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ENERGY WEEK

25-27 ՀՈՒՆՎԱՐ/JANUARY, 2017

ÅF Aries Energía

Masrik-1 PV Plant – Feasibility Study

Masrik-1 PV Plant – Feasibility Study

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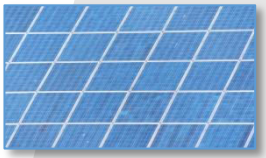
"Enabling Sustainable and Efficient Markets"



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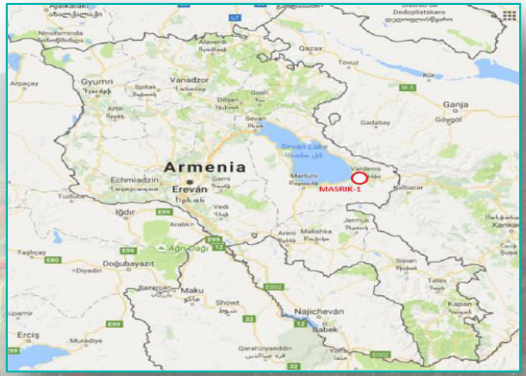
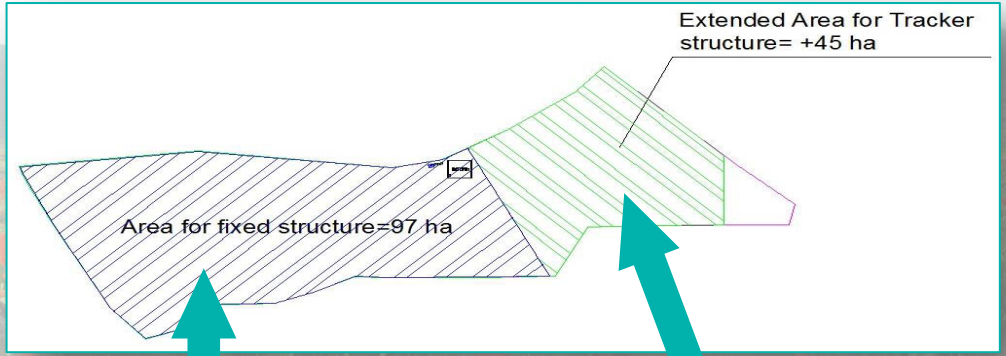
Site Location and Main characteristics



- **Site:** already identified
- **Location:** Mets Masrik
- **Available Area:** 97 Ha+ 45 Ha
- **Communications:** Highway connections to Erevan
- **Height above sea level:** 1930 m
- **Yearly average Rainfall:** 432 mm
- **Snow cover**: 107 days/year, maximum 10 days: 73 cm

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Average temperature (°C) Masrik	-7,1	-6,6	-2,6	2,1	6,5	10,5	11,8	11,9	9,3	3,9	-1,1	-6,0	**2,8**

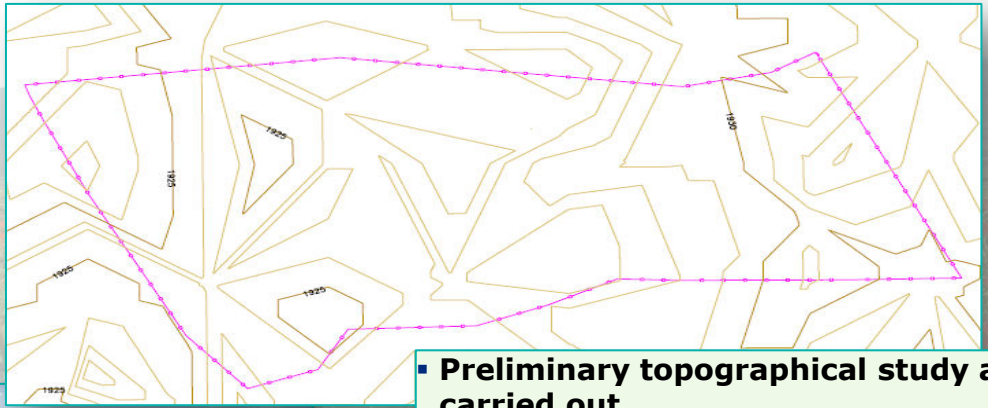
Available area for the 47 MW plant



FIXED STRUCTURE

EXTRA AREA FOR 1 AXIS TRACKING

Topographical conditions



- **Preliminary topographical study already carried out**
- **Flat Area:** As per preliminary topographical study (average slope around 1%)

Geotechnical conditions

- **Preliminary geotechnical study already carried out**
- **Geotechnical conditions**: Favourable for construction works (no geological phenomena in the area)
- **Third seismic zone:** 0,4 g
- **Ground water level**: Estimated average of 2 m with seasonal variation of ± 0.5 m. Ground water not aggressive for concrete

0-1 m	•Vegetation •Sandy Clay Soil
1-4 m	•Clay Difficult Plastic
4-5.5 m	•Sand with boulders and rubble

Connection to the grid

- **Defined grid connection point:** Current option agreed with ENA (Electric Networks of Armenia)
- **Output substation**: A double transformer (2x100% redundancy) step-up substation is requested to connect to the 110 kV network
- **Electrical line**: 10 km double circuit line to connect the output substation to two different lines
- **Connection type:** The output lines will be connected to the network using T connections (one to each line)

Connection to the grid: Options under discussion

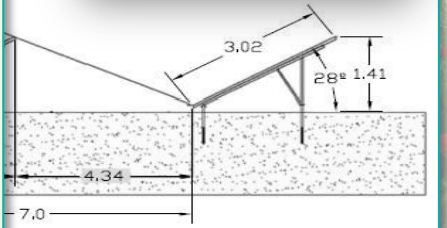
Ongoing discussion with ENA to optimize the current proposal

Possible options:

- **Double transformer:** optimization to a single one
- **Connection type**: In and Out connection instead of T connection type
- **Connection to a single line:** Plant connected to just one of the proposed lines

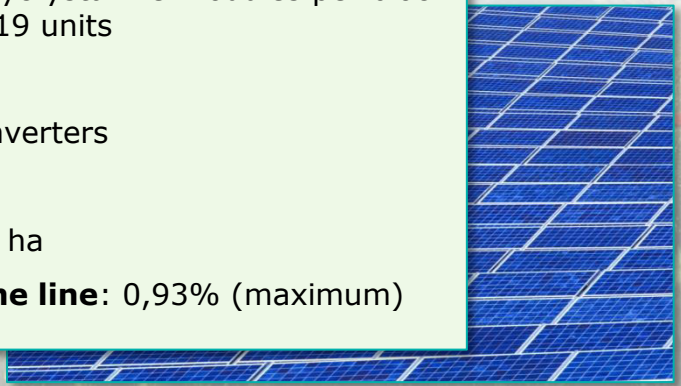
Power plant design and construction

- **Power of the plant:** The rated power capacity of Masrik-1 PV Plant shall be of 47 MW(AC) at the connection Point (optional bigger capacities)
- **Peak Power:** To be decided by the bidders. Around 55 MWp are expected
- **PV modules:** Crystalline modules will be requested, either mono or poly-crystalline
- **Structures:** It will be the decision of the bidder to decide between fixed or one-axis tracking structure
- **Local content:** There is no request of local content



Example of design and performance (1/2)

- **Generating System:** 20 blocks of 2,3 MW (46,55 MW nominal)
- **PV Modules:** 8664 Polycrystalline modules per block connected in series of 19 units
- **DC/AC Ratio**: 20 %
- **Inverters:** 1,15 MW inverters
- **Structure type:** Fixed
- **Area of the Plant:** 97 ha
- **Electrical losses in the line**: 0,93% (maximum)



Example of design and performance (2/2)

MONTH	GHI (kWh/m^2)	TEMP. (ºC)
January	40.5	-7.04
February	52.0	-6.55
March	91.9	-2.64
April	161.1	2.06
May	216.3	6.46
June	256.5	10.50
July	260.0	11.81
August	238.5	11.85
September	189.7	9.29
October	132.9	3.86
November	79.2	-1.10
December	51.6	-5.98
YEAR	**1770.1**	**2.76**

ITEM	VALUE
Energy generated (MWh/year)*	89.109
Specific energy (kWh/kWp/year)*	1.607
Performance Ratio	82.0%

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