17:19	07:20 17:55	06:41 18:26	17:54 (AG07) 18:05 (AG07)	06:52 19:57	06:12 20:27	19:32 (AG08) 19 19:51 (AG08)	05:55 20:51	19:12 (AG08) 65 20:17 (AG08)
13	07:43 17:20	07:19 17:56	06:39 18:27	17:56 (AG07) 18:07 (AG07)	06:50 19:58	06:11 20:28	19:28 (AG08) 26 19:54 (AG08)	05:55 20:51	19:12 (AG08) 65 20:17 (AG08)
14	07:43 17:21	07:18 17:57	06:38 18:28	17:57 (AG07) 18:07 (AG07)	06:49 19:59	06:10 20:29	19:26 (AG08) 30 19:56 (AG08)	05:55 20:52	19:12 (AG08) 66 20:18 (AG08)
15	07:43 17:22	07:17 17:58	06:36 18:29	17:59 (AG07) 18:08 (AG07)	06:47 20:00	06:09 20:30	19:24 (AG08) 34 19:58 (AG08)	05:55 20:52	19:12 (AG08) 66 20:18 (AG08)
16	07:42 17:23	07:15 17:59	06:34 18:30	18:08 (AG07)	06:46 20:01	06:09 20:31	19:22 (AG08) 37 19:59 (AG08)	05:55 20:53	19:12 (AG08) 66 20:18 (AG08)
17	07:42 17:24	07:14 18:01	06:33 18:31	18:08 (AG07)	06:44 20:02	06:08 20:32	19:20 (AG08) 41 20:01 (AG08)	05:55 20:53	19:12 (AG08) 66 20:18 (AG08)
18	07:41 17:25	07:13 18:02	06:31 18:32	18:08 (AG07)	06:43 20:03	06:07 20:33	19:20 (AG08) 43 20:03 (AG08)	05:55 20:53	19:12 (AG08) 67 20:19 (AG08)
19	07:41 17:27	07:12 18:03	06:30 18:33	18:08 (AG07)	06:41 20:04	06:06 20:33	19:19 (AG08) 45 20:04 (AG08)	05:55 20:54	19:13 (AG08) 67 20:20 (AG08)
20	07:40 17:28	07:10 18:04	06:28 18:34	18:08 (AG07)	06:40 20:05	06:05 20:34	19:17 (AG08) 48 20:05 (AG08)	05:55 20:54	19:13 (AG08) 67 20:20 (AG08)
21	07:40 17:29	07:09 18:05	06:26 18:35	18:08 (AG07)	06:38 20:06	06:04 20:35	19:16 (AG08) 49 20:05 (AG08)	05:55 20:54	19:13 (AG08) 67 20:20 (AG08)
22	07:39 17:30	07:08 18:06	06:25 17:44 (AG06) 17:45 (AG06)	18:35	06:37 20:07	06:04 20:36	19:16 (AG08) 51 20:07 (AG08)	05:55 20:54	19:13 (AG08) 67 20:20 (AG08)
23	07:39 17:31	07:06 18:07	06:23 18:37	18:35	06:36 20:08	06:03 20:37	19:15 (AG08) 52 20:07 (AG08)	05:56 20:54	19:13 (AG08) 67 20:20 (AG08)
24	07:38 17:32	07:05 18:09	06:22 18:38	18:35	06:34 20:09	06:02 20:38	19:14 (AG08) 54 20:08 (AG08)	05:56 20:55	19:14 (AG08) 67 20:21 (AG08)
25	07:37 17:33	07:03 18:10	06:20 18:39	18:35	06:33 20:10	06:01 20:39	19:14 (AG08) 55 20:09 (AG08)	05:56 20:55	19:14 (AG08) 66 20:20 (AG08)
26	07:37 17:35	07:02 18:11	06:18 18:40	18:35	06:31 20:11	06:01 20:39	19:13 (AG08) 56 20:09 (AG08)	05:56 20:55	19:14 (AG08) 66 20:20 (AG08)
27	07:36 17:36	07:00 18:12	06:17 18:41	18:35	06:30 20:12	06:00 20:40	19:13 (AG08) 58 20:11 (AG08)	05:57 20:55	19:15 (AG08) 66 20:21 (AG08)
28	07:35 17:37	06:59 18:13	06:15 18:42	18:35	06:29 20:13	06:00 20:41	19:13 (AG08) 58 20:11 (AG08)	05:57 20:55	19:15 (AG08) 66 20:21 (AG08)
29	07:34 17:38		07:14 19:43	18:35	06:27 20:14	05:59 20:42	19:13 (AG08) 59 20:12 (AG08)	05:57 20:55	19:15 (AG08) 66 20:21 (AG08)
30	07:34 17:39		07:12 19:44	18:35	06:26 20:15	05:59 20:43	19:12 (AG08) 60 20:12 (AG08)	05:58 20:55	19:16 (AG08) 65 20:21 (AG08)
31	07:33 17:41		07:10 19:45	18:35		05:58 20:43	19:12 (AG08) 61 20:13 (AG08)		
Potential sun hours	301	299	370	397	445	61	448	1958	
Total, worst case		1	103		944				

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

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

Calculation: Progetto\_layout\_2023\_03\_17Shadow receptor: F19 - D10-A4

### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	July	August	September	October	November	December
1	05:58	19:16 (AG08)	06:21	19:44 (AG08)	06:50	07:24
	20:55	65	20:21 (AG08)	20:37	19:56	17:22
	20:55	65	19:16 (AG08)	06:22	06:51	16:59
2	05:59	19:16 (AG08)	06:22	19:54	07:19	18:32 (AG07)
	20:55	66	20:22 (AG08)	20:36	19:05	11
	20:55	65	19:16 (AG08)	06:23	06:52	18:43 (AG07)
3	05:59	19:16 (AG08)	06:23	19:53	07:20	18:31 (AG07)
	20:55	65	20:21 (AG08)	20:35	19:04	11
	20:55	65	19:16 (AG08)	06:23	06:52	06:53
4	06:00	19:17 (AG08)	06:24	19:53	19:04	11
	20:54	65	20:22 (AG08)	20:34	06:53	18:42 (AG07)
	20:54	65	19:17 (AG08)	06:25	06:53	17:20
5	06:00	19:17 (AG08)	06:25	19:51	07:21	18:30 (AG07)
	20:54	64	20:21 (AG08)	20:33	19:02	10
	20:54	64	19:18 (AG08)	06:26	06:54	18:40 (AG07)
6	06:01	19:18 (AG08)	06:26	19:49	07:22	18:29 (AG07)
	20:54	64	20:22 (AG08)	20:32	06:54	06:55
	20:54	64	19:18 (AG08)	06:27	06:54	07:28
7	06:02	19:18 (AG08)	06:27	19:48	19:01	10
	20:54	64	20:22 (AG08)	20:30	06:55	18:39 (AG07)
	20:54	64	19:18 (AG08)	06:28	06:55	17:18
8	06:02	19:18 (AG08)	06:28	19:48	07:23	18:29 (AG07)
	20:53	63	20:21 (AG08)	20:29	18:59	8
	20:53	63	19:19 (AG08)	06:29	06:56	18:37 (AG07)
9	06:03	19:19 (AG08)	06:29	19:45	07:24	18:28 (AG07)
	20:53	63	20:22 (AG08)	20:28	18:57	7
	20:53	63	19:19 (AG08)	06:29	06:56	18:35 (AG07)
10	06:03	19:19 (AG08)	06:29	19:43	07:25	18:28 (AG07)
	20:53	62	20:21 (AG08)	20:27	06:57	6
	20:53	62	19:19 (AG08)	06:30	06:57	18:34 (AG07)
11	06:04	19:19 (AG08)	06:30	19:40	07:26	18:28 (AG07)
	20:52	62	20:21 (AG08)	20:26	18:54	1
	20:52	62	19:20 (AG08)	06:31	07:27	18:32 (AG07)
12	06:05	19:20 (AG08)	06:31	19:38	18:53	3
	20:52	61	20:21 (AG08)	20:24	07:28	18:28 (AG07)
	20:52	61	19:20 (AG08)	06:32	18:51	1
13	06:05	19:20 (AG08)	06:32	19:36	07:29	18:29 (AG07)
	20:51	60	20:20 (AG08)	20:23	18:50	17:11
	20:51	60	19:21 (AG08)	06:33	07:01	17:11
14	06:06	19:21 (AG08)	06:33	19:36	07:30	18:48
	20:51	59	20:20 (AG08)	20:22	07:31	18:48
	20:51	59	19:22 (AG08)	06:34	07:31	18:47
15	06:07	19:22 (AG08)	06:34	19:35	07:32	18:47
	20:50	58	20:20 (AG08)	20:20	07:32	18:45
	20:50	58	19:23 (AG08)	06:35	18:45	17:08
16	06:08	19:23 (AG08)	06:35	19:33	07:33	18:45
	20:50	57	20:20 (AG08)	20:19	07:34	18:44
	20:50	57	19:22 (AG08)	06:36	07:34	18:44
17	06:08	19:22 (AG08)	06:36	19:32	07:34	18:44
	20:49	57	20:19 (AG08)	20:18	07:34	18:42
	20:49	57	19:23 (AG08)	06:37	07:35	18:42
18	06:09	19:23 (AG08)	06:37	19:30	07:35	18:41
	20:49	56	20:19 (AG08)	20:16	18:41	1
	20:49	56	19:24 (AG08)	06:38	07:36	18:38 (AG06)
19	06:10	19:24 (AG08)	06:38	19:28	07:36	18:38
	20:48	54	20:18 (AG08)	20:15	07:37	18:37
	20:48	54	19:25 (AG08)	06:39	18:39	18:15 (AG06)
20	06:11	19:25 (AG08)	06:39	19:27	07:37	18:35
	20:47	53	20:18 (AG08)	20:14	07:37	18:34
	20:47	53	19:25 (AG08)	06:40	07:38	18:34
21	06:12	19:25 (AG08)	06:40	19:25	07:38	18:33
	20:47	52	20:17 (AG08)	20:12	07:38	18:32
	20:47	52	19:26 (AG08)	06:41	07:39	18:32
22	06:12	19:26 (AG08)	06:41	19:23	07:39	18:31
	20:46	50	20:16 (AG08)	20:11	07:39	18:30
	20:46	50	19:27 (AG08)	06:42	07:41	18:30
23	06:13	19:27 (AG08)	06:42	19:22	07:41	18:29
	20:45	48	20:15 (AG08)	20:09	07:41	18:28
	20:45	48	19:29 (AG08)	06:43	07:42	18:28
24	06:14	19:29 (AG08)	06:43	19:20	07:42	18:27
	20:44	46	20:15 (AG08)	20:08	07:42	18:26
	20:44	46	19:30 (AG08)	06:44	07:43	18:26
25	06:15	19:30 (AG08)	06:44	19:18	07:43	18:25
	20:43	44	20:14 (AG08)	20:06	07:43	18:25
	20:43	44	19:31 (AG08)	06:45	07:44	18:24
26	06:16	19:31 (AG08)	06:45	19:17	07:44	18:24
	20:43	42	20:13 (AG08)	20:05	07:44	18:23
	20:43	42	19:32 (AG08)	06:45	07:45	18:23
27	06:17	19:32 (AG08)	06:45	19:14	07:45	18:23
	20:42	39	20:11 (AG08)	20:03	07:45	18:22
	20:42	39	19:33 (AG08)	06:46	07:46	18:22
28	06:18	19:33 (AG08)	06:46	19:12	07:46	18:21
	20:41	36	20:09 (AG08)	20:02	07:46	18:21
	20:41	36	19:35 (AG08)	06:47	07:47	18:21
29	06:18	19:35 (AG08)	06:47	19:11	07:47	18:21
	20:40	33	20:08 (AG08)	20:00	07:47	18:20
	20:40	33	19:37 (AG08)	06:48	07:48	18:20
30	06:19	19:37 (AG08)	06:48	19:10	07:48	18:20
	20:39	29	20:06 (AG08)	19:59	07:48	18:19
	20:39	29	19:40 (AG08)	06:49	07:49	18:19
31	06:20	19:40 (AG08)	06:49	19:09	07:49	18:18
	20:38	23	20:03 (AG08)	19:57	07:49	18:18
	20:38	23	19:45 (AG08)	06:50	07:50	18:18
Potential sun hours	455		425	374	347	301
Total, worst case	1660		16	29	84	292

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

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

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.  
Via Santa Margherita 4  
IT-09124 Cagliari  
+39 070 658297  
Giuseppe Frongia / direttore@iatprogetti.it  
Calculated:  
20/03/2023 10:00/3.4.415

### SHADOW - Calendar

Calculation: Progetto\_layout\_2023\_03\_17Shadow receptor: F26 - pascolo

#### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December		
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	05:59 20:55	06:21 20:37	06:50 19:56	07:18 19:07	06:51 17:22	16:45 (AG10) 17:00 (AG10)		
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	05:59 20:55	06:22 20:36	06:51 19:54	07:19 19:06	06:52 17:21	16:47 (AG10) 16:59 (AG10)		
3	07:44 17:11	07:30 17:44	06:55 18:16	07:06 19:48	06:23 20:18	05:57 20:46	05:59 20:55	06:23 20:35	06:52 19:53	07:20 19:04	06:53 17:20	16:49 (AG10) 16:59 (AG10)		
4	07:44 17:11	07:29 17:45	06:53 18:17	07:04 19:49	06:21 20:19	05:57 20:46	06:00 20:54	06:24 20:34	06:53 19:51	07:21 19:02	06:54 17:19	16:52 (AG10) 16:59 (AG10)		
5	07:44 17:12	07:28 17:47	06:52 18:19	07:03 19:50	06:20 20:20	05:56 20:47	06:01 20:54	06:25 20:33	06:54 19:49	07:22 19:01	06:55 17:18	16:56 (AG10) 16:59 (AG10)		
6	07:44 17:13	07:27 17:48	06:50 18:20	07:01 19:51	06:19 20:21	05:56 20:48	06:01 20:54	06:26 20:32	06:55 19:48	07:23 18:59	06:56 17:17	16:59 (AG10) 16:59 (AG10)		
7	07:44 17:14	07:26 17:49	17:22 (AG10) 18:21	06:49 19:52	06:18 20:22	05:56 20:48	06:02 20:54	06:27 20:30	06:56 19:46	07:24 18:58	06:57 17:16	16:59 (AG10) 16:59 (AG10)		
8	07:44 17:15	07:25 17:50	17:18 (AG10) 18:22	06:47 19:53	06:17 20:23	05:55 20:49	06:02 20:53	06:28 20:29	06:57 19:45	07:25 18:56	06:58 17:15	16:59 (AG10) 16:59 (AG10)		
9	07:44 17:16	07:24 17:51	17:17 (AG10) 18:23	06:46 19:54	06:16 20:24	05:55 20:49	06:03 20:53	06:29 20:28	06:58 19:43	07:26 18:54	07:00 17:14	16:59 (AG10) 16:59 (AG10)		
10	07:44 17:17	07:23 17:53	17:15 (AG10) 18:24	06:44 19:55	06:15 20:25	05:55 20:50	06:04 20:53	06:30 20:27	06:59 19:41	07:27 18:53	07:01 17:13	16:59 (AG10) 16:59 (AG10)		
11	07:44 17:18	07:22 17:54	17:14 (AG10) 18:25	06:42 19:56	06:14 20:26	05:55 20:50	06:04 20:52	06:31 20:26	06:59 19:40	07:28 18:51	07:02 17:12	16:59 (AG10) 16:59 (AG10)		
12	07:44 17:19	07:20 17:55	17:13 (AG10) 18:26	06:41 19:57	06:13 20:27	05:55 20:51	06:05 20:52	06:31 20:24	07:00 19:38	07:29 18:50	07:03 17:11	16:59 (AG10) 16:59 (AG10)		
13	07:43 17:20	07:19 17:56	17:12 (AG10) 18:27	06:39 19:58	06:12 20:28	05:55 20:51	06:06 20:51	06:32 20:23	07:01 19:37	07:30 18:48	07:04 17:10	16:59 (AG10) 16:59 (AG10)		
14	07:43 17:21	07:18 17:57	17:12 (AG10) 18:28	06:38 19:59	06:11 20:29	05:55 20:52	06:06 20:51	06:33 20:22	07:02 19:35	07:31 18:47	07:05 17:09	16:59 (AG10) 16:59 (AG10)		
15	07:43 17:22	07:17 17:58	17:12 (AG10) 18:29	06:36 20:00	06:10 20:30	05:55 20:52	06:07 20:50	06:34 20:20	07:03 19:33	07:32 18:45	17:52 (AG10) 18:02 (AG10)	16:59 (AG10) 16:59 (AG10)		
16	07:42 17:23	07:15 18:00	17:11 (AG10) 18:30	06:35 20:01	06:09 20:31	05:55 20:53	06:08 20:50	06:35 20:19	07:04 19:32	07:33 18:44	16:59 (AG10) 17:08 (AG10)	16:59 (AG10) 17:00 (AG10)		
17	07:42 17:24	07:14 18:01	17:11 (AG10) 18:31	06:33 20:02	06:08 20:32	05:55 20:53	06:09 20:49	06:36 20:18	07:05 19:30	07:34 18:42	17:47 (AG10) 18:06 (AG10)	16:59 (AG10) 17:07 (AG10)		
18	07:41 17:26	07:13 18:02	17:11 (AG10) 18:32	06:31 20:03	06:07 20:33	05:55 20:53	06:09 20:49	06:37 20:16	07:06 19:28	07:35 18:41	17:45 (AG10) 18:07 (AG10)	16:59 (AG10) 17:06 (AG10)		
19	07:41 17:27	07:12 18:03	17:11 (AG10) 18:33	06:30 20:04	06:06 20:33	05:55 20:54	06:10 20:48	06:38 20:15	07:07 19:27	07:36 18:39	17:43 (AG10) 18:08 (AG10)	16:59 (AG10) 17:05 (AG10)		
20	07:40 17:28	07:10 18:04	17:11 (AG10) 18:34	06:28 20:05	06:04 20:34	05:55 20:54	06:11 20:47	06:39 20:14	07:08 19:25	07:37 18:38	17:43 (AG10) 18:10 (AG10)	16:59 (AG10) 17:05 (AG10)		
21	07:40 17:29	07:09 18:05	17:12 (AG10) 18:35	06:27 20:06	06:04 20:35	05:55 20:54	06:12 20:47	06:40 20:12	07:09 19:23	07:38 18:37	17:42 (AG10) 18:10 (AG10)	16:59 (AG10) 17:04 (AG10)		
22	07:39 17:30	07:08 18:06	17:12 (AG10) 18:36	06:25 20:07	06:37 20:36	05:55 20:54	06:13 20:46	06:41 20:11	07:10 19:22	07:40 18:35	17:42 (AG10) 18:10 (AG10)	16:59 (AG10) 17:03 (AG10)		
23	07:39 17:31	07:06 18:08	17:13 (AG10) 18:37	06:23 20:08	06:36 20:37	05:56 20:54	06:13 20:45	06:42 20:09	07:11 19:20	07:41 18:34	17:41 (AG10) 18:10 (AG10)	16:59 (AG10) 17:03 (AG10)		
24	07:38 17:32	07:05 18:09	17:15 (AG10) 18:38	06:22 20:09	06:34 20:38	05:56 20:55	06:14 20:44	06:43 20:08	07:12 19:19	07:42 18:33	17:41 (AG10) 18:10 (AG10)	16:59 (AG10) 17:02 (AG10)		
25	07:37 17:34	07:03 18:10	17:16 (AG10) 18:39	06:20 20:10	06:33 20:39	05:56 20:55	06:15 20:44	06:44 20:06	07:13 19:17	07:43 17:31	16:41 (AG10) 17:08 (AG10)	16:59 (AG10) 17:02 (AG10)		
26	07:37 17:35	07:02 18:11	17:18 (AG10) 18:40	06:19 20:11	06:32 20:40	05:57 20:55	06:16 20:43	06:45 20:05	07:13 19:15	07:44 17:30	16:40 (AG10) 17:07 (AG10)	16:59 (AG10) 17:01 (AG10)		
27	07:36 17:36	07:01 18:12	17:21 (AG10) 18:41	06:17 20:12	06:30 20:40	05:57 20:55	06:17 20:42	06:46 20:03	07:14 19:14	07:45 17:29	16:41 (AG10) 17:06 (AG10)	16:59 (AG10) 17:01 (AG10)		
28	07:35 17:37	06:59 18:13	17:28 (AG10) 18:42	06:15 20:13	06:29 20:41	05:57 20:55	06:18 20:41	06:46 20:02	07:15 19:12	07:46 17:27	16:42 (AG10) 17:05 (AG10)	16:59 (AG10) 17:01 (AG10)		
29	07:34 17:38	07:34 17:38	07:14 19:43	06:28 20:14	05:59 20:42	05:58 20:55	06:19 20:40	06:47 20:00	07:16 19:10	06:47 17:26	16:42 (AG10) 17:03 (AG10)	16:59 (AG10) 17:00 (AG10)		
30	07:34 17:40	07:34 17:40	07:12 19:44	06:26 20:15	05:59 20:43	05:58 20:55	06:19 20:39	06:48 19:59	07:17 19:09	06:48 17:25	16:43 (AG10) 17:02 (AG10)	16:59 (AG10) 17:00 (AG10)		
31	07:33 17:41	07:33 17:41	07:11 19:45	07:11 19:45	05:58 20:43	05:58 20:55	06:20 20:38	06:49 19:57	07:18 17:24	06:49 17:17	16:43 (AG10) 17:00 (AG10)	16:59 (AG10) 17:00 (AG10)		
Potential sun hours	301	299	423	370	397	445	448	455	425	374	347	392	38	292
Total, worst case														

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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

Via Santa Margherita 4

IT-09124 Cagliari

+39 070 658297

Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

20/03/2023 10:00/3.4.415

### SHADOW - Calendar

Calculation: Progetto\_layout\_2023\_03\_17Shadow receptor: F49 - D03-A03

#### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

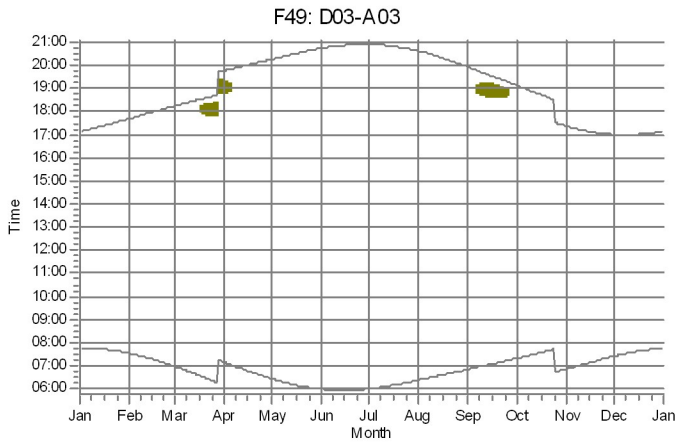
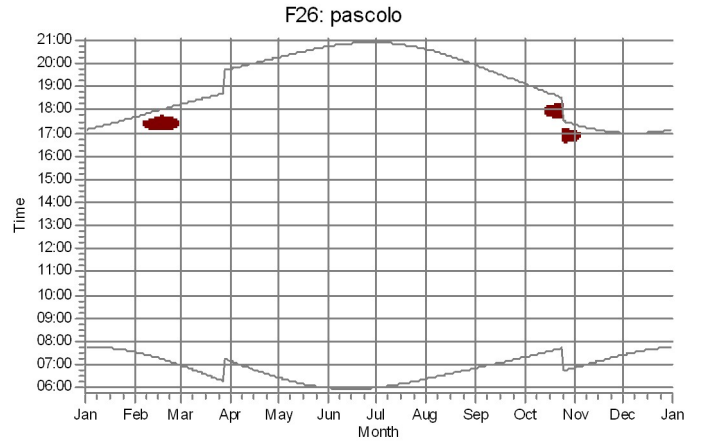
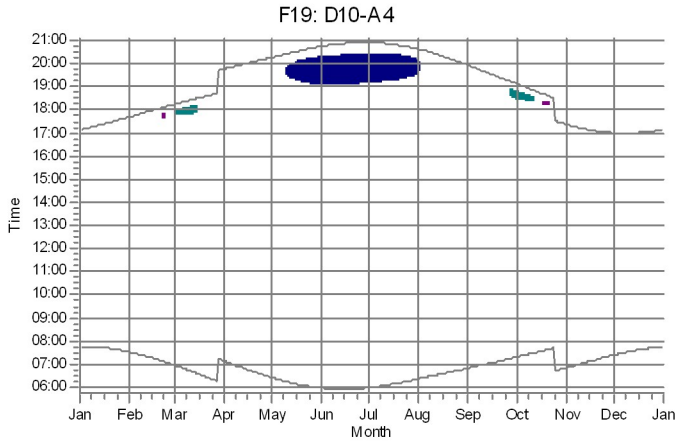
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December			
1	07:44	07:32	06:58	07:09	18:51 (AG09)	06:25	05:58	05:59	06:21	06:50	07:18	06:51	07:24		
	17:09	17:42	18:14	19:46	26 19:17 (AG09)	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00		
2	07:44	07:31	06:56	07:07	18:52 (AG09)	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25		
	17:10	17:43	18:15	19:47	24 19:16 (AG09)	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59		
3	07:44	07:30	06:55	07:06	18:53 (AG09)	06:23	05:57	06:00	06:23	06:52	07:20	06:53	07:26		
	17:11	17:44	18:16	19:48	22 19:15 (AG09)	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59		
4	07:44	07:29	06:53	07:04	18:55 (AG09)	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27		
	17:11	17:46	18:18	19:49	17 19:12 (AG09)	20:19	20:46	20:54	20:34	19:51	19:02	17:19	16:59		
5	07:44	07:28	06:52	07:03	18:57 (AG09)	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28		
	17:12	17:47	18:19	19:50	13 19:10 (AG09)	20:20	20:47	20:54	20:33	19:49	19:01	17:18	16:59		
6	07:44	07:27	06:50	07:01	18:59	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29		
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59			
7	07:44	07:26	06:49	06:59	18:58	06:18	05:56	06:02	06:27	06:56	18:53 (AG09)	07:24	06:57	07:30	
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:30	19:46	11 19:04 (AG09)	18:58	17:16	16:59		
8	07:44	07:25	06:47	06:58	18:57	06:17	05:55	06:02	06:28	06:57	18:50 (AG09)	07:25	06:58	07:31	
	17:15	17:50	18:22	19:53	20:23	20:49	20:53	20:29	19:45	17 19:07 (AG09)	18:56	17:15	16:59		
9	07:44	07:24	06:46	06:56	18:56	06:16	05:55	06:03	06:29	06:58	18:48 (AG09)	07:26	06:59	07:31	
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	21 19:09 (AG09)	18:54	17:14	16:59		
10	07:44	07:23	06:44	06:55	18:55	06:15	05:55	06:04	06:30	06:59	18:46 (AG09)	07:27	07:01	07:32	
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:41	24 19:10 (AG09)	18:53	17:13	16:59		
11	07:44	07:22	06:42	06:53	18:54	06:14	05:55	06:04	06:31	07:00	18:44 (AG09)	07:28	07:02	07:33	
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	26 19:10 (AG09)	18:51	17:12	16:59		
12	07:44	07:20	06:41	06:52	18:53	06:13	05:55	06:05	06:32	07:00	18:42 (AG09)	07:29	07:03	07:34	
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	28 19:10 (AG09)	18:50	17:11	16:59		
13	07:43	07:19	06:39	06:50	18:52	06:12	05:55	06:06	06:32	07:01	18:42 (AG09)	07:30	07:04	07:35	
	17:20	17:56	18:27	19:58	20:28	20:51	20:51	20:23	19:37	28 19:10 (AG09)	18:48	17:10	16:59		
14	07:43	07:18	06:38	06:49	18:51	06:11	05:55	06:06	06:33	07:02	18:41 (AG09)	07:31	07:05	07:35	
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	30 19:11 (AG09)	18:47	17:09	16:59		
15	07:43	07:17	06:36	06:47	18:50	06:10	05:55	06:07	06:34	07:03	18:40 (AG09)	07:32	07:06	07:36	
	17:22	17:58	18:29	20:00	20:30	20:52	20:50	20:20	19:33	31 19:11 (AG09)	18:45	17:08	17:00		
16	07:42	07:16	06:35	06:46	18:49	06:09	05:55	06:08	06:35	07:04	18:40 (AG09)	07:33	07:08	07:37	
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	30 19:10 (AG09)	18:44	17:08	17:00		
17	07:42	07:14	06:33	06:44	18:48	06:08	05:55	06:09	06:36	07:05	18:40 (AG09)	07:34	07:09	07:38	
	17:25	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	28 19:08 (AG09)	18:42	17:07	17:00		
18	07:41	07:13	06:31	06:43	18:47	06:07	05:55	06:09	06:37	07:06	18:39 (AG09)	07:35	07:10	07:38	
	17:26	18:02	18:32	9 18:12 (AG09)	20:03	20:33	20:53	20:49	20:16	19:28	28 19:07 (AG09)	18:41	17:06	17:00	
19	07:41	07:12	06:30	06:41	18:46	06:06	05:55	06:10	06:38	07:07	18:39 (AG09)	07:36	07:11	07:39	
	17:27	18:03	18:33	14 18:13 (AG09)	20:04	20:33	20:54	20:48	20:15	19:27	26 19:05 (AG09)	18:40	17:05	17:01	
20	07:40	07:10	06:28	06:40	18:45	06:05	05:55	06:11	06:39	07:08	18:40 (AG09)	07:37	07:12	07:39	
	17:28	18:04	18:34	16 18:13 (AG09)	20:05	20:34	20:54	20:47	20:14	19:25	24 19:04 (AG09)	18:38	17:05	17:01	
21	07:40	07:09	06:27	06:38	18:44	06:04	05:55	06:12	06:40	07:09	18:39 (AG09)	07:39	07:13	07:40	
	17:29	18:05	18:35	19 18:15 (AG09)	20:06	20:35	20:54	20:47	20:12	19:23	22 19:01 (AG09)	18:37	17:04	17:02	
22	07:39	07:08	06:25	06:37	18:43	06:04	05:55	06:13	06:41	07:10	18:40 (AG09)	07:40	07:14	07:40	
	17:30	18:06	18:36	21 18:15 (AG09)	20:07	20:36	20:54	20:46	20:11	19:22	20 19:00 (AG09)	18:35	17:03	17:02	
23	07:39	07:06	06:23	06:36	18:42	06:03	05:56	06:13	06:42	07:11	18:41 (AG09)	07:41	07:15	07:41	
	17:31	18:08	18:37	23 18:17 (AG09)	20:08	20:37	20:54	20:45	20:09	19:20	17 18:58 (AG09)	18:34	17:03	17:03	
24	07:38	07:05	06:22	06:34	18:41	06:02	05:56	06:14	06:43	07:12	18:42 (AG09)	07:42	07:16	07:41	
	17:32	18:09	18:38	26 18:18 (AG09)	20:09	20:38	20:55	20:44	20:08	19:19	14 18:56 (AG09)	18:33	17:02	17:03	
25	07:37	07:03	06:20	06:33	18:40	06:02	05:56	06:15	06:44	07:13	18:44 (AG09)	06:43	07:18	07:42	
	17:34	18:10	18:39	27 18:18 (AG09)	20:10	20:39	20:55	20:44	20:06	19:17	11 18:55 (AG09)	17:31	17:02	17:04	
26	07:37	07:02	06:19	06:32	18:39	06:01	05:57	06:16	06:45	07:14	18:48 (AG09)	06:44	07:19	07:42	
	17:35	18:11	18:40	29 18:20 (AG09)	20:11	20:40	20:55	20:43	20:05	19:15	5 18:53 (AG09)	17:30	17:01	17:04	
27	07:36	07:01	06:17	06:30	18:38	06:00	05:57	06:17	06:46	07:14	18:47	06:45	07:20	07:43	
	17:36	18:12	18:41	29 18:20 (AG09)	20:12	20:40	20:55	20:42	20:03	19:14	17:29	17:01	17:05		
28	07:35	06:59	06:15	06:29	18:37	06:00	05:57	06:18	06:47	07:15	18:46	06:46	07:21	07:43	
	17:37	18:13	18:42	30 18:20 (AG09)	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06		
29	07:34		07:14	06:28	18:36	05:59	05:58	06:19	06:47	07:16	18:47	06:47	07:22	07:43	
	17:38		19:43	29 19:20 (AG09)	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06		
30	07:34		07:12	06:26	18:35	05:59	05:58	06:20	06:48	07:17	18:48	06:48	07:23	07:43	
	17:40		19:44	29 19:19 (AG09)	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07		
31	07:33		07:11	06:25	18:34	05:58		06:20	06:49		18:49	06:49	07:24	07:44	
	17:41		19:45	28 19:19 (AG09)	20:16	20:43		20:38	19:57		17:24		17:08		
Potential sun hours	301	299	370	397	445	448	455	425	374	441	347	301	292		
Total, worst case			329	102											

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

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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**SHADOW - Calendar, graphical**  
 Calculation: Progetto\_layout\_2023\_03\_17



WTGs

- AG07: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (70)
- AG08: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (71)
- AG10: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (72)

- AG09: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (74)
- AG06: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (75)

## SHADOW - Calendar per WTG

Calculation: Progetto\_layout\_2023\_03\_17WTG: AG01 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (65)

### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44	07:32	06:58	07:09	06:25	05:58	05:59	06:21	06:50	07:18	06:51	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59
3	07:44	07:30	06:55	07:06	06:23	05:57	06:00	06:23	06:52	07:20	06:53	07:26
	17:11	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:46	18:18	19:49	20:19	20:46	20:55	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:03	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:19	19:50	20:20	20:47	20:54	20:33	19:50	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	07:00	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:31	19:46	18:58	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:59	07:31
	17:15	17:50	18:22	19:53	20:23	20:49	20:54	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:32
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:55	17:14	16:59
10	07:44	07:23	06:44	06:55	06:15	05:55	06:04	06:30	06:59	07:27	07:01	07:32
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:42	18:53	17:13	16:59
11	07:44	07:22	06:43	06:53	06:14	05:55	06:04	06:31	07:00	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:51	20:52	20:26	19:40	18:51	17:12	16:59
12	07:44	07:20	06:41	06:52	06:13	05:55	06:05	06:32	07:01	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:12	05:55	06:06	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:52	20:23	19:37	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:11	05:55	06:06	06:33	07:02	07:31	07:05	07:36
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:10	05:55	06:07	06:34	07:03	07:32	07:07	07:36
	17:22	17:59	18:29	20:00	20:30	20:52	20:51	20:21	19:33	18:45	17:08	17:00
16	07:42	07:16	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:08	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:09	06:36	07:05	07:34	07:09	07:38
	17:25	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:42	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:26	18:02	18:32	20:03	20:33	20:53	20:49	20:17	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:34	20:54	20:48	20:15	19:27	18:40	17:05	17:01
20	07:41	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:38	07:12	07:39
	17:28	18:04	18:34	20:05	20:35	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:27	06:39	06:04	05:55	06:12	06:40	07:09	07:39	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:24	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:13	06:41	07:10	07:40	07:14	07:41
	17:30	18:07	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:16	07:41
	17:31	18:08	18:37	20:08	20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:17	07:42
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:19	18:33	17:02	17:03
25	07:38	07:04	06:20	06:33	06:02	05:56	06:15	06:44	07:13	06:43	07:18	07:42
	17:34	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:19	06:32	06:01	05:57	06:16	06:45	07:14	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:46	07:15	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:04	19:14	17:29	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:47	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06
29	07:35		07:14	06:28	05:59	05:58	06:19	06:48	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:20	06:48	07:17	06:48	07:23	07:44
	17:40		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:11		05:58		06:20	06:49		06:50		07:44
	17:41		19:45		20:44		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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: Progetto\_layout\_2023\_03\_17WTG: AG02 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (69)

### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44	07:32	06:58	07:09	06:25	05:58	05:59	06:21	06:50	07:18	06:51	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59
3	07:44	07:30	06:55	07:06	06:23	05:57	05:59	06:23	06:52	07:20	06:53	07:26
	17:11	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:46	18:18	19:49	20:19	20:46	20:55	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:03	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:19	19:50	20:20	20:47	20:54	20:33	19:50	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	06:59	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:31	19:46	18:58	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:59	07:31
	17:15	17:50	18:22	19:53	20:23	20:49	20:54	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:32
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:59
10	07:44	07:23	06:44	06:55	06:15	05:55	06:04	06:30	06:59	07:27	07:01	07:32
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:42	18:53	17:13	16:59
11	07:44	07:22	06:43	06:53	06:14	05:55	06:04	06:31	07:00	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:51	20:52	20:26	19:40	18:51	17:12	16:59
12	07:44	07:20	06:41	06:52	06:13	05:55	06:05	06:32	07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:12	05:55	06:06	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:52	20:23	19:37	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:11	05:55	06:06	06:33	07:02	07:31	07:05	07:36
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:10	05:55	06:07	06:34	07:03	07:32	07:07	07:36
	17:22	17:58	18:29	20:00	20:30	20:52	20:51	20:21	19:33	18:45	17:08	17:00
16	07:42	07:16	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:08	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:09	06:36	07:05	07:34	07:09	07:38
	17:25	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:42	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:26	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:34	20:54	20:48	20:15	19:27	18:40	17:05	17:01
20	07:41	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:38	07:12	07:39
	17:28	18:04	18:34	20:05	20:35	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:27	06:38	06:04	05:55	06:12	06:40	07:09	07:39	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:24	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:13	06:41	07:10	07:40	07:14	07:41
	17:30	18:07	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41
	17:31	18:08	18:37	20:08	20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:17	07:42
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:19	18:33	17:02	17:03
25	07:38	07:04	06:20	06:33	06:02	05:56	06:15	06:44	07:13	06:43	07:18	07:42
	17:34	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:19	06:32	06:01	05:57	06:16	06:45	07:14	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:46	07:15	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:29	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:47	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06
29	07:35		07:14	06:28	05:59	05:58	06:19	06:47	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:20	06:48	07:17	06:48	07:23	07:44
	17:40		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:11		05:58		06:20	06:49		06:50		07:44
	17:41		19:45		20:44		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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: Progetto\_layout\_2023\_03\_17WTG: AG03 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (66)

### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44	07:32	06:58	07:09	06:25	05:58	05:58	06:21	06:50	07:18	06:51	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59
3	07:44	07:30	06:55	07:06	06:23	05:57	05:59	06:23	06:52	07:20	06:53	07:26
	17:11	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:45	18:18	19:49	20:19	20:46	20:55	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:03	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:19	19:50	20:20	20:47	20:54	20:33	19:50	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	06:59	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:31	19:46	18:58	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:59	07:31
	17:15	17:50	18:22	19:53	20:23	20:49	20:54	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:31
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:59
10	07:44	07:23	06:44	06:55	06:15	05:55	06:04	06:30	06:59	07:27	07:01	07:32
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:41	18:53	17:13	16:59
11	07:44	07:22	06:43	06:53	06:14	05:55	06:04	06:31	07:00	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	18:51	17:12	16:59
12	07:44	07:20	06:41	06:52	06:13	05:55	06:05	06:31	07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:12	05:55	06:06	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:52	20:23	19:37	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:11	05:55	06:06	06:33	07:02	07:31	07:05	07:35
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:10	05:55	06:07	06:34	07:03	07:32	07:06	07:36
	17:22	17:58	18:29	20:00	20:30	20:52	20:51	20:21	19:33	18:45	17:08	16:59
16	07:42	07:16	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:08	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:09	06:36	07:05	07:34	07:09	07:38
	17:24	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:42	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:26	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:34	20:54	20:48	20:15	19:27	18:40	17:05	17:01
20	07:41	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:37	07:12	07:39
	17:28	18:04	18:34	20:05	20:34	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:27	06:38	06:04	05:55	06:12	06:40	07:09	07:39	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:23	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:13	06:41	07:10	07:40	07:14	07:41
	17:30	18:06	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41
	17:31	18:08	18:37	20:08	20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:17	07:42
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:19	18:33	17:02	17:03
25	07:38	07:03	06:20	06:33	06:02	05:56	06:15	06:44	07:13	06:43	07:18	07:42
	17:34	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:19	06:32	06:01	05:56	06:16	06:45	07:14	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:46	07:14	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:29	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:47	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06
29	07:34		07:14	06:28	05:59	05:58	06:19	06:47	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:19	06:48	07:17	06:48	07:23	07:44
	17:39		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:11		05:58		06:20	06:49		06:49		07:44
	17:41		19:45		20:44		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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: Progetto\_layout\_2023\_03\_17WTG: AG04 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (67)

### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44	07:32	06:58	07:09	06:25	05:58	05:58	06:21	06:50	07:18	06:51	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59
3	07:44	07:30	06:55	07:06	06:23	05:57	05:59	06:23	06:52	07:20	06:53	07:26
	17:11	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:56	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:45	18:17	19:49	20:19	20:46	20:55	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:03	06:20	05:56	06:00	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:19	19:50	20:20	20:47	20:54	20:33	19:49	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	06:59	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:30	19:46	18:58	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:58	07:31
	17:15	17:50	18:22	19:53	20:23	20:49	20:54	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:31
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:59
10	07:44	07:23	06:44	06:55	06:15	05:55	06:04	06:30	06:59	07:27	07:01	07:32
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:41	18:53	17:13	16:59
11	07:44	07:22	06:42	06:53	06:13	05:55	06:04	06:31	06:59	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	18:51	17:12	16:59
12	07:44	07:20	06:41	06:52	06:12	05:55	06:05	06:31	07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:11	05:55	06:06	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:52	20:23	19:37	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:10	05:55	06:06	06:33	07:02	07:31	07:05	07:35
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:10	05:55	06:07	06:34	07:03	07:32	07:06	07:36
	17:22	17:58	18:29	20:00	20:30	20:52	20:51	20:20	19:33	18:45	17:08	16:59
16	07:42	07:16	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:07	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:08	06:36	07:05	07:34	07:09	07:38
	17:24	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:42	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:26	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:34	20:54	20:48	20:15	19:27	18:39	17:05	17:01
20	07:41	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:37	07:12	07:39
	17:28	18:04	18:34	20:05	20:34	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:27	06:38	06:04	05:55	06:12	06:40	07:09	07:39	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:23	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:12	06:41	07:10	07:40	07:14	07:41
	17:30	18:06	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41
	17:31	18:08	18:37	20:08	20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:17	07:41
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:19	18:33	17:02	17:03
25	07:37	07:03	06:20	06:33	06:02	05:56	06:15	06:44	07:13	06:43	07:18	07:42
	17:34	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:19	06:31	06:01	05:56	06:16	06:45	07:13	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:46	07:14	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:29	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:46	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:00	17:06
29	07:34		07:14	06:28	05:59	05:58	06:19	06:47	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:19	06:48	07:17	06:48	07:23	07:44
	17:39		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:11		05:58		06:20	06:49		06:49		07:44
	17:41		19:45		20:44		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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: Progetto\_layout\_2023\_03\_17WTG: AG05 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (68)

### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	05:58 20:55	06:21 20:37	06:50 19:56	07:18 19:07	06:51 17:22	07:24 16:59
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	05:59 20:55	06:22 20:36	06:51 19:54	07:19 19:05	06:52 17:21	07:25 16:59
3	07:44 17:11	07:30 17:44	06:55 18:16	07:06 19:48	06:22 20:18	05:57 20:46	05:59 20:55	06:23 20:35	06:52 19:53	07:20 19:04	06:53 17:20	07:26 16:59
4	07:44 17:12	07:29 17:47	06:53 18:18	07:04 19:50	06:21 20:20	05:56 20:47	06:00 20:54	06:24 20:34	06:53 19:51	07:21 19:02	06:54 17:19	07:27 16:59
5	07:44 17:13	07:28 17:48	06:52 18:20	07:02 19:51	06:20 20:21	05:56 20:48	06:00 20:54	06:25 20:32	06:54 19:48	07:22 18:59	06:55 17:17	07:28 16:59
6	07:44 17:14	07:27 17:49	06:50 18:21	07:01 19:52	06:19 20:22	05:56 20:48	06:01 20:54	06:26 20:30	06:55 19:46	07:23 18:57	06:56 17:16	07:29 16:59
7	07:44 17:15	07:26 17:50	06:49 18:22	06:59 19:53	06:18 20:23	05:55 20:49	06:02 20:53	06:27 20:29	06:56 19:45	07:24 18:56	06:57 17:15	07:30 16:58
8	07:44 17:16	07:25 17:51	06:47 18:23	06:58 19:54	06:17 20:24	05:55 20:49	06:02 20:53	06:28 20:28	06:57 19:43	07:25 18:54	06:58 17:14	07:31 16:58
9	07:44 17:17	07:24 17:52	06:46 18:24	06:56 19:55	06:16 20:25	05:55 20:50	06:03 20:53	06:29 20:27	06:58 19:41	07:26 18:53	07:00 17:13	07:31 16:59
10	07:44 17:18	07:22 17:54	06:42 18:25	06:53 19:56	06:13 20:26	05:55 20:50	06:04 20:52	06:30 20:26	06:59 19:40	07:28 18:51	07:02 17:12	07:33 16:59
11	07:44 17:19	07:21 17:55	06:41 18:26	06:52 19:57	06:12 20:27	05:55 20:51	06:05 20:52	06:31 20:24	07:00 19:38	07:29 18:50	07:03 17:11	07:34 16:59
12	07:43 17:20	07:19 17:56	06:39 18:27	06:50 19:58	06:11 20:28	05:55 20:51	06:05 20:51	06:32 20:23	07:01 19:36	07:30 18:48	07:04 17:10	07:35 16:59
13	07:43 17:21	07:18 17:57	06:38 18:28	06:49 19:59	06:10 20:29	05:55 20:52	06:06 20:51	06:33 20:22	07:02 19:35	07:31 18:47	07:05 17:09	07:35 16:59
14	07:43 17:22	07:17 17:58	06:36 18:29	06:47 20:00	06:09 20:30	05:55 20:52	06:07 20:50	06:34 20:20	07:03 19:33	07:32 18:45	07:06 17:08	07:36 16:59
15	07:42 17:23	07:15 17:59	06:35 18:30	06:46 20:01	06:09 20:31	05:55 20:53	06:08 20:50	06:35 20:19	07:04 19:32	07:33 18:44	07:08 17:07	07:37 17:00
16	07:42 17:24	07:14 18:01	06:33 18:31	06:44 20:02	06:08 20:32	05:55 20:53	06:08 20:49	06:36 20:18	07:05 19:30	07:34 18:42	07:09 17:07	07:38 17:00
17	07:41 17:25	07:13 18:02	06:31 18:32	06:43 20:03	06:07 20:33	05:55 20:53	06:09 20:49	06:37 20:16	07:06 19:28	07:35 18:41	07:10 17:06	07:38 17:00
18	07:41 17:26	07:12 18:03	06:30 18:33	06:41 20:04	06:06 20:33	05:55 20:54	06:10 20:48	06:38 20:15	07:07 19:27	07:36 18:39	07:11 17:05	07:39 17:01
19	07:41 17:27	07:11 18:04	06:30 18:34	06:41 20:05	06:06 20:34	05:55 20:54	06:10 20:47	06:38 20:14	07:07 19:25	07:36 18:38	07:11 17:05	07:39 17:01
20	07:40 17:28	07:10 18:04	06:28 18:34	06:40 20:05	06:05 20:34	05:55 20:54	06:11 20:47	06:39 20:14	07:08 19:25	07:37 18:38	07:12 17:05	07:39 17:01
21	07:40 17:29	07:09 18:05	06:27 18:35	06:38 20:06	06:04 20:35	05:55 20:54	06:12 20:47	06:40 20:12	07:09 19:23	07:38 18:37	07:13 17:04	07:40 17:01
22	07:39 17:30	07:08 18:06	06:25 18:36	06:37 20:07	06:04 20:36	05:55 20:54	06:12 20:46	06:41 20:11	07:10 19:22	07:39 18:35	07:14 17:03	07:40 17:02
23	07:39 17:31	07:06 18:07	06:23 18:37	06:36 20:08	06:03 20:37	05:56 20:55	06:13 20:45	06:42 20:09	07:11 19:20	07:41 18:34	07:15 17:03	07:41 17:02
24	07:38 17:32	07:05 18:09	06:22 18:38	06:34 20:09	06:02 20:38	05:56 20:55	06:14 20:44	06:43 20:08	07:12 19:18	07:42 18:32	07:16 17:02	07:41 17:03
25	07:37 17:33	07:03 18:10	06:20 18:39	06:33 20:10	06:01 20:39	05:56 20:55	06:15 20:44	06:44 20:06	07:12 19:17	07:43 17:31	07:18 17:02	07:42 17:04
26	07:37 17:35	07:02 18:11	06:18 18:40	06:31 20:11	06:01 20:40	05:56 20:55	06:16 20:43	06:45 20:05	07:13 19:15	07:44 17:30	07:19 17:01	07:42 17:04
27	07:36 17:36	07:01 18:12	06:17 18:41	06:30 20:12	06:00 20:40	05:57 20:55	06:17 20:42	06:45 20:03	07:14 19:14	07:45 17:28	07:20 17:01	07:43 17:05
28	07:35 17:37	06:59 18:13	06:15 18:42	06:29 20:13	06:00 20:41	05:57 20:55	06:18 20:41	06:46 20:02	07:15 19:12	07:46 17:27	07:21 17:00	07:43 17:06
29	07:34 17:38		07:14 19:43	06:27 20:14	05:59 20:42	05:57 20:55	06:18 20:40	06:47 20:00	07:16 19:10	06:47 17:26	07:22 17:00	07:43 17:06
30	07:34 17:39		07:12 19:44	06:26 20:15	05:59 20:43	05:58 20:55	06:19 20:39	06:48 19:59	07:17 19:09	06:48 17:25	07:23 17:00	07:43 17:07
31	07:33 17:41		07:10 19:45		05:58 20:43		06:20 20:38	06:49 19:57		06:49 17:23		07:44 17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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: Progetto\_layout\_2023\_03\_17WTG: AG06 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (75)  
 Assumptions for shadow calculations

- The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December	
1	07:44	07:32	06:58	07:09	06:25	05:58	05:58	06:21	06:50	07:18	06:51	07:24	
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	17:00	
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25	
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59	
3	07:44	07:30	06:55	07:06	06:23	05:57	05:59	06:23	06:52	07:20	06:53	07:26	
	17:11	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59	
4	07:44	07:29	06:53	07:04	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27	
	17:11	17:45	18:17	19:49	20:19	20:46	20:54	20:34	19:51	19:02	17:19	16:59	
5	07:44	07:28	06:52	07:03	06:20	05:56	06:00	06:25	06:54	07:22	06:55	07:28	
	17:12	17:47	18:19	19:50	20:20	20:47	20:54	20:33	19:49	19:01	17:18	16:59	
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29	
	17:13	17:48	18:20	19:51	20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59	
7	07:44	07:26	06:49	06:59	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30	
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:30	19:46	18:58	17:16	16:59	
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:58	07:31	
	17:15	17:50	18:22	19:53	20:23	20:49	20:53	20:29	19:45	18:56	17:15	16:59	
9	07:44	07:24	06:46	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:31	
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:59	
10	07:44	07:23	06:44	06:55	06:15	05:55	06:04	06:30	06:59	07:27	07:01	07:32	
	17:17	17:53	18:24	19:55	20:25	20:50	20:53	20:27	19:41	18:53	17:13	16:59	
11	07:44	07:22	06:42	06:53	06:14	05:55	06:04	06:31	06:59	07:28	07:02	07:33	
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	18:51	17:12	16:59	
12	07:44	07:20	06:41	06:52	06:12	05:55	06:05	06:31	07:00	07:29	07:03	07:34	
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59	
13	07:43	07:19	06:39	06:50	06:11	05:55	06:06	06:32	07:01	07:30	07:04	07:35	
	17:20	17:56	18:27	19:58	20:28	20:51	20:52	20:23	19:37	18:48	17:10	16:59	
14	07:43	07:18	06:38	06:49	06:11	05:55	06:06	06:33	07:02	07:31	07:05	07:35	
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59	
15	07:43	07:17	06:36	06:47	06:10	05:55	06:07	06:34	07:03	07:32	07:06	07:36	
	17:22	17:58	18:29	20:00	20:30	20:52	20:50	20:20	19:33	18:45	17:08	16:59	
16	07:42	07:16	06:35	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:08	07:37	
	17:23	18:00	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:08	17:00	
17	07:42	07:14	06:33	06:44	06:08	05:55	06:09	06:36	07:05	07:34	07:09	07:38	
	17:24	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00	
18	07:41	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	18:17-18:18/1	07:10	07:38
	17:26	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00	
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39	
	17:27	18:03	18:33	20:04	20:34	20:54	20:48	20:15	19:27	18:39	17:05	17:01	
20	07:40	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:37	18:15-18:16/1	07:12	07:39
	17:28	18:04	18:34	20:05	20:34	20:54	20:47	20:14	19:25	18:38	17:05	17:01	
21	07:40	07:09	06:27	06:38	06:04	05:55	06:12	06:40	07:09	07:38	07:13	07:40	
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:23	18:37	17:04	17:02	
22	07:39	07:08	17:44-17:45/1	06:25	06:37	06:04	05:55	06:13	06:41	07:10	07:40	07:14	07:40
	17:30	18:06	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02	
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41	
	17:31	18:08	18:37	20:08	20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:03	
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:16	07:41	
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:19	18:33	17:02	17:03	
25	07:37	07:03	06:20	06:33	06:02	05:56	06:15	06:44	07:13	06:43	07:18	07:42	
	17:34	18:10	18:39	20:10	20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04	
26	07:37	07:02	06:19	06:32	06:01	05:56	06:16	06:45	07:13	06:44	07:19	07:42	
	17:35	18:11	18:40	20:11	20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04	
27	07:36	07:01	06:17	06:30	06:00	05:57	06:17	06:46	07:14	06:45	07:20	07:43	
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:29	17:01	17:05	
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:46	07:15	06:46	07:21	07:43	
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:01	17:06	
29	07:34		07:14	06:28	05:59	05:58	06:19	06:47	07:16	06:47	07:22	07:43	
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06	
30	07:34		07:12	06:26	05:59	05:58	06:19	06:48	07:17	06:48	07:23	07:44	
	17:39		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07	
31	07:33		07:11		05:58		06:20	06:49		06:49		07:44	
	17:41		19:45		20:43		20:38	19:57		17:24		17:08	
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292	
Sum of minutes with flicker	0	1	0	0	0	0	0	0	0	2	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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

Via Santa Margherita 4

IT-09124 Cagliari

+39 070 658297

Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

20/03/2023 10:00/3.4.415

### SHADOW - Calendar per WTG

Calculation: Progetto\_layout\_2023\_03\_17WTG: AG07 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (70)

#### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December	
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	05:58 20:55	06:21 20:37	06:50 19:56	07:18 19:07	18:34-18:45/11	06:51 17:22	07:24 17:00
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	05:59 20:55	06:22 20:36	06:51 19:54	07:19 19:05	18:32-18:43/11	06:52 17:21	07:25 16:59
3	07:44 17:11	07:30 17:44	06:55 18:16	17:54-17:55/1	07:06 19:48	06:23 20:18	05:57 20:46	05:59 20:55	06:23 20:35	06:52 19:53	18:31-18:42/11	06:53 17:20	07:26 16:59
4	07:44 17:11	07:29 17:45	06:53 18:17	17:54-17:57/3	07:04 19:49	06:21 20:19	05:56 20:46	06:00 20:54	06:24 20:34	06:53 19:51	18:30-18:40/10	06:54 17:19	07:27 16:59
5	07:44 17:12	07:28 17:47	06:52 18:19	17:53-17:57/4	07:03 19:50	06:20 20:20	05:56 20:47	06:00 20:54	06:25 20:33	06:54 19:49	18:29-18:39/10	06:55 17:18	07:28 16:59
6	07:44 17:13	07:27 17:48	06:50 18:20	17:53-17:59/6	07:01 19:51	06:19 20:21	05:56 20:48	06:01 20:54	06:26 20:32	06:55 19:48	18:29-18:37/8	06:56 17:17	07:29 16:59
7	07:44 17:14	07:26 17:49	06:49 18:21	17:52-18:00/8	06:59 19:52	06:18 20:22	05:56 20:48	06:02 20:54	06:27 20:30	06:56 19:46	18:28-18:35/7	06:57 17:16	07:30 16:59
8	07:44 17:15	07:25 17:50	06:47 18:22	17:52-18:00/8	06:58 19:53	06:17 20:23	05:55 20:49	06:02 20:53	06:28 20:29	06:57 19:45	18:28-18:34/6	06:58 17:15	07:31 16:59
9	07:44 17:16	07:24 17:51	06:46 18:23	17:52-18:02/10	06:56 19:54	06:16 20:24	05:55 20:49	06:03 20:53	06:29 20:28	06:58 19:43	18:28-18:32/4	07:00 17:14	07:31 16:59
10	07:44 17:17	07:23 17:53	06:44 18:24	17:52-18:03/11	06:55 19:55	06:15 20:25	05:55 20:50	06:03 20:53	06:30 20:27	06:59 19:41	18:28-18:31/3	07:01 17:13	07:32 16:59
11	07:44 17:18	07:22 17:54	06:42 18:25	17:53-18:04/11	06:53 19:56	06:13 20:26	05:55 20:50	06:04 20:52	06:30 20:26	06:59 19:40	18:28-18:29/1	07:02 17:12	07:33 16:59
12	07:44 17:19	07:20 17:55	06:41 18:26	17:54-18:05/11	06:52 19:57	06:12 20:27	05:55 20:51	06:05 20:52	06:31 20:24	07:00 19:38	18:28-18:31/3	07:03 17:11	07:34 16:59
13	07:43 17:20	07:19 17:56	06:39 18:27	17:56-18:07/11	06:50 19:58	06:11 20:28	05:55 20:51	06:06 20:51	06:32 20:23	07:01 19:37	18:28-18:31/3	07:04 17:10	07:35 16:59
14	07:43 17:21	07:18 17:57	06:38 18:28	17:57-18:07/10	06:49 19:59	06:10 20:29	05:55 20:52	06:06 20:51	06:33 20:22	07:02 19:35	18:28-18:31/3	07:05 17:09	07:35 16:59
15	07:43 17:22	07:17 17:58	06:36 18:29	17:59-18:08/9	06:47 20:00	06:10 20:30	05:55 20:52	06:07 20:50	06:34 20:20	07:03 19:33	18:28-18:31/3	07:06 17:08	07:36 16:59
16	07:42 17:23	07:15 18:00	06:35 18:30	17:59-18:08/9	06:46 20:01	06:09 20:31	05:55 20:53	06:08 20:50	06:35 20:19	07:04 19:32	18:28-18:31/3	07:07 17:07	07:37 17:00
17	07:42 17:24	07:14 18:01	06:33 18:31	17:59-18:08/9	06:44 20:02	06:08 20:32	05:55 20:53	06:08 20:49	06:36 20:18	07:05 19:30	18:28-18:31/3	07:08 17:06	07:38 17:00
18	07:41 17:26	07:13 18:02	06:31 18:32	17:59-18:08/9	06:43 20:03	06:07 20:33	05:55 20:53	06:09 20:49	06:37 20:16	07:06 19:28	18:28-18:31/3	07:09 17:05	07:39 17:01
19	07:41 17:27	07:12 18:03	06:30 18:33	17:59-18:08/9	06:41 20:04	06:06 20:33	05:55 20:54	06:10 20:48	06:38 20:15	07:07 19:27	18:28-18:31/3	07:10 17:04	07:40 17:01
20	07:40 17:28	07:10 18:04	06:28 18:34	17:59-18:08/9	06:40 20:05	06:05 20:34	05:55 20:54	06:11 20:47	06:39 20:14	07:08 19:25	18:28-18:31/3	07:11 17:03	07:41 17:01
21	07:40 17:29	07:09 18:05	06:27 18:35	17:59-18:08/9	06:38 20:06	06:04 20:35	05:55 20:54	06:12 20:47	06:40 20:12	07:09 19:23	18:28-18:31/3	07:12 17:02	07:42 17:01
22	07:39 17:30	07:08 18:06	06:25 18:36	17:59-18:08/9	06:37 20:07	06:04 20:36	05:55 20:54	06:12 20:46	06:41 20:11	07:10 19:22	18:28-18:31/3	07:13 17:01	07:43 17:01
23	07:39 17:31	07:06 18:08	06:23 18:37	17:59-18:08/9	06:36 20:08	06:03 20:37	05:56 20:54	06:13 20:45	06:42 20:09	07:11 19:20	18:28-18:31/3	07:14 17:00	07:44 17:01
24	07:38 17:32	07:05 18:09	06:22 18:38	17:59-18:08/9	06:34 20:09	06:02 20:38	05:56 20:55	06:14 20:44	06:43 20:08	07:12 19:18	18:28-18:31/3	07:15 17:00	07:45 17:01
25	07:37 17:34	07:03 18:10	06:20 18:39	17:59-18:08/9	06:33 20:10	06:02 20:39	05:56 20:55	06:15 20:44	06:44 20:06	07:13 19:17	18:28-18:31/3	07:16 17:00	07:46 17:01
26	07:37 17:35	07:02 18:11	06:18 18:40	17:59-18:08/9	06:31 20:11	06:01 20:40	05:56 20:55	06:16 20:43	06:45 20:05	07:13 19:15	18:28-18:31/3	07:17 17:00	07:47 17:01
27	07:36 17:36	07:01 18:12	06:17 18:41	17:59-18:08/9	06:30 20:12	06:00 20:40	05:57 20:55	06:17 20:42	06:46 20:03	07:14 19:14	18:28-18:31/3	07:18 17:00	07:48 17:01
28	07:35 17:37	06:59 18:13	06:15 18:42	17:59-18:08/9	06:29 20:13	06:00 20:41	05:57 20:55	06:18 20:41	06:46 20:02	18:42-18:50/8	18:28-18:31/3	07:19 17:00	07:49 17:01
29	07:34 17:38	07:34 19:43	07:14 19:42	17:59-18:08/9	06:28 20:14	05:59 20:42	05:58 20:55	06:19 20:40	06:47 20:00	07:16 19:10	18:38-18:48/10	07:20 17:00	07:50 17:01
30	07:34 17:39	07:34 19:44	07:12 19:44	17:59-18:08/9	06:26 20:15	05:59 20:43	05:58 20:55	06:19 20:39	06:48 19:59	07:17 19:09	18:36-18:47/11	07:21 17:00	07:51 17:01
31	07:33 17:41	07:33 19:45	07:10 19:45	17:59-18:08/9	06:25 20:16	05:58 20:44	05:57 20:55	06:18 20:38	06:47 19:57	07:18 19:09	18:36-18:47/11	07:22 17:00	07:52 17:01
Potential sun hours	301	299	370	397	445	448	455	425	374	29	82	301	292
Sum of minutes with flicker	0	0	103	0	0	0	0	0	0	29	82	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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

Via Santa Margherita 4

IT-09124 Cagliari

+39 070 658297

Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

20/03/2023 10:00/3.4.415

### SHADOW - Calendar per WTG

Calculation: Progetto\_layout\_2023\_03\_17WTG: AG08 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (71)

#### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December				
1	07:44	07:32	06:58	07:09	06:25	05:58	19:11-20:13/62	05:58	19:16-20:21/65	06:21	19:44-20:00/16	06:50	07:18	06:50	07:24	
	17:09	17:42	18:14	19:46	20:16	20:44		20:55		20:37		19:56	19:07	17:22	16:59	
2	07:44	07:31	06:56	07:07	06:24	05:57	19:12-20:13/61	05:59	19:16-20:22/66	06:22		06:51	07:19	06:52	07:25	
	17:10	17:43	18:15	19:47	20:17	20:45		20:55		20:36		19:54	19:05	17:21	16:59	
3	07:44	07:30	06:55	07:06	06:22	05:57	19:12-20:14/62	05:59	19:16-20:21/65	06:23		06:52	07:20	06:53	07:26	
	17:10	17:44	18:16	19:48	20:18	20:46		20:55		20:35		19:53	19:04	17:20	16:59	
4	07:44	07:29	06:53	07:04	06:21	05:56	19:11-20:14/63	06:00	19:17-20:22/65	06:24		06:53	07:21	06:54	07:27	
	17:11	17:45	18:17	19:49	20:19	20:46		20:54		20:34		19:51	19:02	17:19	16:59	
5	07:44	07:28	06:52	07:02	06:20	05:56	19:11-20:15/64	06:00	19:17-20:21/64	06:25		06:54	07:22	06:55	07:28	
	17:12	17:47	18:18	19:50	20:20	20:47		20:54		20:33		19:49	19:01	17:18	16:59	
6	07:44	07:27	06:50	07:01	06:19	05:56	19:11-20:15/64	06:01	19:18-20:22/64	06:26		06:55	07:23	06:56	07:29	
	17:13	17:48	18:20	19:51	20:21	20:48		20:54		20:32		19:48	18:59	17:17	16:59	
7	07:44	07:26	06:49	06:59	06:18	05:56	19:12-20:16/64	06:02	19:18-20:22/64	06:27		06:56	07:24	06:57	07:30	
	17:14	17:49	18:21	19:52	20:22	20:48		20:54		20:30		19:46	18:57	17:16	16:59	
8	07:44	07:25	06:47	06:58	06:17	05:55	19:12-20:16/64	06:02	19:18-20:21/63	06:28		06:57	07:25	06:58	07:30	
	17:15	17:50	18:22	19:53	20:23	20:49		20:53		20:29		19:45	18:56	17:15	16:59	
9	07:44	07:24	06:46	06:56	06:16	05:55	19:11-20:16/65	06:03	19:19-20:22/63	06:29		06:58	07:26	07:00	07:31	
	17:16	17:51	18:23	19:54	20:24	20:49		20:53		20:28		19:43	18:54	17:14	16:59	
10	07:44	07:23	06:44	06:55	06:14	05:55	19:11-20:16/65	06:03	19:19-20:21/62	06:30		06:58	07:27	07:01	07:32	
	17:17	17:52	18:24	19:55	20:25	20:50		20:53		20:27		19:41	18:53	17:13	16:59	
11	07:44	07:22	06:42	06:53	06:13	19:37-19:45/8	05:55	19:11-20:17/66	06:04	19:19-20:21/62	06:30		06:59	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:50		20:52		20:26		19:40	18:51	17:12	16:59	
12	07:44	07:20	06:41	06:52	06:12	19:32-19:51/19	05:55	19:12-20:17/65	06:05	19:20-20:21/61	06:31		07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51		20:52		20:24		19:38	18:50	17:11	16:59	
13	07:43	07:19	06:39	06:50	06:11	19:28-19:54/26	05:55	19:12-20:17/65	06:05	19:20-20:20/60	06:32		07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51		20:51		20:23		19:36	18:48	17:10	16:59	
14	07:43	07:18	06:38	06:49	06:10	19:26-19:56/30	05:55	19:12-20:18/66	06:06	19:21-20:20/59	06:33		07:02	07:31	07:05	07:35
	17:21	17:57	18:28	19:59	20:29	20:52		20:51		20:22		19:35	18:47	17:09	16:59	
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	17:22	17:58	18:29	20:00	20:30	20:52		20:50		20:20		19:33	18:45	17:08	16:59	
16	07:42	07:15	06:35	06:46	06:09	19:22-19:59/37	05:55	19:12-20:18/66	06:08	19:23-20:20/57	06:35		07:04	07:33	07:08	07:37
	17:23	18:00	18:30	20:01	20:31	20:53		20:50		20:19		19:32	18:44	17:07	17:00	
17	07:42	07:14	06:33	06:44	06:08	19:20-20:01/41	05:55	19:12-20:18/66	06:08	19:22-20:19/57	06:36		07:05	07:34	07:09	07:37
	17:24	18:01	18:31	20:02	20:32	20:53		20:49		20:18		19:30	18:42	17:07	17:00	
18	07:41	07:13	06:31	06:43	06:07	19:20-20:03/43	05:55	19:12-20:19/67	06:09	19:23-20:19/56	06:37		07:06	07:35	07:10	07:38
	17:25	18:02	18:32	20:03	20:33	20:53		20:49		20:16		19:28	18:41	17:06	17:00	
19	07:41	07:12	06:30	06:41	06:06	19:19-20:04/45	05:55	19:13-20:20/67	06:10	19:24-20:18/54	06:38		07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:33	20:54		20:48		20:15		19:27	18:39	17:05	17:01	
20	07:40	07:10	06:28	06:40	06:05	19:17-20:05/48	05:55	19:13-20:20/67	06:11	19:25-20:18/53	06:39		07:08	07:37	07:12	07:39
	17:28	18:04	18:34	20:05	20:34	20:54		20:47		20:14		19:25	18:38	17:05	17:01	
21	07:40	07:09	06:27	06:38	06:04	19:16-20:05/49	05:55	19:13-20:20/67	06:12	19:25-20:17/52	06:40		07:09	07:38	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54		20:47		20:12		19:23	18:37	17:04	17:02	
22	07:39	07:08	06:25	06:37	06:04	19:16-20:07/51	05:55	19:13-20:20/67	06:12	19:26-20:16/50	06:41		07:10	07:40	07:14	07:40
	17:30	18:06	18:36	20:07	20:36	20:54		20:46		20:11		19:22	18:35	17:03	17:02	
23	07:39	07:06	06:23	06:36	06:03	19:15-20:07/52	05:56	19:13-20:20/67	06:13	19:27-20:15/48	06:42		07:11	07:41	07:15	07:41
	17:31	18:07	18:37	20:08	20:37	20:54		20:45		20:09		19:20	18:34	17:03	17:03	
24	07:38	07:05	06:22	06:34	06:02	19:14-20:08/54	05:56	19:14-20:21/67	06:14	19:29-20:15/46	06:43		07:12	07:42	07:16	07:41
	17:32	18:09	18:38	20:09	20:38	20:55		20:44		20:08		19:18	18:32	17:02	17:03	
25	07:37	07:03	06:20	06:33	06:01	19:14-20:09/55	05:56	19:14-20:20/66	06:15	19:30-20:14/44	06:44		07:12	06:43	07:18	07:42
	17:33	18:10	18:39	20:10	20:39	20:55		20:44		20:06		19:17	17:31	17:02	17:04	
26	07:37	07:02	06:18	06:31	06:01	19:13-20:09/56	05:56	19:14-20:20/66	06:16	19:31-20:13/42	06:45		07:13	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:40	20:55		20:43		20:05		19:15	17:30	17:01	17:04	
27	07:36	07:01	06:17	06:30	06:00	19:13-20:11/58	05:57	19:15-20:21/66	06:17	19:32-20:11/39	06:45		07:14	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55		20:42		20:03		19:14	17:29	17:01	17:05	
28	07:35	06:59	06:15	06:29	06:00	19:13-20:11/58	05:57	19:15-20:21/66	06:18	19:33-20:09/36	06:46		07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55		20:41		20:02		19:12	17:27	17:00	17:06	
29	07:34		07:14	06:27	05:59	19:13-20:12/59	05:58	19:15-20:21/66	06:18	19:35-20:08/33	06:47		07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55		20:40		20:00		19:10	17:26	17:00	17:06	
30	07:34		07:12	06:26	05:59	19:12-20:12/60	05:58	19:16-20:21/65	06:19	19:37-20:06/29	06:48		07:17	06:48	07:23	07:43
	17:39		19:44	20:15	20:43	20:55		20:39		19:59		19:09	17:25	17:00	17:07	
31	07:33		07:10		05:58	19:12-20:13/61		06:20	19:40-20:03/23	06:49			06:49		07:44	
	17:41		19:45		20:43			20:38		19:57			17:24		17:08	
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292				
Sum of minutes with flicker	0	0	0	0	944	1958	1660	16	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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

Via Santa Margherita 4

IT-09124 Cagliari

+39 070 658297

Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

20/03/2023 10:00/3.4.415

### SHADOW - Calendar per WTG

Calculation: Progetto\_layout\_2023\_03\_17WTG: AG09 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (74)

#### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December		
1	07:44	07:32	06:58	07:09	18:51-19:17/26	06:25	05:58	05:59	06:21	06:50	07:18	06:51	07:24	
	17:09	17:42	18:14	19:46		20:16	20:44	20:55	20:37	19:56	19:07	17:23	17:00	
2	07:44	07:31	06:56	07:07	18:52-19:16/24	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25	
	17:10	17:43	18:15	19:47		20:17	20:45	20:55	20:36	19:54	19:06	17:21	16:59	
3	07:44	07:30	06:55	07:06	18:53-19:15/22	06:23	05:57	06:00	06:23	06:52	07:20	06:53	07:26	
	17:11	17:44	18:16	19:48		20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59	
4	07:44	07:29	06:53	07:04	18:55-19:12/17	06:21	05:57	06:00	06:24	06:53	07:21	06:54	07:27	
	17:12	17:46	18:18	19:49		20:19	20:46	20:54	20:34	19:51	19:02	17:19	16:59	
5	07:44	07:28	06:52	07:03	18:57-19:10/13	06:20	05:56	06:01	06:25	06:54	07:22	06:55	07:28	
	17:12	17:47	18:19	19:50		20:20	20:47	20:54	20:33	19:50	19:01	17:18	16:59	
6	07:44	07:27	06:50	07:01		06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29	
	17:13	17:48	18:20	19:51		20:21	20:48	20:54	20:32	19:48	18:59	17:17	16:59	
7	07:44	07:26	06:49	07:00		06:18	05:56	06:02	06:27	06:56	18:53-19:04/11	07:24	06:57	07:30
	17:14	17:49	18:21	19:52		20:22	20:48	20:54	20:31	19:46	18:58	17:16	16:59	
8	07:44	07:25	06:47	06:58		06:17	05:56	06:02	06:28	06:57	18:50-19:07/17	07:25	06:59	07:31
	17:15	17:50	18:22	19:53		20:23	20:49	20:54	20:29	19:45	18:56	17:15	16:59	
9	07:44	07:24	06:46	06:56		06:16	05:55	06:03	06:29	06:58	18:48-19:09/21	07:26	07:00	07:31
	17:16	17:52	18:23	19:54		20:24	20:49	20:53	20:28	19:43	18:55	17:14	16:59	
10	07:44	07:23	06:44	06:55		06:15	05:55	06:04	06:30	06:59	18:46-19:10/24	07:27	07:01	07:32
	17:17	17:53	18:24	19:55		20:25	20:50	20:53	20:27	19:42	18:53	17:13	16:59	
11	07:44	07:22	06:43	06:53		06:14	05:55	06:04	06:31	07:00	18:44-19:10/26	07:28	07:02	07:33
	17:18	17:54	18:25	19:56		20:26	20:50	20:52	20:26	19:40	18:51	17:12	16:59	
12	07:44	07:20	06:41	06:52		06:13	05:55	06:05	06:32	07:01	18:42-19:10/28	07:29	07:03	07:34
	17:19	17:55	18:26	19:57		20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59	
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	17:20	17:56	18:27	19:58		20:28	20:51	20:52	20:23	19:37	18:48	17:10	16:59	
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	17:21	17:57	18:28	19:59		20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59	
15	07:43	07:17	06:36	06:47		06:10	05:55	06:07	06:34	07:03	18:40-19:11/31	07:32	07:06	07:36
	17:22	17:59	18:29	20:00		20:30	20:52	20:51	20:21	19:33	18:45	17:08	17:00	
16	07:42	07:16	06:35	06:46		06:09	05:55	06:08	06:35	07:04	18:40-19:10/30	07:33	07:08	07:37
	17:23	18:00	18:30	20:01		20:31	20:53	20:50	20:19	19:32	18:44	17:08	17:00	
17	07:42	07:14	06:33	06:44		06:08	05:55	06:09	06:36	07:05	18:40-19:08/28	07:34	07:09	07:38
	17:25	18:01	18:31	20:02		20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00	
18	07:42	07:13	06:31	18:03-18:12/9	06:43	06:07	05:55	06:09	06:37	07:06	18:39-19:07/28	07:35	07:10	07:38
	17:26	18:02	18:32	20:03		20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:01	
19	07:41	07:12	06:30	17:59-18:13/14	06:41	06:06	05:55	06:10	06:38	07:07	18:39-19:05/26	07:36	07:11	07:39
	17:27	18:03	18:33	20:04		20:34	20:54	20:48	20:15	19:27	18:40	17:05	17:01	
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	17:28	18:04	18:34	20:05		20:34	20:54	20:47	20:14	19:25	18:38	17:05	17:01	
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	17:29	18:05	18:35	20:06		20:35	20:54	20:47	20:12	19:24	18:37	17:04	17:02	
22	07:39	07:08	06:25	17:54-18:15/21	06:37	06:04	05:56	06:13	06:41	07:10	18:40-19:00/20	07:40	07:14	07:41
	17:30	18:07	18:36	20:07		20:36	20:54	20:46	20:11	19:22	18:35	17:04	17:02	
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	17:31	18:08	18:37	20:08		20:37	20:55	20:45	20:09	19:20	18:34	17:03	17:03	
24	07:38	07:05	06:22	17:52-18:18/26	06:34	06:02	05:56	06:14	06:43	07:12	18:42-18:56/14	07:42	07:17	07:41
	17:33	18:09	18:38	20:09		20:38	20:55	20:44	20:08	19:19	18:33	17:02	17:03	
25	07:37	07:03	06:20	17:51-18:18/27	06:33	06:02	05:56	06:15	06:44	07:13	18:44-18:55/11	06:43	07:18	07:42
	17:34	18:10	18:39	20:10		20:39	20:55	20:44	20:06	19:17	17:31	17:02	17:04	
26	07:37	07:02	06:19	17:51-18:20/29	06:32	06:01	05:57	06:16	06:45	07:14	18:48-18:53/5	06:44	07:19	07:42
	17:35	18:11	18:40	20:11		20:40	20:55	20:43	20:05	19:15	17:30	17:01	17:04	
27	07:36	07:01	06:17	17:51-18:20/29	06:30	06:00	05:57	06:17	06:46	07:15	06:45	07:20	07:43	
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28	07:35	06:59	06:15	17:50-18:20/30	06:29	06:00	05:57	06:18	06:47	07:15	06:46	07:21	07:43	
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29	07:34	07:14	18:51-19:20/29	06:28	05:59	05:58	06:19	06:48	07:16	06:47	06:47	07:22	07:43	
	17:38		19:43	20:14		20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:07	
30	07:34		18:50-19:19/29	06:26	05:59	05:58	06:20	06:48	07:17	06:48	06:48	07:23	07:44	
	17:40		19:44	20:15		20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07	
31	07:33		18:51-19:19/28	06:25	05:58	05:58	06:20	06:49			06:49	06:49	07:44	
	17:41		19:45	20:13		20:43	20:58	20:38	19:57		17:24	17:08	17:08	
Potential sun hours	301	299	370	397	445	448	455	425	374	441	347	301	292	
Sum of minutes with flicker	0	0	329	102	0	0	0	0	0	441	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:

Progetto\_Vestas\_Escalaplano

Licensed user:

I.A.T. Consulenza e progetti S.r.l.

Via Santa Margherita 4

IT-09124 Cagliari

+39 070 658297

Giuseppe Frongia / direttore@iatprogetti.it

Calculated:

20/03/2023 10:00/3.4.415

### SHADOW - Calendar per WTG

Calculation: Progetto\_layout\_2023\_03\_17WTG: AG10 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (72)

#### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	05:59 20:55	06:21 20:37	06:50 19:56	07:18 19:07	06:51 17:19	16:45-17:00/15 17:00
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	05:59 20:55	06:22 20:36	06:51 19:54	07:19 19:06	06:52 17:21	16:47-16:58/11 16:59
3	07:44 17:11	07:30 17:44	06:55 18:16	07:06 19:48	06:23 20:18	05:57 20:46	06:00 20:55	06:23 20:35	06:52 19:53	07:20 19:04	06:53 17:20	16:49-16:57/8 16:59
4	07:44 17:12	07:29 17:46	06:53 18:18	07:04 19:49	06:21 20:19	05:57 20:46	06:00 20:54	06:24 20:34	06:53 19:51	07:21 19:02	06:54 17:19	16:52-16:56/4 16:59
5	07:44 17:12	07:28 17:47	06:52 18:19	07:03 19:50	06:20 20:20	05:56 20:47	06:01 20:54	06:25 20:33	06:54 19:50	07:22 19:01	06:55 17:18	16:52-16:56/4 16:59
6	07:44 17:13	07:27 17:48	06:50 18:20	07:01 19:51	06:19 20:21	05:56 20:48	06:01 20:54	06:26 20:32	06:55 19:48	07:23 18:59	06:56 17:17	16:52-16:56/4 16:59
7	07:44 17:14	07:26 17:49	06:49 18:21	06:59 19:52	06:18 20:22	05:56 20:48	06:02 20:54	06:27 20:30	06:56 19:46	07:24 18:58	06:57 17:16	16:52-16:56/4 16:59
8	07:44 17:15	07:25 17:50	06:47 18:22	06:58 19:53	06:17 20:23	05:55 20:49	06:02 20:53	06:28 20:29	06:57 19:45	07:25 18:56	06:58 17:15	16:52-16:56/4 16:59
9	07:44 17:16	07:24 17:51	06:46 18:23	06:56 19:54	06:16 20:24	05:55 20:49	06:03 20:53	06:29 20:28	06:58 19:43	07:26 18:54	07:00 17:14	16:52-16:56/4 16:59
10	07:44 17:17	07:23 17:53	06:44 18:24	06:55 19:55	06:15 20:25	05:55 20:50	06:04 20:53	06:30 20:27	06:59 19:41	07:27 18:53	07:01 17:13	16:52-16:56/4 16:59
11	07:44 17:18	07:22 17:54	06:43 18:25	06:53 19:56	06:14 20:26	05:55 20:50	06:04 20:52	06:31 20:26	07:00 19:40	07:28 18:51	07:02 17:12	16:52-16:56/4 16:59
12	07:44 17:19	07:20 17:55	06:41 18:26	06:52 19:57	06:13 20:27	05:55 20:51	06:05 20:52	06:32 20:24	07:00 19:38	07:29 18:50	07:03 17:11	16:52-16:56/4 16:59
13	07:43 17:20	07:19 17:56	06:39 18:27	06:50 19:58	06:12 20:28	05:55 20:51	06:06 20:52	06:32 20:23	07:01 19:37	07:30 18:48	07:04 17:10	16:52-16:56/4 16:59
14	07:43 17:21	07:18 17:57	06:38 18:28	06:49 19:59	06:11 20:29	05:55 20:52	06:06 20:51	06:33 20:22	07:02 19:35	07:31 18:47	07:05 17:09	16:52-16:56/4 16:59
15	07:43 17:22	07:17 17:59	06:36 18:29	06:47 20:00	06:10 20:30	05:55 20:52	06:07 20:51	06:34 20:20	07:03 19:33	07:32 18:45	17:52-18:02/10 17:08	16:52-16:56/4 16:59
16	07:42 17:23	07:16 18:00	06:35 18:30	06:46 20:01	06:09 20:31	05:55 20:53	06:08 20:50	06:35 20:19	07:04 19:32	07:33 18:44	17:49-18:05/16 17:08	16:52-16:56/4 16:59
17	07:42 17:25	07:14 18:01	06:33 18:31	06:44 20:02	06:08 20:32	05:55 20:53	06:09 20:49	06:36 20:18	07:05 19:30	07:34 18:42	17:47-18:06/19 17:07	16:52-16:56/4 16:59
18	07:41 17:26	07:13 18:02	06:31 18:32	06:43 20:03	06:07 20:33	05:55 20:53	06:09 20:49	06:37 20:16	07:06 19:28	07:35 18:41	17:45-18:07/22 17:06	16:52-16:56/4 16:59
19	07:41 17:27	07:12 18:03	06:30 18:33	06:41 20:04	06:06 20:34	05:55 20:54	06:10 20:48	06:38 20:15	07:07 19:27	07:36 18:40	17:43-18:08/25 17:05	16:52-16:56/4 16:59
20	07:41 17:28	07:10 18:04	06:28 18:34	06:40 20:05	06:05 20:34	05:55 20:54	06:11 20:47	06:39 20:14	07:08 19:25	07:37 18:38	17:43-18:10/27 17:05	16:52-16:56/4 16:59
21	07:40 17:29	07:09 18:05	06:27 18:35	06:38 20:06	06:05 20:35	05:55 20:54	06:12 20:47	06:40 20:12	07:09 19:23	07:39 18:37	17:42-18:10/28 17:04	16:52-16:56/4 16:59
22	07:39 17:30	07:08 18:07	06:25 18:36	06:37 20:07	06:04 20:36	05:56 20:54	06:13 20:46	06:41 20:11	07:10 19:22	07:40 18:35	17:42-18:10/28 17:03	16:52-16:56/4 16:59
23	07:39 17:31	07:06 18:08	06:23 18:37	06:36 20:08	06:03 20:37	05:56 20:55	06:13 20:45	06:42 20:09	07:11 19:20	07:41 18:34	17:41-18:10/29 17:03	16:52-16:56/4 16:59
24	07:38 17:33	07:05 18:09	06:22 18:38	06:34 20:09	06:02 20:38	05:56 20:55	06:14 20:44	06:43 20:08	07:12 19:19	07:42 18:33	17:41-18:10/29 17:02	16:52-16:56/4 16:59
25	07:37 17:34	07:03 18:10	06:20 18:39	06:33 20:10	06:02 20:39	05:56 20:55	06:15 20:44	06:44 20:06	07:13 19:17	06:43 17:31	16:41-17:08/27 17:02	16:52-16:56/4 16:59
26	07:37 17:35	07:02 18:11	06:19 18:40	06:32 20:11	06:01 20:40	05:57 20:55	06:16 20:43	06:45 20:05	07:14 19:15	06:44 17:30	16:40-17:07/27 17:01	16:52-16:56/4 16:59
27	07:36 17:36	07:01 18:12	06:17 18:41	06:30 20:12	06:00 20:40	05:57 20:55	06:17 20:42	06:46 20:03	07:14 19:14	06:45 17:29	16:41-17:06/25 17:01	16:52-16:56/4 16:59
28	07:35 17:37	06:59 18:13	06:15 18:42	06:29 20:13	06:00 20:41	05:57 20:55	06:18 20:41	06:47 20:02	07:15 19:12	06:46 17:27	16:42-17:05/23 17:01	16:52-16:56/4 16:59
29	07:34 17:38		07:14 19:43	06:28 20:14	05:59 20:42	05:58 20:55	06:19 20:40	06:47 20:00	07:16 19:10	06:47 17:26	16:42-17:03/21 17:00	16:52-16:56/4 16:59
30	07:34 17:40		07:12 19:44	06:26 20:15	05:59 20:43	05:58 20:55	06:20 20:39	06:48 19:59	07:17 19:09	06:48 17:25	16:43-17:02/19 17:00	16:52-16:56/4 16:59
31	07:33 17:41		07:11 19:45	06:25 20:15	05:58 20:43	05:57 20:55	06:20 20:38	06:49 19:57		06:49 17:24	16:43-17:00/17 17:00	16:52-16:56/4 16:59
Potential sun hours	301	299	370	397	445	448	455	425	374	347	392	38
Sum of minutes with flicker	0	423	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: Progetto\_layout\_2023\_03\_17WTG: AG11 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (73)

### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44 17:09	07:32 17:42	06:58 18:14	07:09 19:46	06:25 20:16	05:58 20:44	05:58 20:55	06:21 20:37	06:50 19:56	07:18 19:07	06:51 17:22	07:24 17:00
2	07:44 17:10	07:31 17:43	06:56 18:15	07:07 19:47	06:24 20:17	05:57 20:45	05:59 20:55	06:22 20:36	06:51 19:54	07:19 19:05	06:52 17:21	07:25 16:59
3	07:44 17:11	07:30 17:44	06:55 18:16	07:06 19:48	06:23 20:18	05:57 20:46	05:59 20:55	06:23 20:35	06:52 19:53	07:20 19:04	06:53 17:20	07:26 16:59
4	07:44 17:11	07:29 17:45	06:53 18:17	07:04 19:49	06:21 20:19	05:57 20:46	06:00 20:54	06:24 20:34	06:53 19:51	07:21 19:02	06:54 17:19	07:27 16:59
5	07:44 17:12	07:28 17:47	06:52 18:19	07:03 19:50	06:20 20:20	05:56 20:47	06:01 20:54	06:25 20:33	06:54 19:49	07:22 19:01	06:55 17:18	07:28 16:59
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13	07:43 17:20	07:19 17:56	06:39 18:27	06:50 19:58	06:11 20:28	05:55 20:51	06:06 20:51	06:32 20:23	07:01 19:37	07:30 18:48	07:04 17:10	07:35 16:59
14	07:43 17:21	07:18 17:57	06:38 18:28	06:49 19:59	06:11 20:29	05:55 20:52	06:06 20:51	06:33 20:22	07:02 19:35	07:31 18:47	07:05 17:09	07:35 16:59
15	07:43 17:22	07:17 17:58	06:36 18:29	06:47 20:00	06:10 20:30	05:55 20:52	06:07 20:50	06:34 20:20	07:03 19:33	07:32 18:45	07:06 17:08	07:36 16:59
16	07:42 17:23	07:15 18:00	06:35 18:30	06:46 20:01	06:09 20:31	05:55 20:53	06:08 20:50	06:35 20:19	07:04 19:32	07:33 18:44	07:08 17:08	07:37 17:00
17	07:42 17:24	07:14 18:01	06:33 18:31	06:44 20:02	06:08 20:32	05:55 20:53	06:09 20:49	06:36 20:18	07:05 19:30	07:34 18:42	07:09 17:07	07:38 17:00
18	07:41 17:26	07:13 18:02	06:31 18:32	06:43 20:03	06:07 20:33	05:55 20:53	06:09 20:49	06:37 20:16	07:06 19:28	07:06 18:41	07:10 17:06	07:38 17:00
19	07:41 17:27	07:12 18:03	06:30 18:33	06:41 20:04	06:06 20:33	05:55 20:54	06:10 20:48	06:38 20:15	07:07 19:27	07:36 18:39	07:11 17:05	07:39 17:01
20	07:40 17:28	07:10 18:04	06:28 18:34	06:40 20:05	06:05 20:34	05:55 20:54	06:11 20:47	06:39 20:14	07:08 19:25	07:37 18:38	07:12 17:05	07:39 17:01
21	07:40 17:29	07:09 18:05	06:27 18:35	06:38 20:06	06:04 20:35	05:55 20:54	06:12 20:47	06:40 20:12	07:09 19:23	07:38 18:37	07:13 17:04	07:40 17:02
22	07:39 17:30	07:08 18:06	06:25 18:36	06:37 20:07	06:04 20:36	05:55 20:54	06:13 20:46	06:41 20:11	07:10 19:22	07:40 18:35	07:14 17:03	07:40 17:02
23	07:39 17:31	07:06 18:08	06:23 18:37	06:36 20:08	06:03 20:37	05:56 20:54	06:13 20:45	06:42 20:09	07:11 19:20	07:41 18:34	07:15 17:03	07:41 17:03
24	07:38 17:32	07:05 18:09	06:22 18:38	06:34 20:09	06:02 20:38	05:56 20:55	06:14 20:44	06:43 20:08	07:12 19:18	07:42 18:33	07:16 17:02	07:41 17:03
25	07:37 17:34	07:03 18:10	06:20 18:39	06:33 20:10	06:02 20:39	05:56 20:55	06:15 20:44	06:44 20:06	07:13 19:17	07:43 17:31	07:18 17:02	07:42 17:04
26	07:37 17:35	07:02 18:11	06:19 18:40	06:32 20:11	06:01 20:40	05:56 20:55	06:16 20:43	06:45 20:05	07:13 19:15	07:44 17:30	07:19 17:01	07:42 17:04
27	07:36 17:36	07:01 18:12	06:17 18:41	06:30 20:12	06:00 20:40	05:57 20:55	06:17 20:42	06:46 20:03	07:14 19:14	07:45 17:29	07:20 17:01	07:43 17:05
28	07:35 17:37	06:59 18:13	06:15 18:42	06:29 20:13	06:00 20:41	05:57 20:55	06:18 20:41	06:46 20:02	07:15 19:12	07:46 17:27	07:21 17:01	07:43 17:06
29	07:34 17:38		07:14 19:43	06:28 20:14	05:59 20:42	05:58 20:55	06:19 20:40	06:47 20:00	07:16 19:10	07:47 17:26	07:22 17:00	07:43 17:06
30	07:34 17:39		07:12 19:44	06:26 20:15	05:59 20:43	05:58 20:55	06:19 20:39	06:48 19:59	07:17 19:09	07:48 17:25	07:23 17:00	07:43 17:07
31	07:33 17:41		07:10 19:45		05:58 20:43		06:20 20:38	06:49 19:57		06:49 17:24		07:44 17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
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) 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

Calculation: Progetto\_layout\_2023\_03\_17WTG: AG12 - VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (76)

### Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset

The rotor plane is always perpendicular to the line from the WTG to the sun

The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:44	07:32	06:58	07:09	06:25	05:58	05:58	06:21	06:50	07:18	06:50	07:24
	17:09	17:42	18:14	19:46	20:16	20:44	20:55	20:37	19:56	19:07	17:22	16:59
2	07:44	07:31	06:56	07:07	06:24	05:57	05:59	06:22	06:51	07:19	06:52	07:25
	17:10	17:43	18:15	19:47	20:17	20:45	20:55	20:36	19:54	19:05	17:21	16:59
3	07:44	07:30	06:55	07:06	06:22	05:57	05:59	06:23	06:52	07:20	06:53	07:26
	17:10	17:44	18:16	19:48	20:18	20:46	20:55	20:35	19:53	19:04	17:20	16:59
4	07:44	07:29	06:53	07:04	06:21	05:56	06:00	06:24	06:53	07:21	06:54	07:27
	17:11	17:45	18:17	19:49	20:19	20:46	20:54	20:34	19:51	19:02	17:19	16:59
5	07:44	07:28	06:52	07:02	06:20	05:56	06:00	06:25	06:54	07:22	06:55	07:28
	17:12	17:47	18:18	19:50	20:20	20:47	20:54	20:33	19:49	19:01	17:18	16:59
6	07:44	07:27	06:50	07:01	06:19	05:56	06:01	06:26	06:55	07:23	06:56	07:29
	17:13	17:48	18:20	19:51	20:21	20:47	20:54	20:32	19:48	18:59	17:17	16:59
7	07:44	07:26	06:49	06:59	06:18	05:56	06:02	06:27	06:56	07:24	06:57	07:30
	17:14	17:49	18:21	19:52	20:22	20:48	20:54	20:30	19:46	18:57	17:16	16:59
8	07:44	07:25	06:47	06:58	06:17	05:55	06:02	06:28	06:57	07:25	06:58	07:30
	17:15	17:50	18:22	19:53	20:23	20:49	20:53	20:29	19:45	18:56	17:15	16:59
9	07:44	07:24	06:45	06:56	06:16	05:55	06:03	06:29	06:58	07:26	07:00	07:31
	17:16	17:51	18:23	19:54	20:24	20:49	20:53	20:28	19:43	18:54	17:14	16:59
10	07:44	07:23	06:44	06:55	06:14	05:55	06:03	06:29	06:58	07:27	07:01	07:32
	17:17	17:52	18:24	19:55	20:25	20:50	20:53	20:27	19:41	18:53	17:13	16:59
11	07:44	07:21	06:42	06:53	06:13	05:55	06:04	06:30	06:59	07:28	07:02	07:33
	17:18	17:54	18:25	19:56	20:26	20:50	20:52	20:26	19:40	18:51	17:12	16:59
12	07:43	07:20	06:41	06:52	06:12	05:55	06:05	06:31	07:00	07:29	07:03	07:34
	17:19	17:55	18:26	19:57	20:27	20:51	20:52	20:24	19:38	18:50	17:11	16:59
13	07:43	07:19	06:39	06:50	06:11	05:55	06:05	06:32	07:01	07:30	07:04	07:35
	17:20	17:56	18:27	19:58	20:28	20:51	20:51	20:23	19:36	18:48	17:10	16:59
14	07:43	07:18	06:38	06:49	06:10	05:55	06:06	06:33	07:02	07:31	07:05	07:35
	17:21	17:57	18:28	19:59	20:29	20:52	20:51	20:22	19:35	18:47	17:09	16:59
15	07:43	07:17	06:36	06:47	06:09	05:55	06:07	06:34	07:03	07:32	07:06	07:36
	17:22	17:58	18:29	20:00	20:30	20:52	20:50	20:20	19:33	18:45	17:08	16:59
16	07:42	07:15	06:34	06:46	06:09	05:55	06:08	06:35	07:04	07:33	07:07	07:37
	17:23	17:59	18:30	20:01	20:31	20:53	20:50	20:19	19:32	18:44	17:07	17:00
17	07:42	07:14	06:33	06:44	06:08	05:55	06:08	06:36	07:05	07:34	07:09	07:37
	17:24	18:01	18:31	20:02	20:32	20:53	20:49	20:18	19:30	18:42	17:07	17:00
18	07:41	07:13	06:31	06:43	06:07	05:55	06:09	06:37	07:06	07:35	07:10	07:38
	17:25	18:02	18:32	20:03	20:33	20:53	20:49	20:16	19:28	18:41	17:06	17:00
19	07:41	07:12	06:30	06:41	06:06	05:55	06:10	06:38	07:07	07:36	07:11	07:39
	17:27	18:03	18:33	20:04	20:33	20:54	20:48	20:15	19:27	18:39	17:05	17:01
20	07:40	07:10	06:28	06:40	06:05	05:55	06:11	06:39	07:08	07:37	07:12	07:39
	17:28	18:04	18:34	20:05	20:34	20:54	20:47	20:14	19:25	18:38	17:05	17:01
21	07:40	07:09	06:26	06:38	06:04	05:55	06:12	06:40	07:09	07:38	07:13	07:40
	17:29	18:05	18:35	20:06	20:35	20:54	20:47	20:12	19:23	18:37	17:04	17:02
22	07:39	07:08	06:25	06:37	06:04	05:55	06:12	06:41	07:10	07:39	07:14	07:40
	17:30	18:06	18:36	20:07	20:36	20:54	20:46	20:11	19:22	18:35	17:03	17:02
23	07:39	07:06	06:23	06:36	06:03	05:56	06:13	06:42	07:11	07:41	07:15	07:41
	17:31	18:07	18:37	20:08	20:37	20:54	20:45	20:09	19:20	18:34	17:03	17:03
24	07:38	07:05	06:22	06:34	06:02	05:56	06:14	06:43	07:12	07:42	07:16	07:41
	17:32	18:09	18:38	20:09	20:38	20:55	20:44	20:08	19:18	18:32	17:02	17:03
25	07:37	07:03	06:20	06:33	06:01	05:56	06:15	06:44	07:12	06:43	07:17	07:42
	17:33	18:10	18:39	20:10	20:39	20:55	20:43	20:06	19:17	17:31	17:02	17:04
26	07:37	07:02	06:18	06:31	06:01	05:56	06:16	06:45	07:13	06:44	07:19	07:42
	17:35	18:11	18:40	20:11	20:39	20:55	20:43	20:05	19:15	17:30	17:01	17:04
27	07:36	07:00	06:17	06:30	06:00	05:57	06:17	06:45	07:14	06:45	07:20	07:43
	17:36	18:12	18:41	20:12	20:40	20:55	20:42	20:03	19:14	17:28	17:01	17:05
28	07:35	06:59	06:15	06:29	06:00	05:57	06:18	06:46	07:15	06:46	07:21	07:43
	17:37	18:13	18:42	20:13	20:41	20:55	20:41	20:02	19:12	17:27	17:00	17:06
29	07:34		07:14	06:27	05:59	05:58	06:18	06:47	07:16	06:47	07:22	07:43
	17:38		19:43	20:14	20:42	20:55	20:40	20:00	19:10	17:26	17:00	17:06
30	07:34		07:12	06:26	05:59	05:58	06:19	06:48	07:17	06:48	07:23	07:43
	17:39		19:44	20:15	20:43	20:55	20:39	19:59	19:09	17:25	17:00	17:07
31	07:33		07:10		05:58		06:20	06:49		06:49		07:44
	17:41		19:45		20:43		20:38	19:57		17:24		17:08
Potential sun hours	301	299	370	397	445	448	455	425	374	347	301	292
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

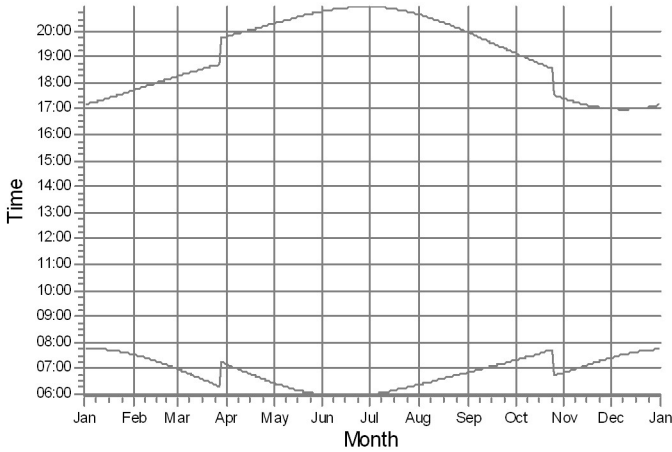
Table layout: For each day in each month the following matrix apply

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

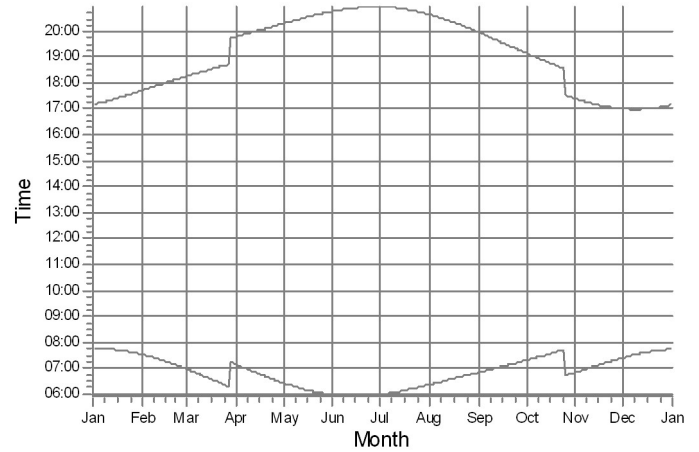
## SHADOW - Calendar per WTG, graphical

Calculation: Progetto\_layout\_2023\_03\_17

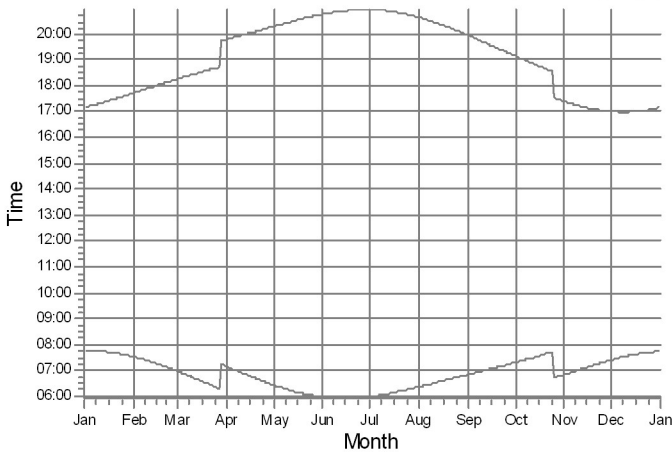
AG01: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (6€



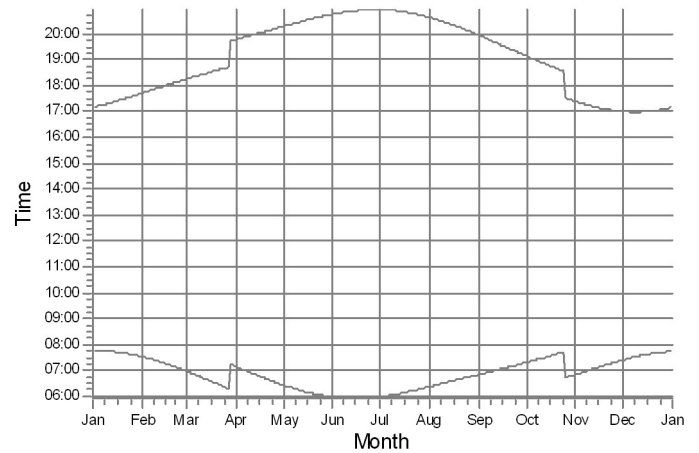
AG02: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (6€



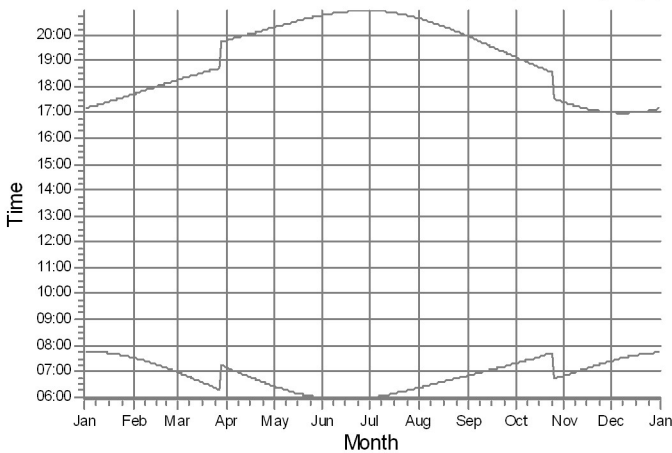
AG03: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (6€



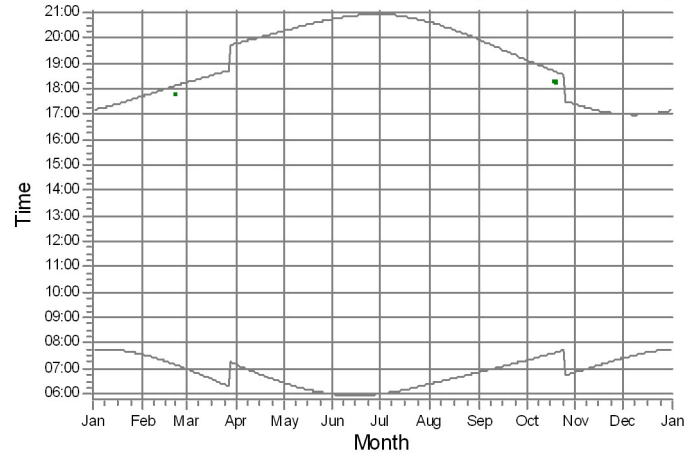
AG04: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (67



AG05: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (6€



AG06: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (75



Shadow receptors

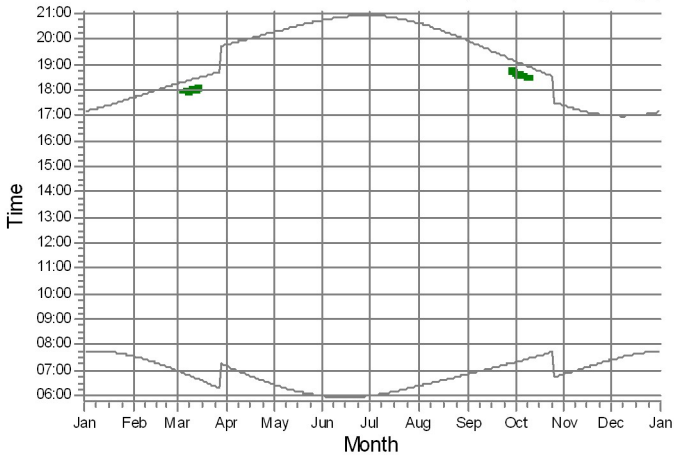
 F19: D10-A4



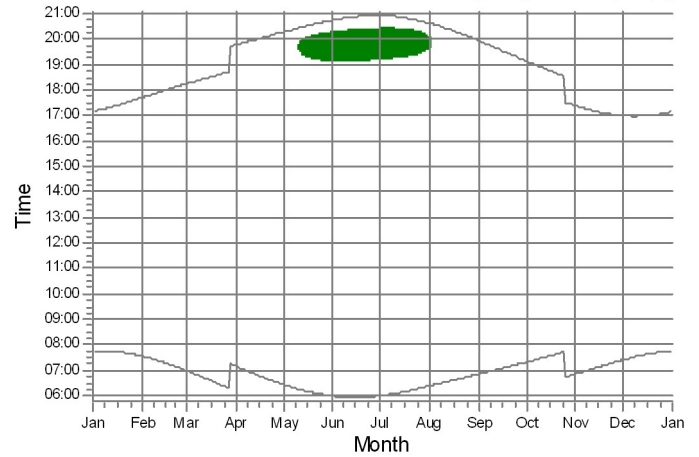
## SHADOW - Calendar per WTG, graphical

Calculation: Progetto\_layout\_2023\_03\_17

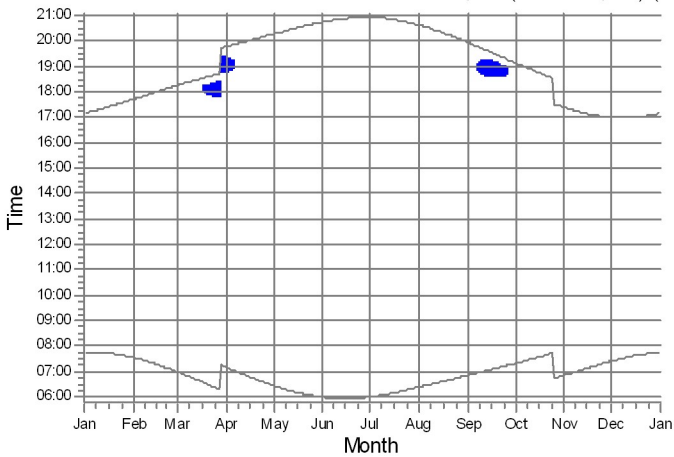
AG07: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (70)



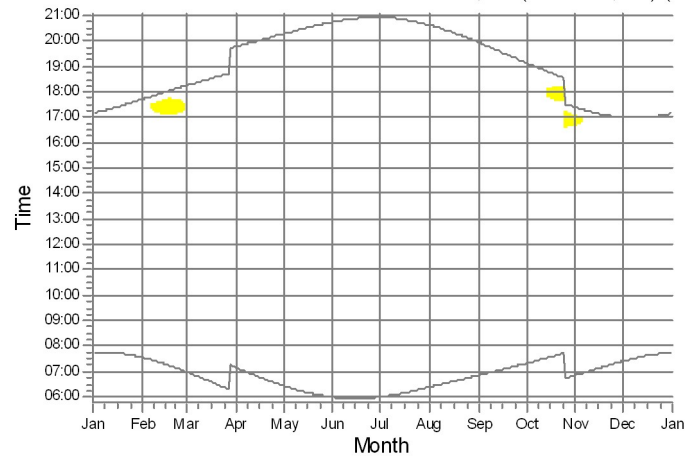
AG08: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (71)



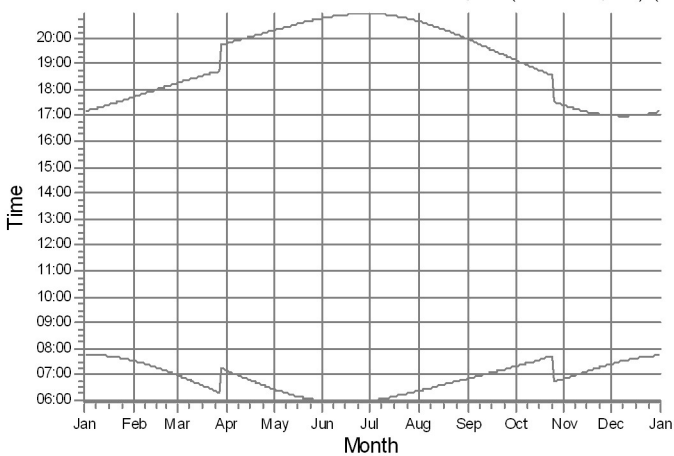
AG09: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (74)



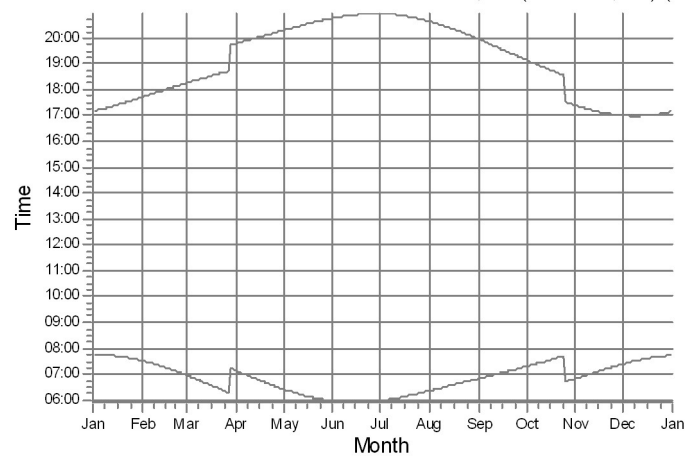
AG10: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (72)



AG11: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (73)



AG12: VESTAS V162-6.0 6000 162.0 !O! hub: 125,0 m (TOT: 206,0 m) (76)



Shadow receptors

- F19: D10-A4
- F26: pascolo
- F49: D03-A03