Floating PV in alpine environment

Return of experience after 4 years for the first alpine FPV and perspectives

ROMANDE ENERGIE

17.10.2024, Andy Kaufmann

Summary

Presentation of the PV plant

Site location

Lake Les Toules, 1’810 m asl

Up to 2m of snow in 24h

60cm ice layer on the lake

Temperature between -25°C and +25°C

Technical description

Structure consists of

35 floaters covered with 40 PV panels (1'400 panels)
1 floater with invertors (PVS-175-TL) and transformer (0.8/20kV, 0.63MVA), weather station

Total surface of PV panels	2240 m^2	frameless bi-facial panels
Row spacing	1.95 m	
Tilt	37° floating	32° aground
Installed PV power	448 kWp	
Annual production	635 MWh	1'418 kWh/kWp
Water level variation	17.40 m	
Considered wind load	42.8 m/s	wind gust 50y return period

Aground from mid December to May

The plant was commissioned in November 2019

Technical description

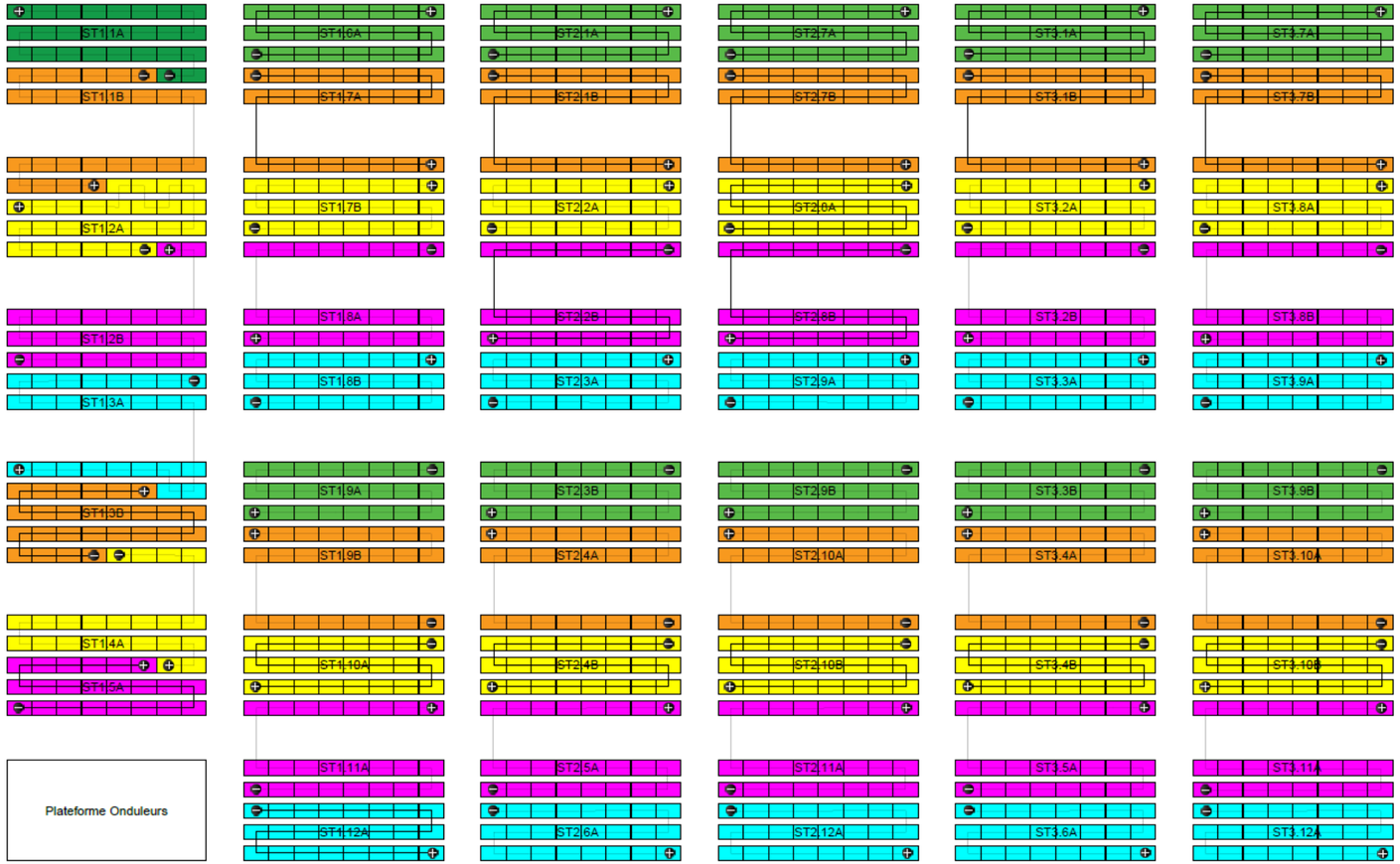
Lessons learned

Lessons learned

Strings composed of 22 or 24 modules.

Each floater hosts 2 or 3 strings. Strings must connect to 2 platforms, making maintenance on water more challenging.

Access to inverters and transformers during winter is conditioned by natural hazards (ice, avalanches, ...)



Lessons learned

Instability of the grounding Plateforme

- Internal erosions due to rain or snow melt
- Soil compaction locally >80cm

Anchoring system

- Needs large aera around the plant
- Unsuitable for larger water level variations

Earthing system

- Variation between floating and grounded states
- Due to ice movements some components were ripped off

PV design

History of PV conception

2013, construction of a terrestrial pilot structure

- Determination of ideal tilt angle
  (compromise between production and snow removal)
- Confirm bi-facial benefit

→ Optimal tilt angle 30°..35°

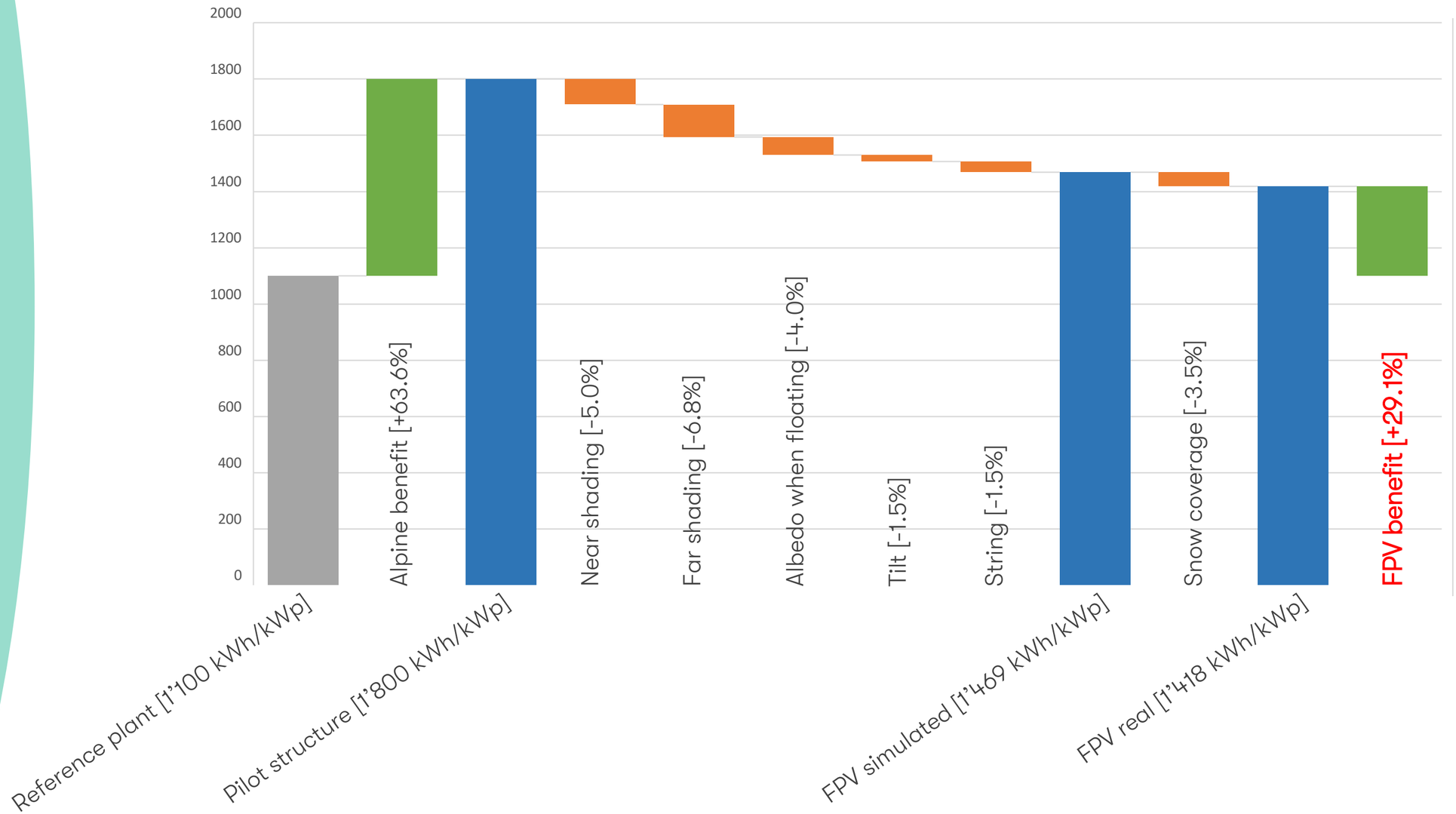
→ Yield >1'800 kWh/kWp

→ No particular ageing process was identified (PValps)

Simulation of floating PV plant (near/far shading, albedo, ...)

→ Expected yield: 1'469 kWh/kWp

Yield evolution from simulation to production



Influence of near shading and snow coverage can be diminished.
A yield of 1'500 kWh/kWp could be attained at Lake les Toules

Losses due to snow

Snowfall

Even with low irradiation, snow removal takes place as forecast (except around winter solstice)

30.03.2020, 9h10

30.03.2020, 10h30

30.03.2020, 11h10

Snowdrift

Preferential areas are subject to heavy deposits of blown snow.

07.02.2021

19.02.2021

module tilting due to overload

Outlook for future projects

Future projects

Technical feasibility for alpine FPV is confirmed

Extension Les Toules

- 13.5 MWp
- 20 ha surface
- New optimized design for floating structure
- Double portrait PV design
- Horizontal axis tracking system under development (wind safety)

Romande Energie has conducted a potential study on hydropower lakes in Switzerland:

- 25 hydropower lakes in Switzerland analysed;
- 11 are favourable;
- 550 GWh/y, >200GWh winter semester

Missing technical and legal framework:

- International development required;
- Proof of structural safety of retaining structures.

Thank you for your attention

Andy Kaufmann
FPV development manager
andy.kaufmann@romande-energie.ch