



EGAT's Experiences in PV Power Generation

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INTRODUCTION

- ◆ EGAT's Existing PV Demonstration Sites.
- ◆ EGAT's PV Projects with Supported Fund.
- ◆ EGAT's Future PV Projects.
- ◆ Conclusion.

EGAT's Existing PV Demonstration Sites

Electricity Generating Authority of Thailand (EGAT) has been involved in renewable energy since 1977.

Firstly, 40% of PV modules are used for small-scale applications.



Such as : warning lights for high voltage transmission tower, reservoir buoys, meteorological equipment, small lighting & communication in survey camps, remote mountain-top microwave relay stations etc.

EGAT's Existing PV Demonstration Sites

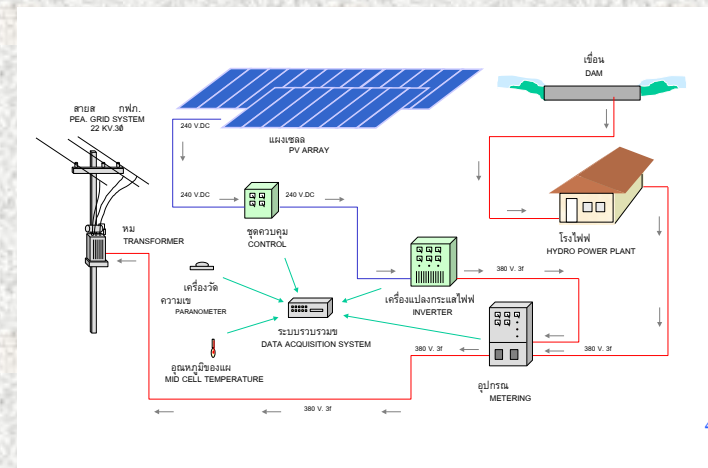
EGAT has 8 PV demonstration sites that are set up to the hybrid/grid connected concept.

1) Klong Chong Klam Village

About 300 km East of Bangkok, this site has existing 20 kW micro hydro power plant and already connected to 22 kV local distribution line of PEA.

:-In 1986, EGAT had installed 20 kWp of PV power system.

:-This is the first PV demonstration site of EGAT's renewable energy program.



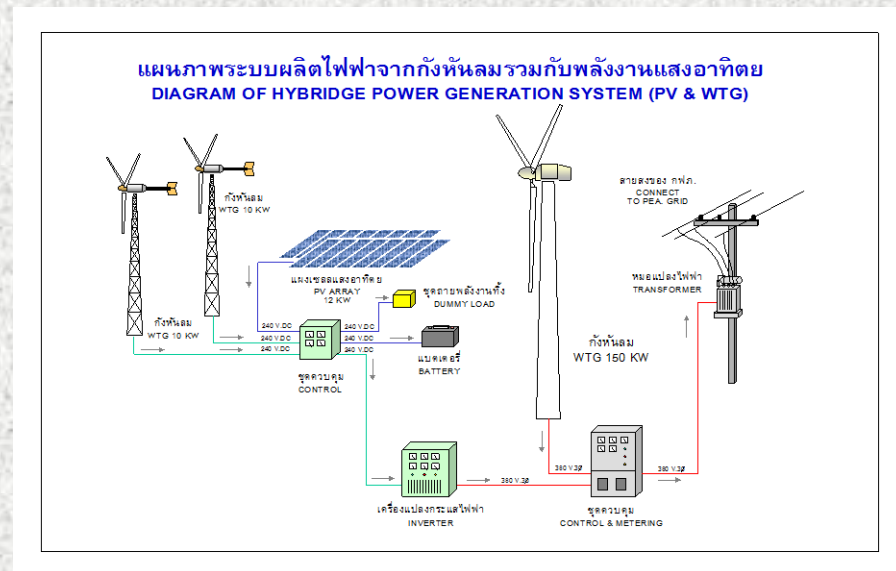
EGAT's Existing PV Demonstration Sites (Cont.)

2) Promthep Alternative Energy Station, Phuket Island.

:- Promthep is an ideal location for wind/PV experimental work and located at about 900 km south of Bangkok.

:- In 1986, EGAT had installed 11 kWp of PV modules, battery, inverters, switch gear and metering facility and hybrid with 150 kW and 2 x 10 kW wind turbines.

:- Nowadays, only 150 kW, 850 W wind turbine and PV 5 kWp are existing.



EGAT's Existing PV Demonstration Sites (Cont.)

3) San Kampaeng Alternative Energy Site

This site is located at about 50 km East of Chiang Mai city with the installation capacity of 34.648 kW.

:- System Components,

*PV Array : 22.97 kWp of Fixed System
11.678 kWp of Tracking System*

Data Acquisition : Webpage base real time monitoring

Local Grid Voltage : 22 kV.

EGAT's Existing PV Demonstration Sites (Cont.)

3) San Kampaeng Alternative Energy Site(cont)



4.5 kWp



14.0 kWp

EGAT's Existing PV Demonstration Sites (Cont.)

3) San Kampaeng Alternative Energy Site(cont)



16.3 kWp

EGAT's Existing PV Demonstration Sites (Cont.)

4) EGAT's Head Office (Building T100)

- Capacity: 5.1 kWp(a-Si)
- Grid Connected: Feb11, 2000



EGAT's Existing PV Demonstration Sites (Cont.)

5) Mae Moe Training Center (Mae Moe Mine, Northern part of Thailand)

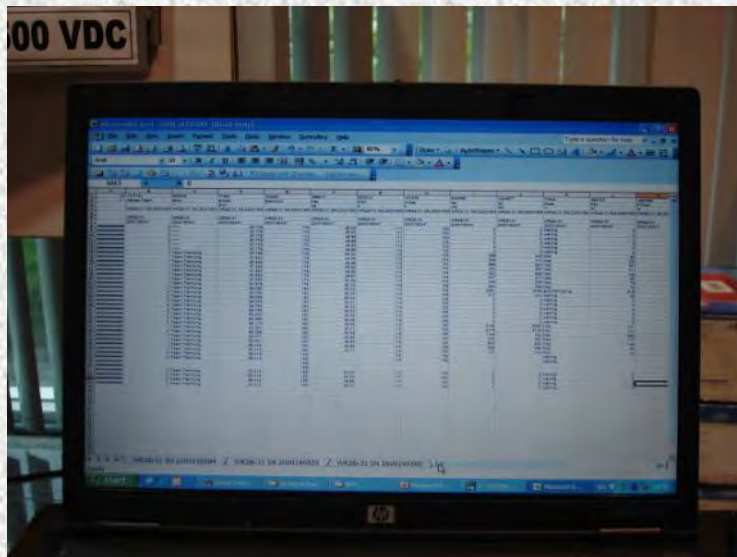
- Capacity: 4.5 kWp(c-Si)
- Grid Connected: September 16, 2002.



EGAT's Existing PV Demonstration Sites (Cont.)

6) EGAT's Head Office (Building T102)

- *a-Si 65 Wp/module*
- *Capacity: 27.82 kWp*
- *Inverter 8 x 2,800W, 1 x 5,000 W*
- *Grid Connected: October, 2007*
- *Generation 22,738 kWh/year.*



EGAT's Existing PV Demonstration Sites (Cont.)

7) Sirindhorn Solar Power Plant (1.014 MWp)



EGAT's Existing PV Demonstration Sites (Cont.)

Sirindhorn Solar Power Plant located on North-East of Thailand

:- System Components,

PV Array : 891.2 kWp of poly-crystalline silicon
120.8 kWp of amorphous silicon
2 kWp of CIS

Inverters : 8x120 kW and 3x2.5 kW

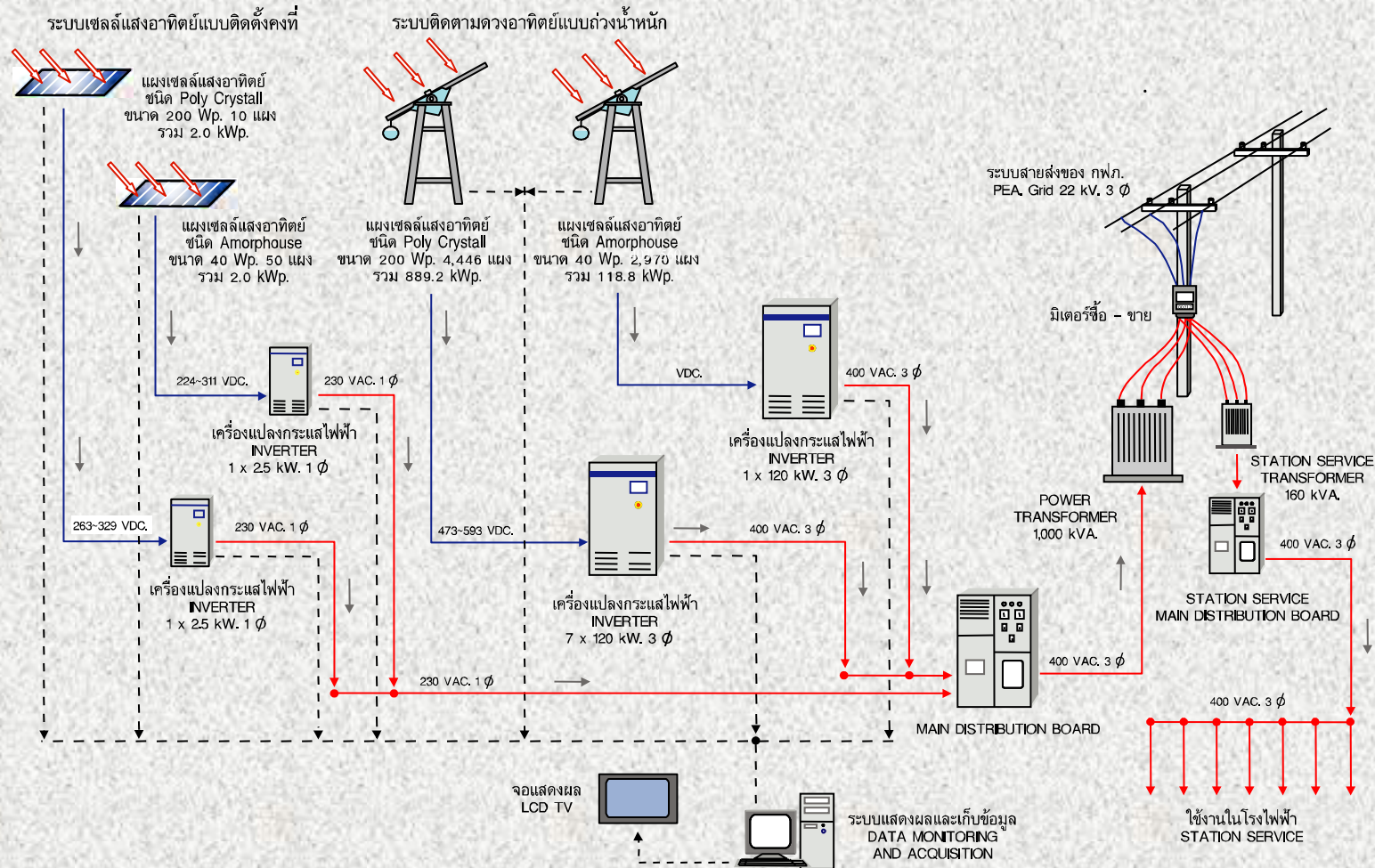
Area : 40,000 m².

Local Grid Voltage : 22 kV. of PEA's network.

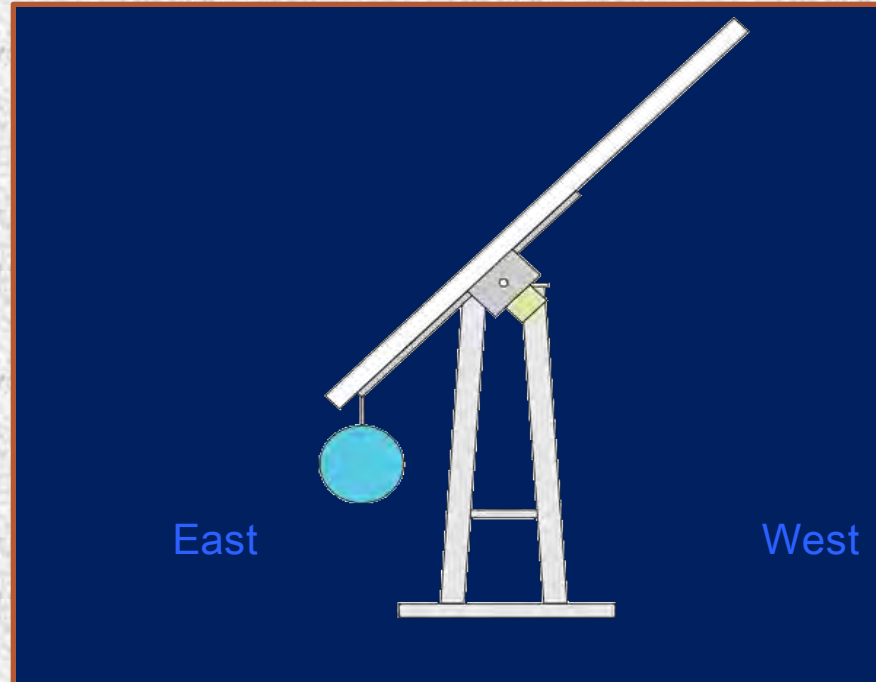
This project was finished and signed Commercial Operation Date (COD) on 30 Nov 2009 by using investment cost of 208 million baht.(6.7 million US\$)

EGAT's Existing PV Demonstration Sites (Cont.)

Circuit Diagram of 1 MW Sirindhorn Dam Solar Power Plant

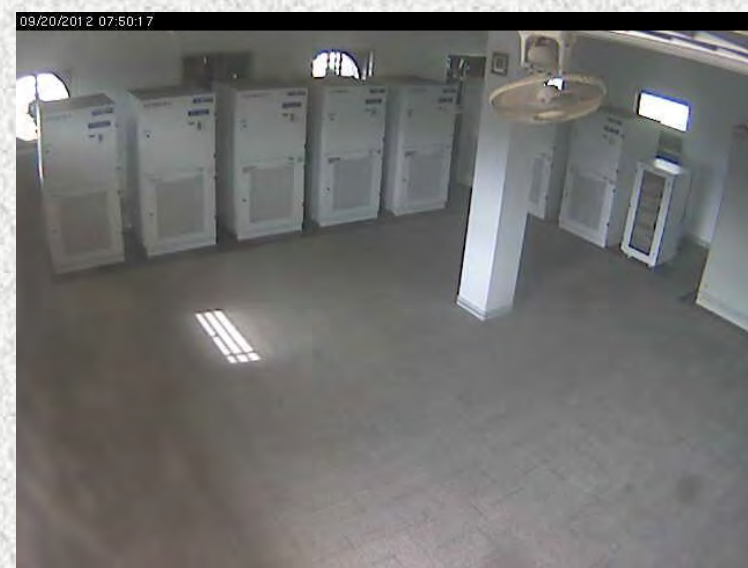


Operation of Solar Tracking by using water weighted



Solar Tracker Animation

EGAT's Existing PV Demonstration Sites (Cont.)



CCTV 5 points

EGAT's Existing PV Demonstration Sites (Cont.)

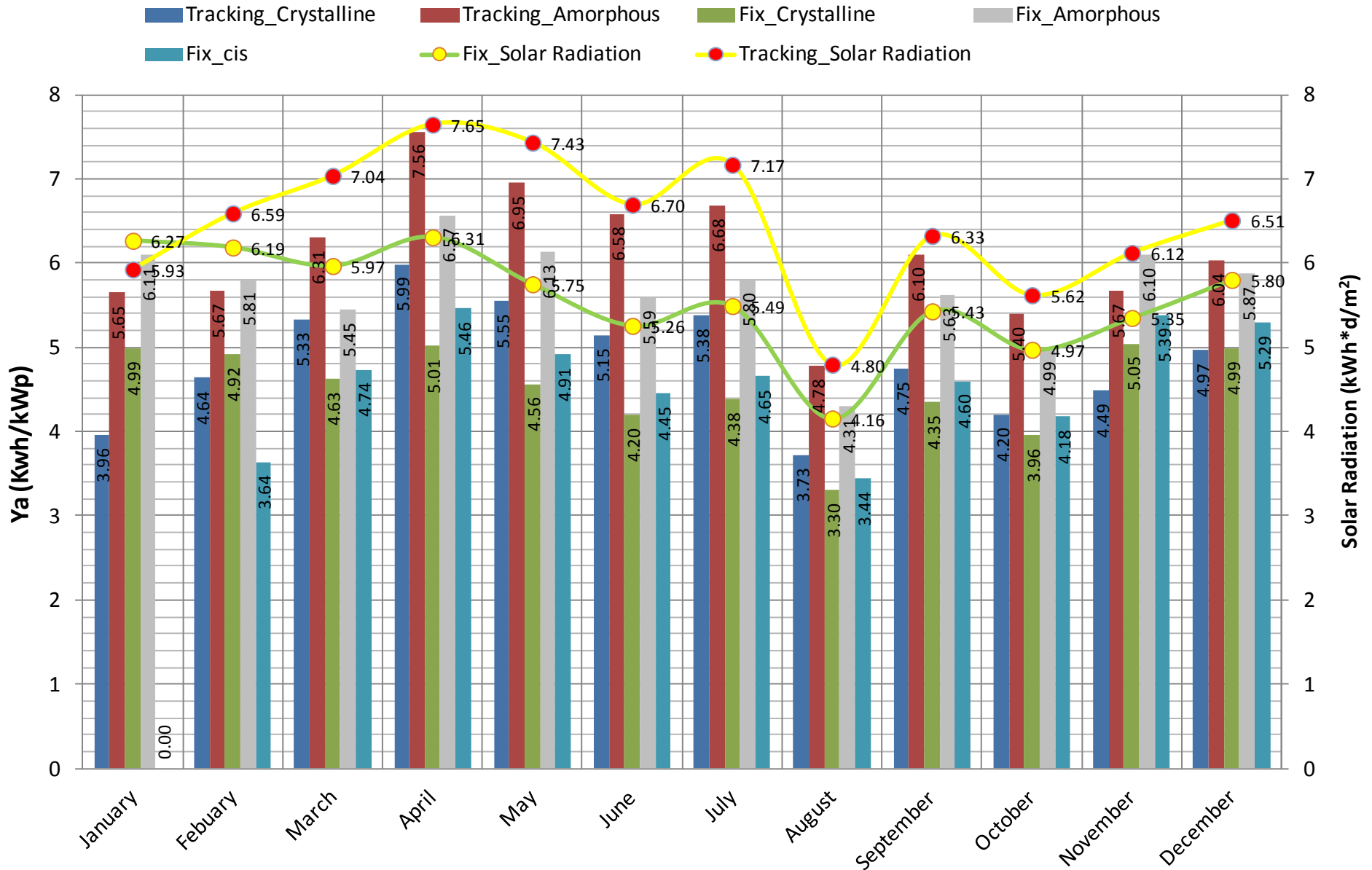
SOLAR CELL POWER PLANT SIRINDHORN DAM

TRACKING SYSTEM

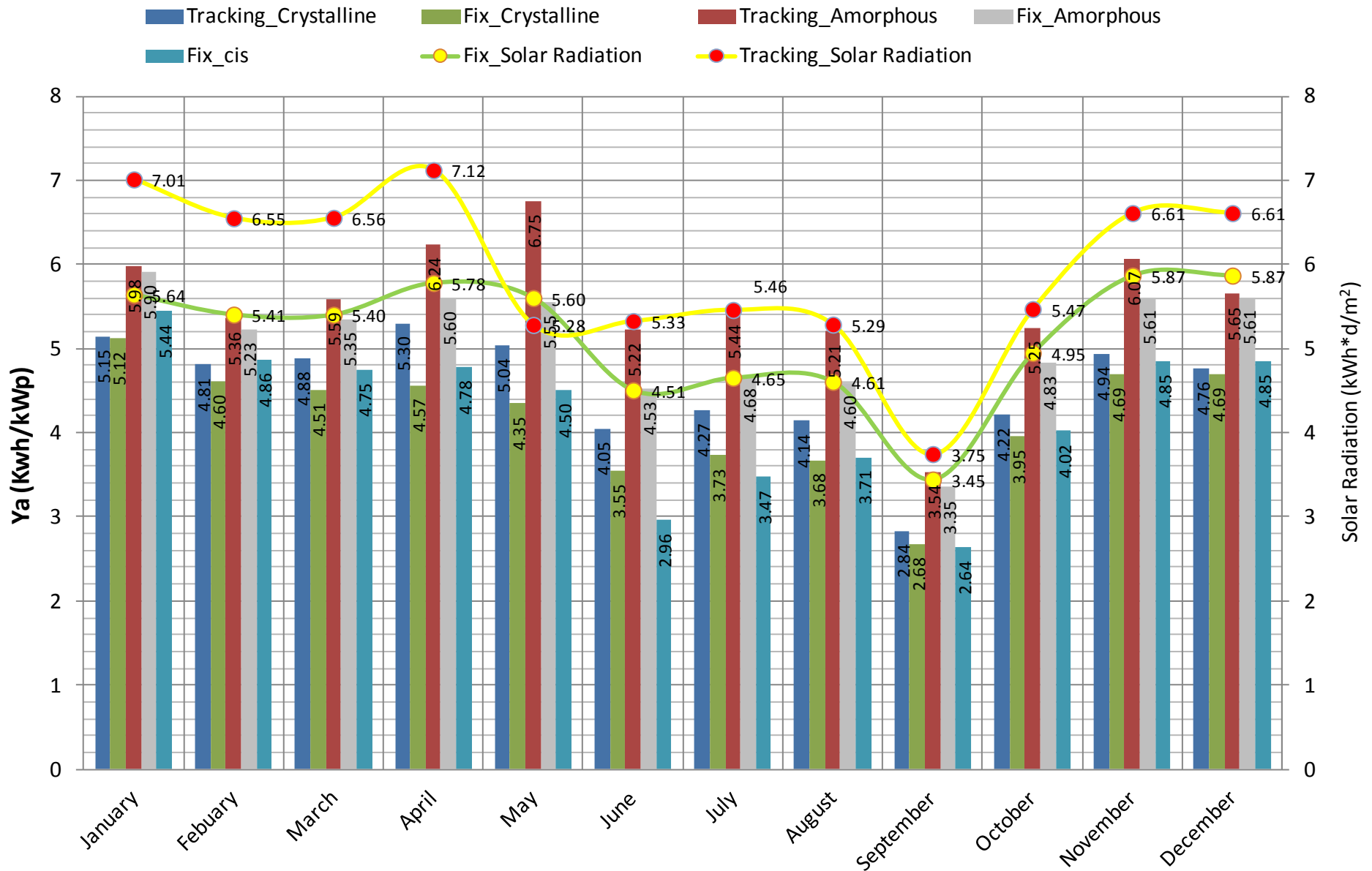
FIXED SYSTEM



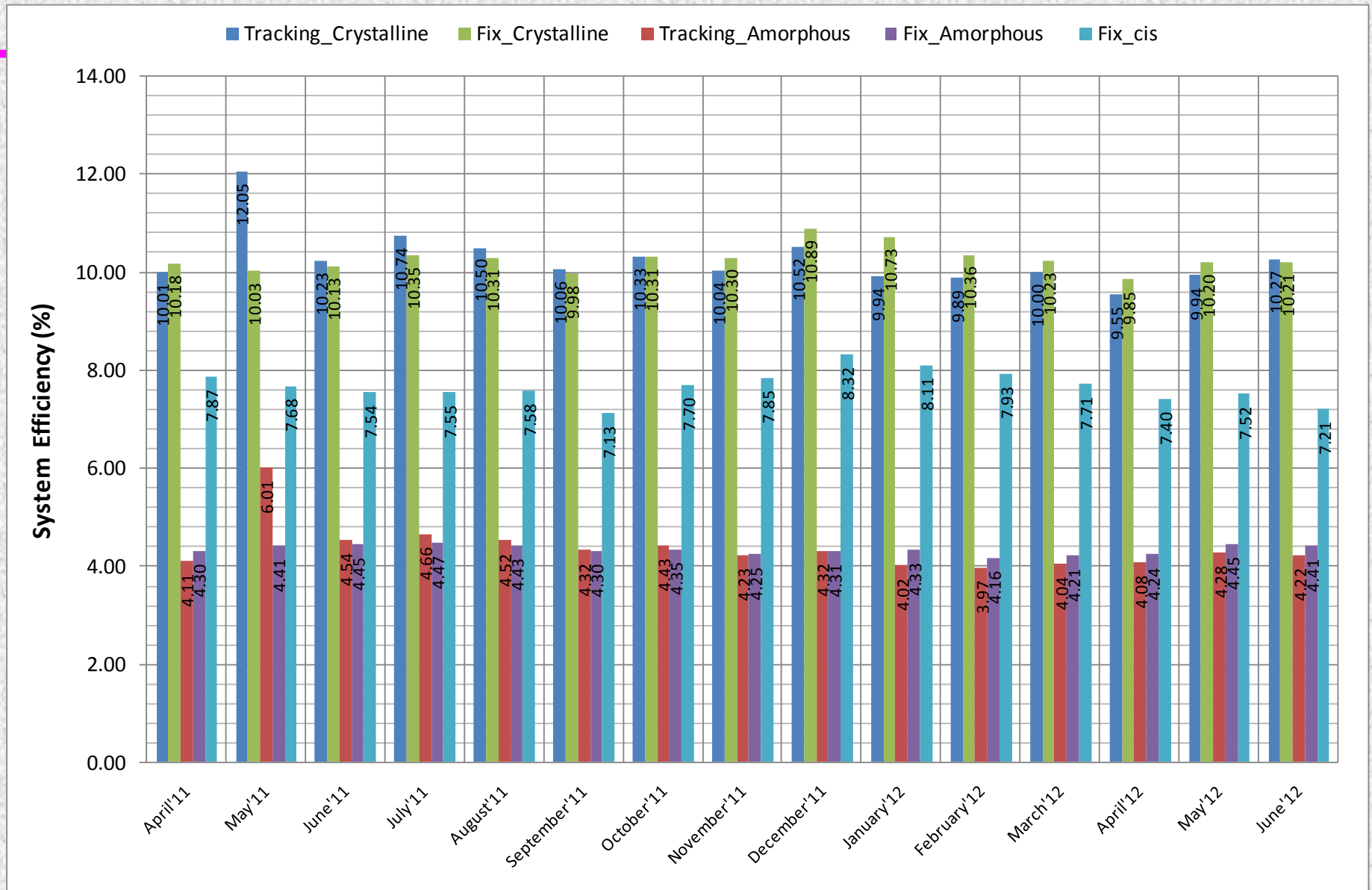
Energy Yield in 2010



Energy Yield in 2011



System Efficiency



Result for Track and Fix Comparing Data

Month	Multi Cryst. Si	Multi Cryst. Si	% Yield > Fixed	Amorphous Si	Amorphous Si	% Yield > Fixed
	tracking	fixed		tracking	fixed	
January	128.07	140.91	- 9.11	170.67	172.53	- 1.07
February	123.07	115.74	6.33	147.06	138.13	6.47
March	162.02	135.34	19.71	191.66	160.16	19.67
April	170.07	136.86	24.27	188.33	179.28	5.05
May	163.90	128.74	27.31	207.77	173.11	20.03
June	147.44	114.71	28.54	190.32	152.76	24.59
July	152.13	119.06	27.78	189.28	157.56	20.13
August	114.63	97.22	17.90	146.78	126.56	15.98
September	138.02	118.77	16.20	176.80	153.64	15.08
October	127.43	111.65	14.14	159.03	140.83	12.92
November	122.22	118.61	3.04	155.24	143.43	8.24
December	147.63	140.90	4.78	178.21	165.76	7.51
รวม	1,696.63	1,478.51	15.07	2,101.15	1,863.75	12.88

EGAT's Existing PV Demonstration Sites (Cont.)

8) Srinakarin Dam Float Solar Power Plant (30.24 kWp)

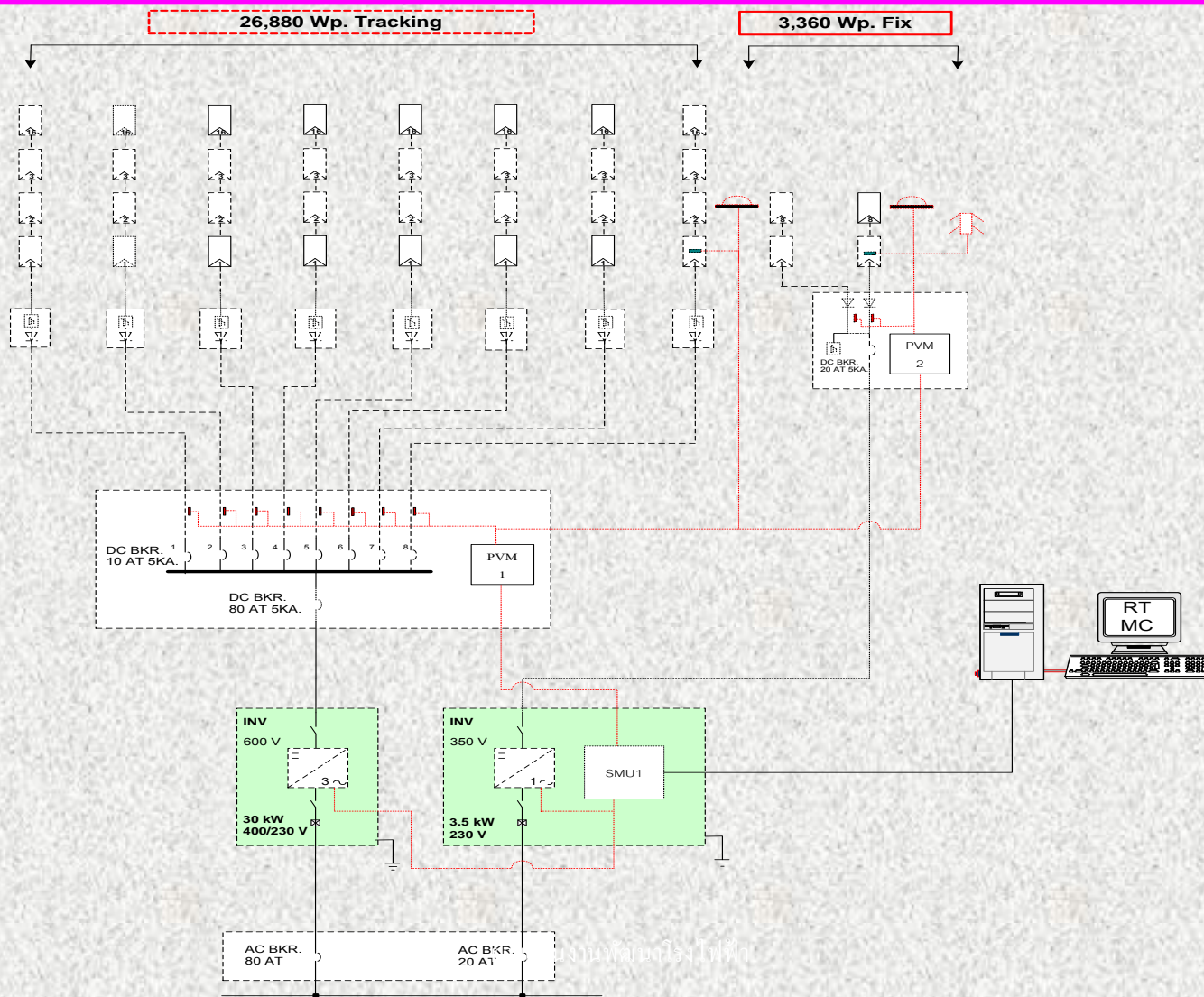


- Using Water Weighted Tracking System
 - Tracking 26.88 kWp
 - Fixed 3.36 kWp
- Total Cost 165,850 USD (5.35 M.baht)

- Location in Kanjanaburi province, middle part of Thailand
- Solar Cell Type c-Si
- Project Finished on April 2011

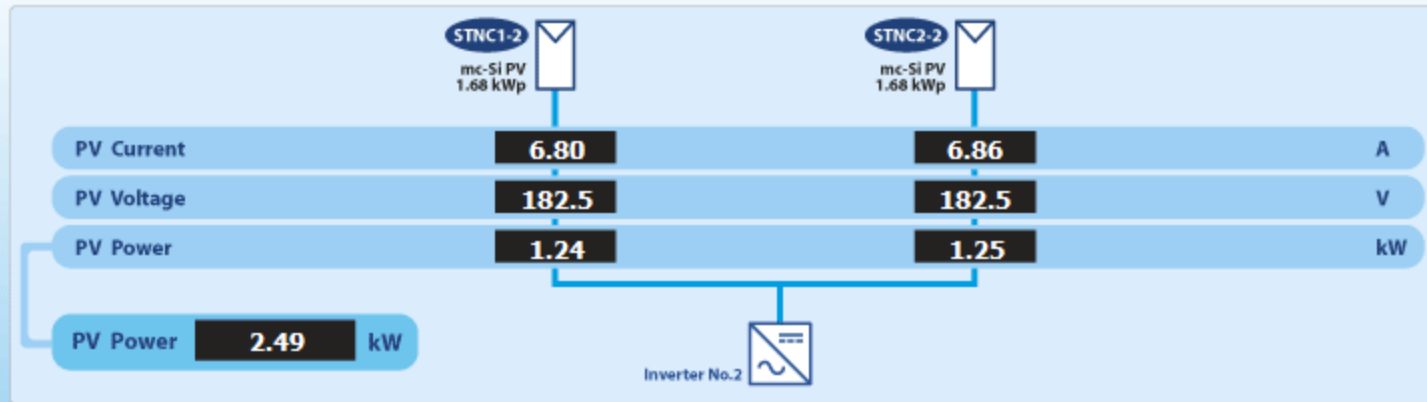
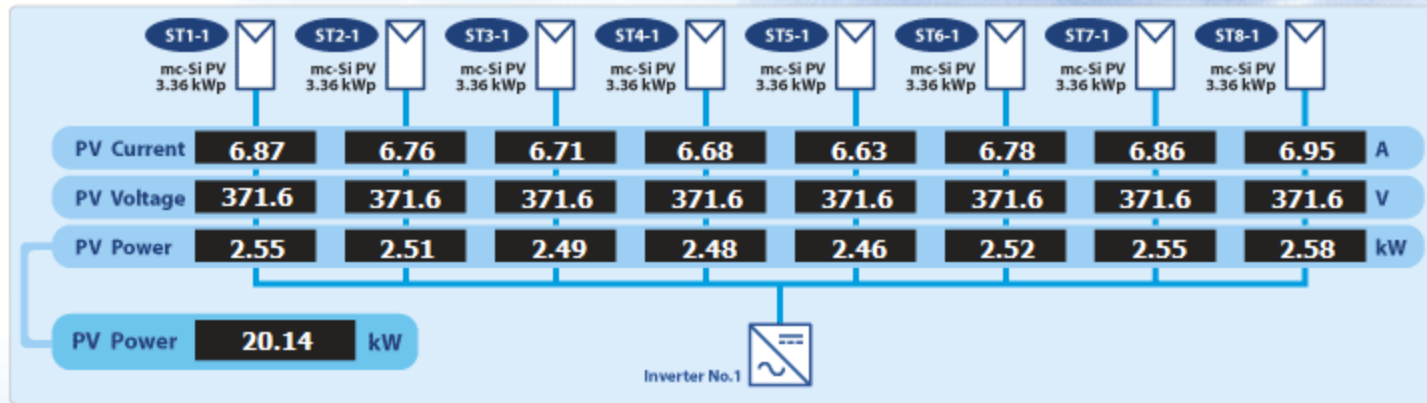


System Diagram



Data Monitoring System

SRINAKARIND DAM SOLAR CELL FLOATING POWER PLANT



Tracking System Meteorological Data

Irradiance	868	W/m ²
Irradiation	2.45	kWh/m ² .day

mc-Si Back Module Temperature	46	°C
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Fixed System Meteorological Data

Irradiance	831	W/m ²
Irradiation	2.19	kWh/m ² .day

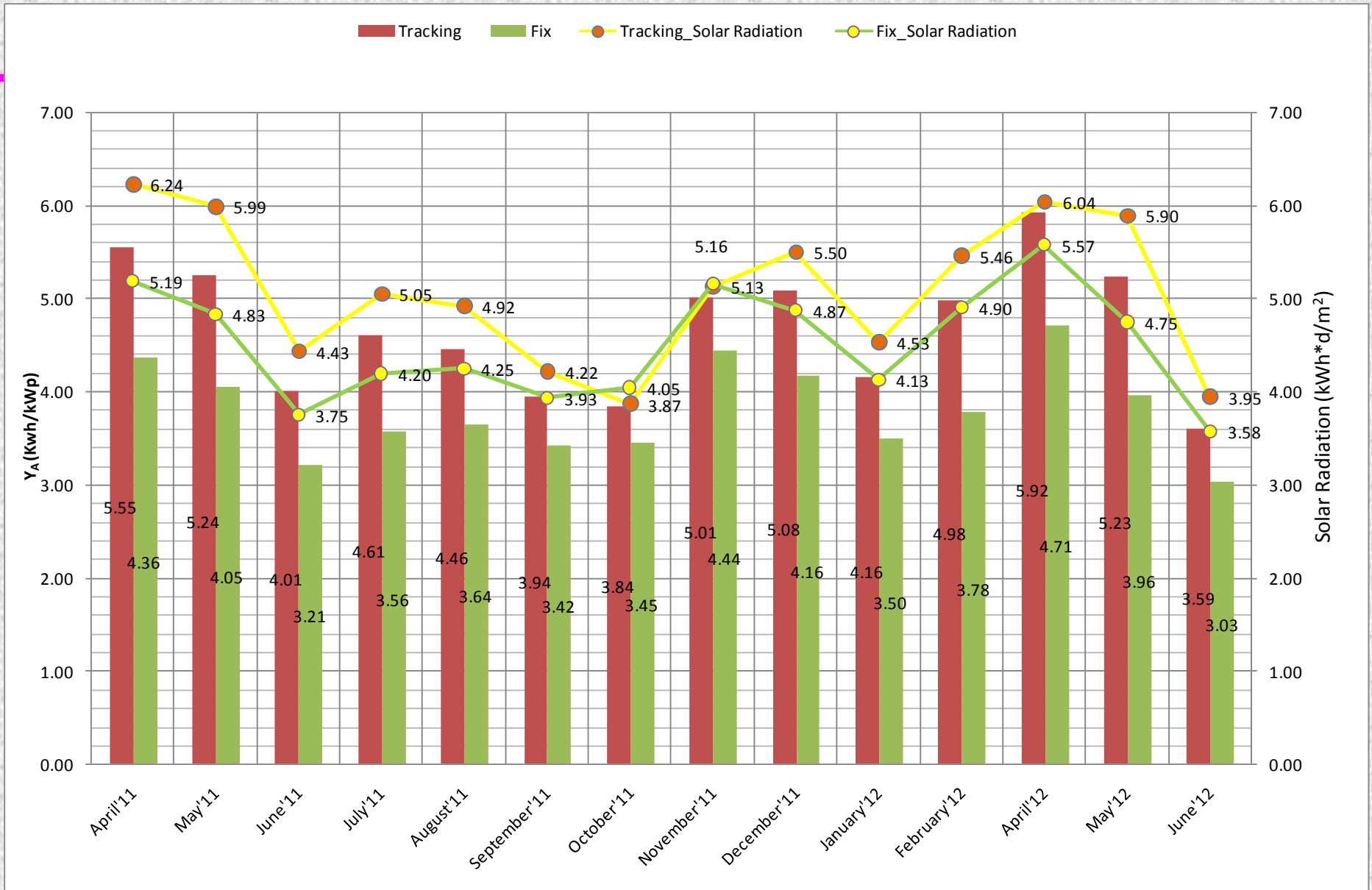
mc-Si Back Module Temperature	52	°C
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Ambient Temperature	31	°C
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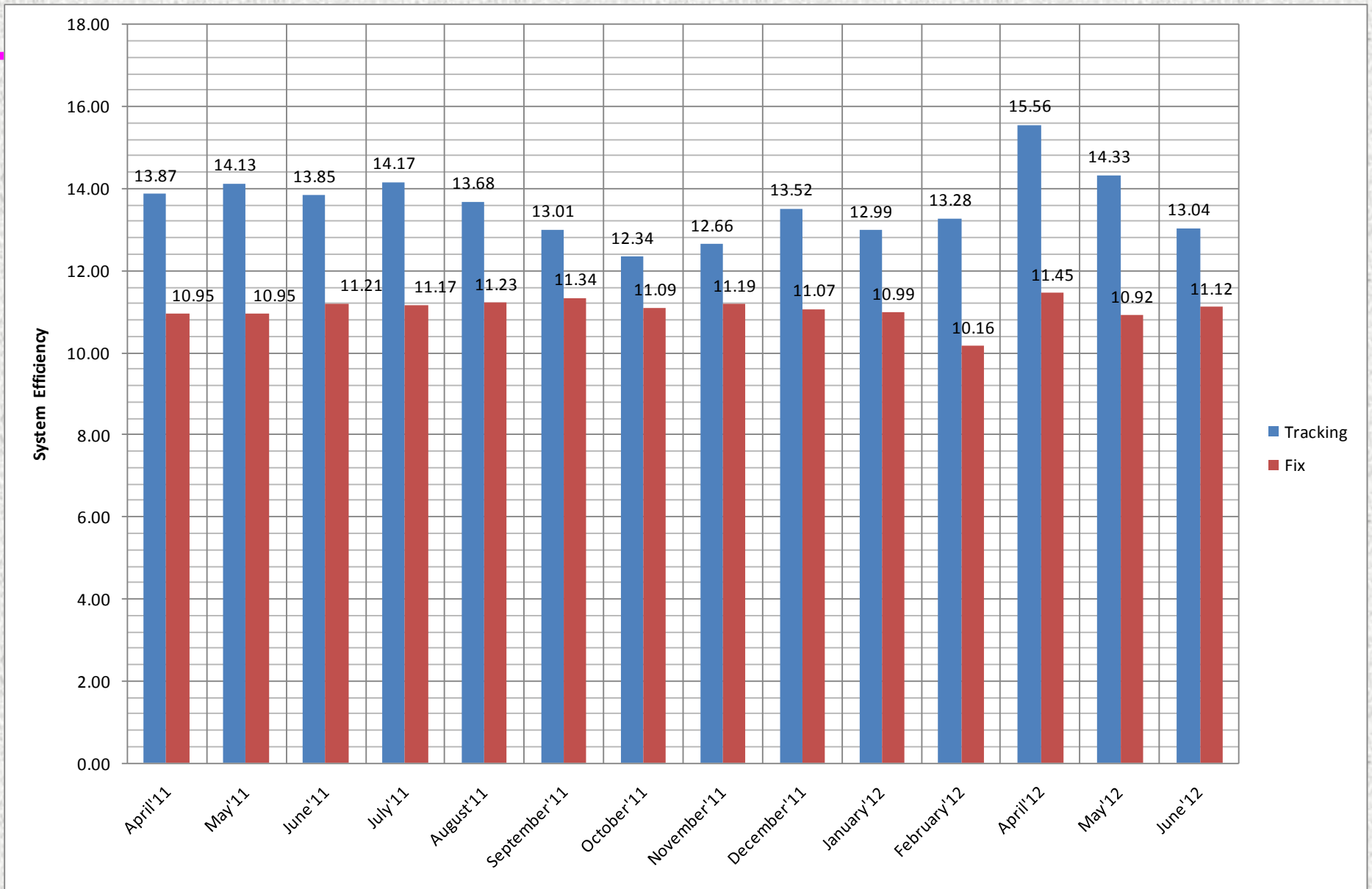
Wind Barrier



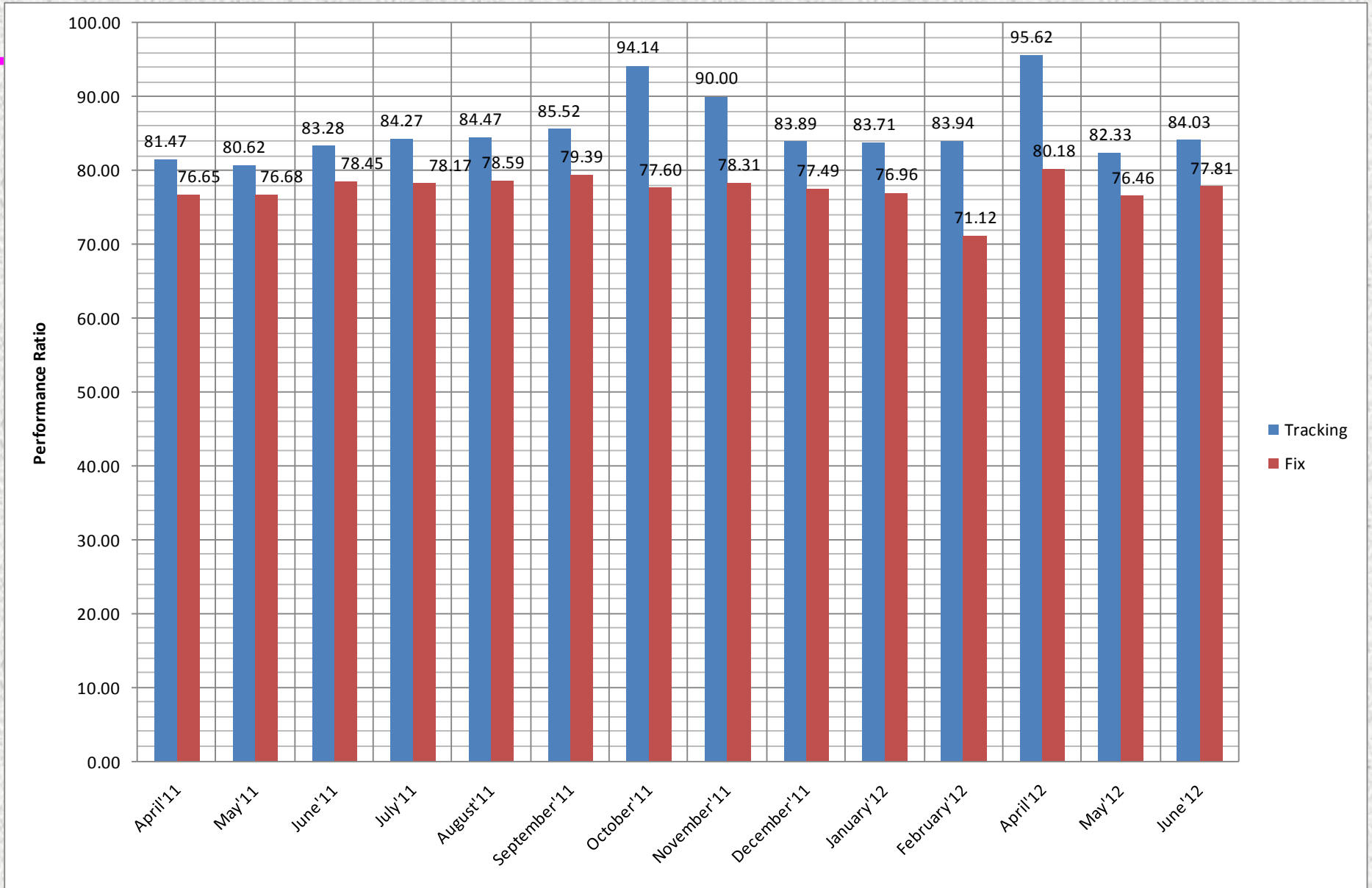
Energy Production (kWh/kWp) DC (SNR)



System Efficiency



Performance Ratio (PR)



Comparison data (Tracking)

Srinakarin Dam

Month	Tracked						Irr (kWh/m ² /d)	Amb Temp	
	YA_p-Si	Yf_p-Si	Eff. PV	Eff. In	Eff.sys	PR			PR(Ya)
April	5.55	5.06	12.76	91.19	13.87	81.47	88.94	6.24	36.30
June	4.01	3.66	13.03	91.31	13.85	83.28	90.35	4.43	32.77
July	4.61	4.20	13.19	91.25	14.17	84.27	91.17	5.05	32.84
August	4.26	3.92	12.82	91.71	13.26	82.27	88.89	4.79	31.90
September	3.94	3.59	13.41	91.07	13.01	85.52	93.52	4.22	31.77

Sirinthorn Dam

Month	Avg_1-7 (Tracked)						Irr_FIX (kWh/m ² /d)	Amb Temp	
	YA_p-Si	Yf_p-Si	Eff. PV	Eff. In	Eff.sys	PR			PR (Ya)
April	5.30	5.02	10.56	94.78	10.01	70.59	74.36	5.78	39.23
June	4.05	3.83	10.84	94.35	10.23	72.13	76.04	4.51	35.87
July	4.27	4.02	11.44	93.90	10.74	75.70	78.21	4.65	36.19
August	4.14	3.89	11.22	93.61	10.50	74.05	78.30	4.61	35.61
September	2.84	2.65	10.82	92.93	10.06	70.90	75.68	3.45	33.53

หมายเหตุ เดือน May ตรวจสอบเครื่องแปลงการส่ไฟฟ้าระบบติดตามดวงอาทิตย์
 หน่วยงานพัฒนาพลังงานทดแทน

Comparison data(Fixed)

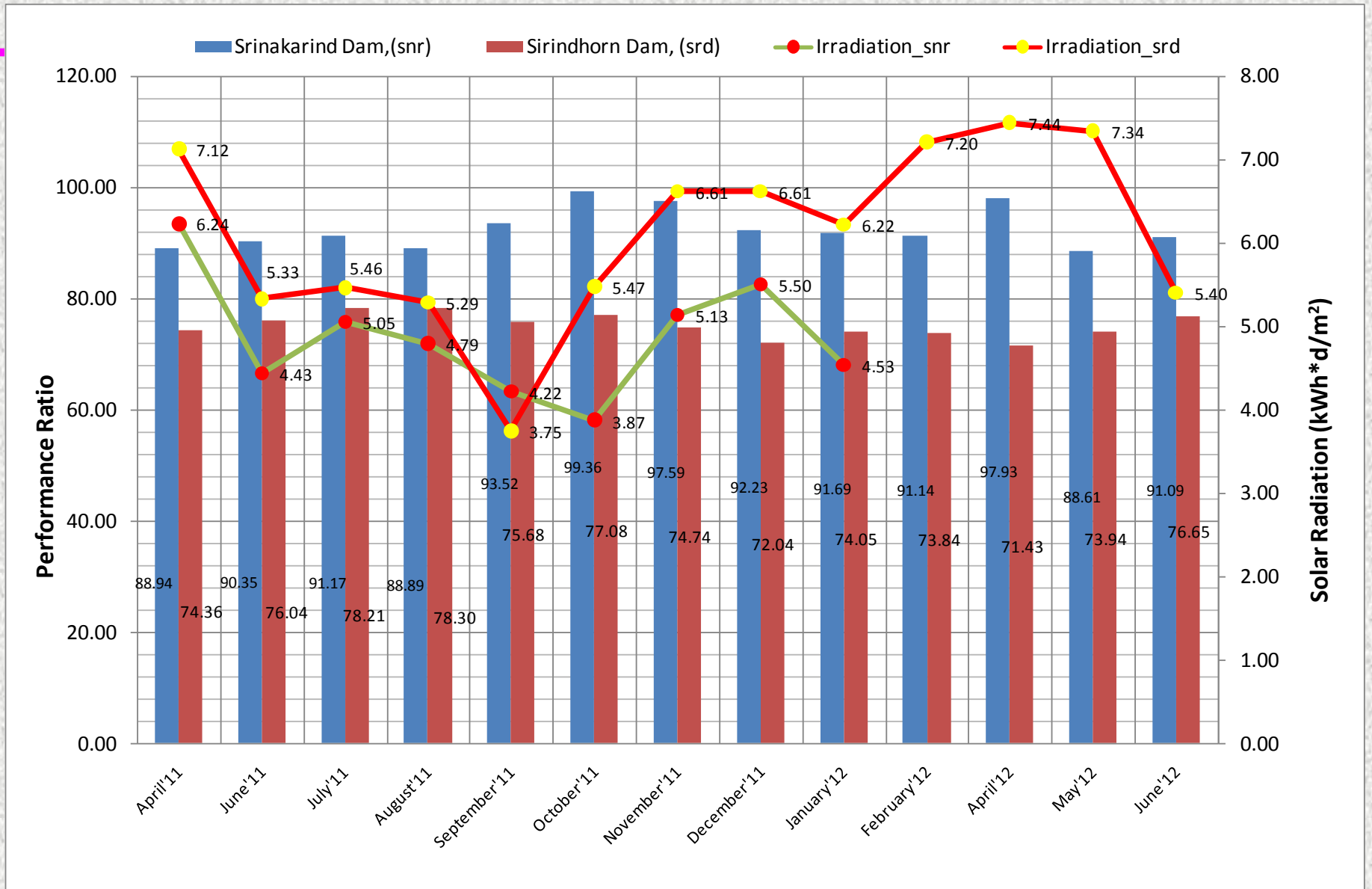
Srinakarin Dam

Month	Fix							Max PV Temp	Irr (kWh/m ² /d)	Amb Temp
	YA_p-Si	Yf_p-Si	Eff. PV	Eff. In	Eff.sys	PR	PR(Ya)			
April	4.36	3.97	12.03	91.05	10.95	76.65	84.06	59.10	6.24	36.30
May	4.05	3.69	12.02	91.10	10.95	76.68	83.72	60.97	5.99	35.06
June	3.21	2.93	12.29	91.21	11.21	78.45	85.67	53.23	4.43	32.77
July	3.56	3.25	12.24	91.20	11.17	78.17	84.92	54.71	5.05	32.84
August	3.58	3.27	12.37	91.17	11.27	78.91	85.96	53.13	4.79	31.90
September	3.42	3.11	12.46	91.04	11.34	79.39	86.81	54.15	4.22	31.77

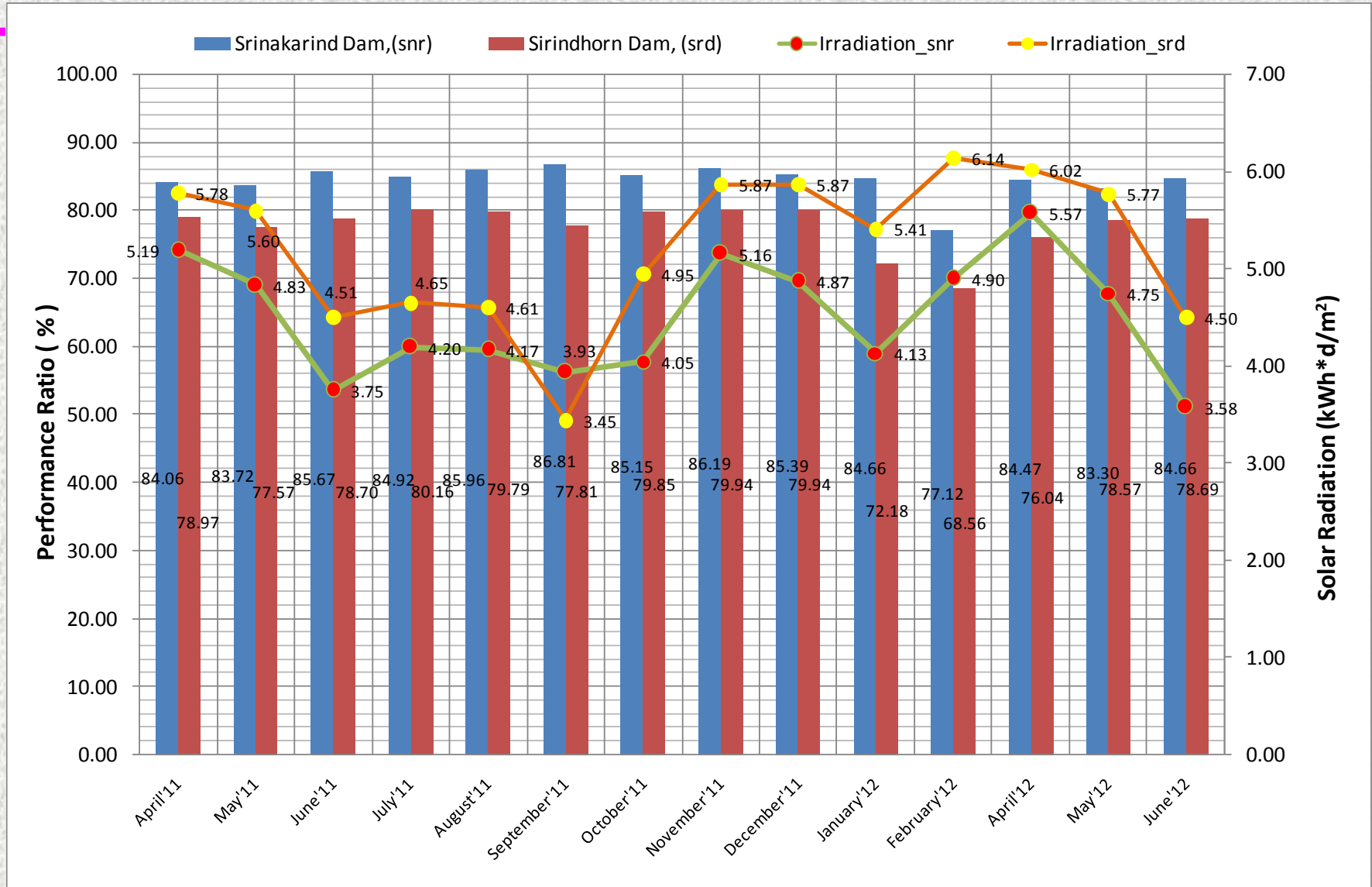
Sirinthorn Dam

Month	p-Si							Max PV Temp	Irr (kWh/m ² /d)	Amb Temp
	YA_p-Si	Yf_p-Si	Eff. PV	Eff. In	Eff.sys	PR	PR(Ya)			
April	4.57	4.16	11.18	91.03	10.18	71.77	78.97	60.03	7.12	39.23
May	4.35	3.96	11.01	91.09	10.03	70.74	77.57	59.80	5.28	37.40
June	3.55	3.23	11.12	91.10	10.13	71.44	78.70	55.40	5.33	35.87
July	3.73	3.40	11.36	91.09	10.35	73.01	80.16	55.13	5.46	36.19
August	3.68	3.35	11.32	91.06	10.31	72.69	79.79	56.16	5.29	35.61
September	2.68	2.44	10.96	91.04	9.98	70.41	77.81	52.13	3.75	33.53

Performance Ratio (Tracking)



Performance Ratio (Fixed)



EGAT's Projects with Supporting Fund

500 kW PV Generation Mae Hong Son -2

Project's supporting fund:

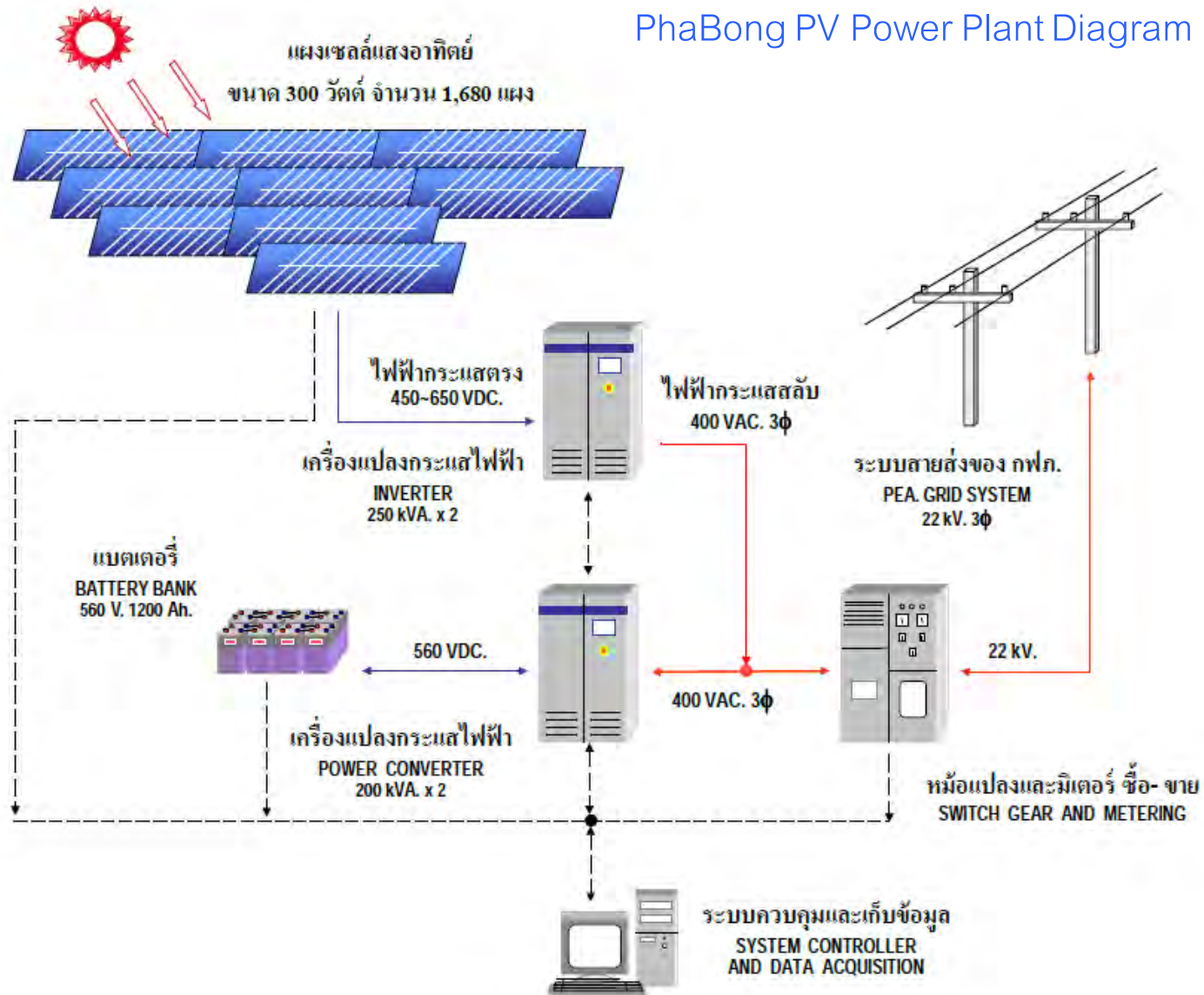
- EPPO. = 163.36 ล้านบาท (3.65 MUS\$) = 87.31 %
- EGAT. = 23.75 ล้านบาท (0.53 MUS\$) = 12.69 %
- Total = 187.11 ล้านบาท (4.18 MUS\$) = 100.00 %

Project finished on 9 April 2004



EGAT's Projects with Supporting Fund (cont.)

PhaBong PV Power Plant Diagram

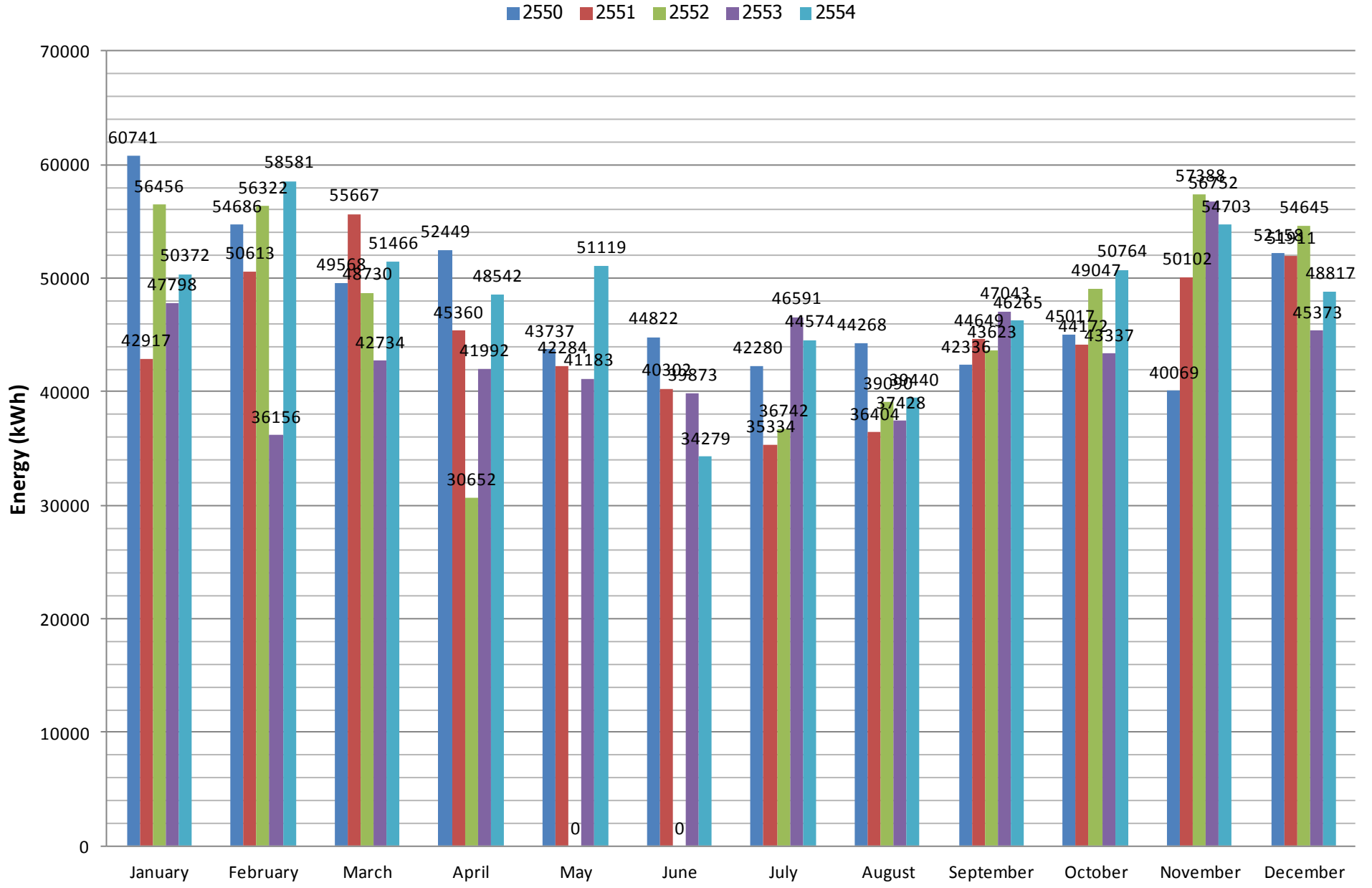


EGAT's Projects with Supporting Fund (cont.)

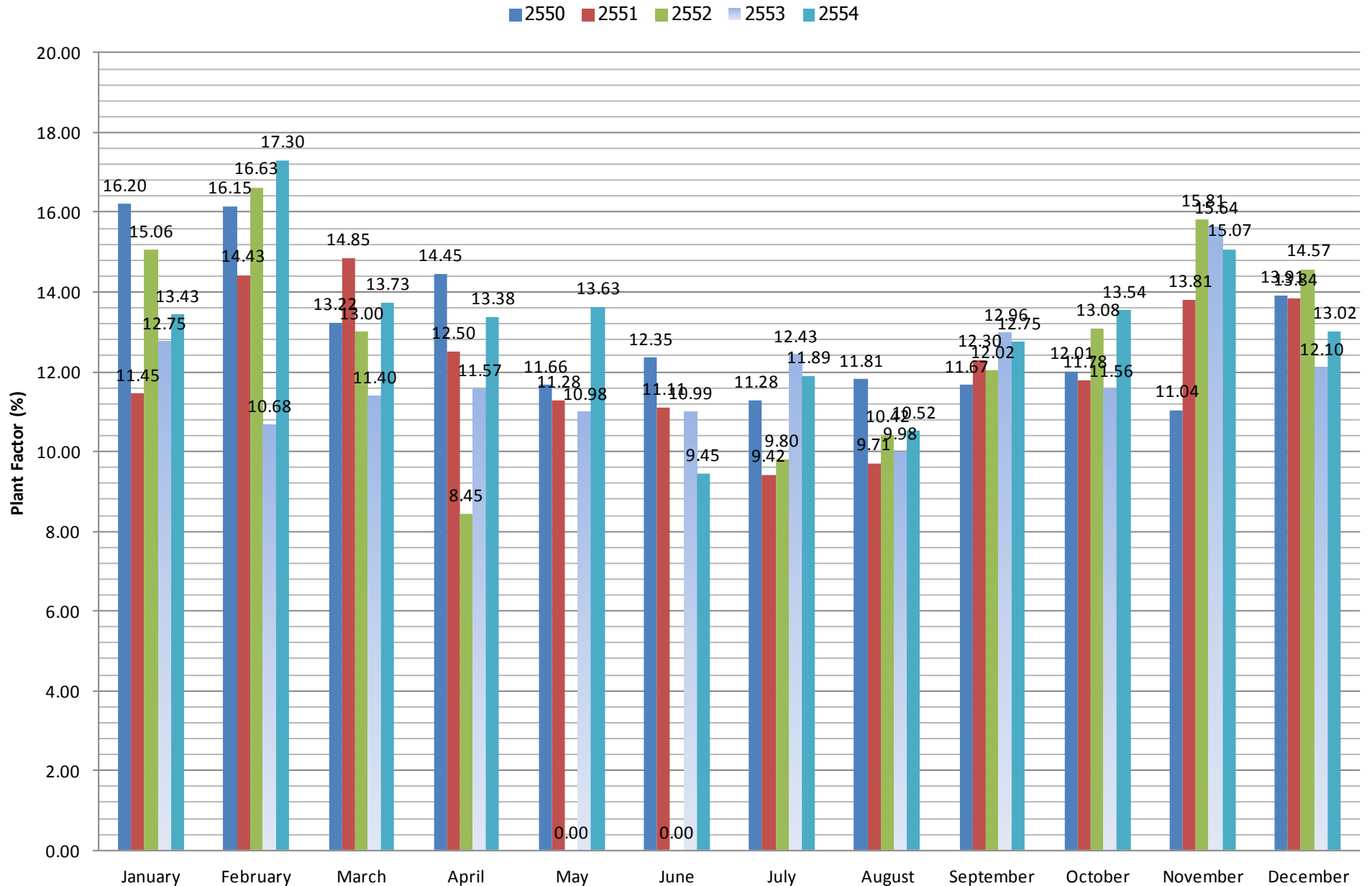
Site Area



Production data of Phabong PV Power Plant



Production Plant Factor of Phabong PV Power Plant



EGAT's Future Projects

5 MW PV grid connected system

- :- EGAT is planning to install solar power plant in the Southern part of Thailand (Prajuabkheereekhan province)*
- :- This solar power plant will feed the power to the grid in the end of 2013*

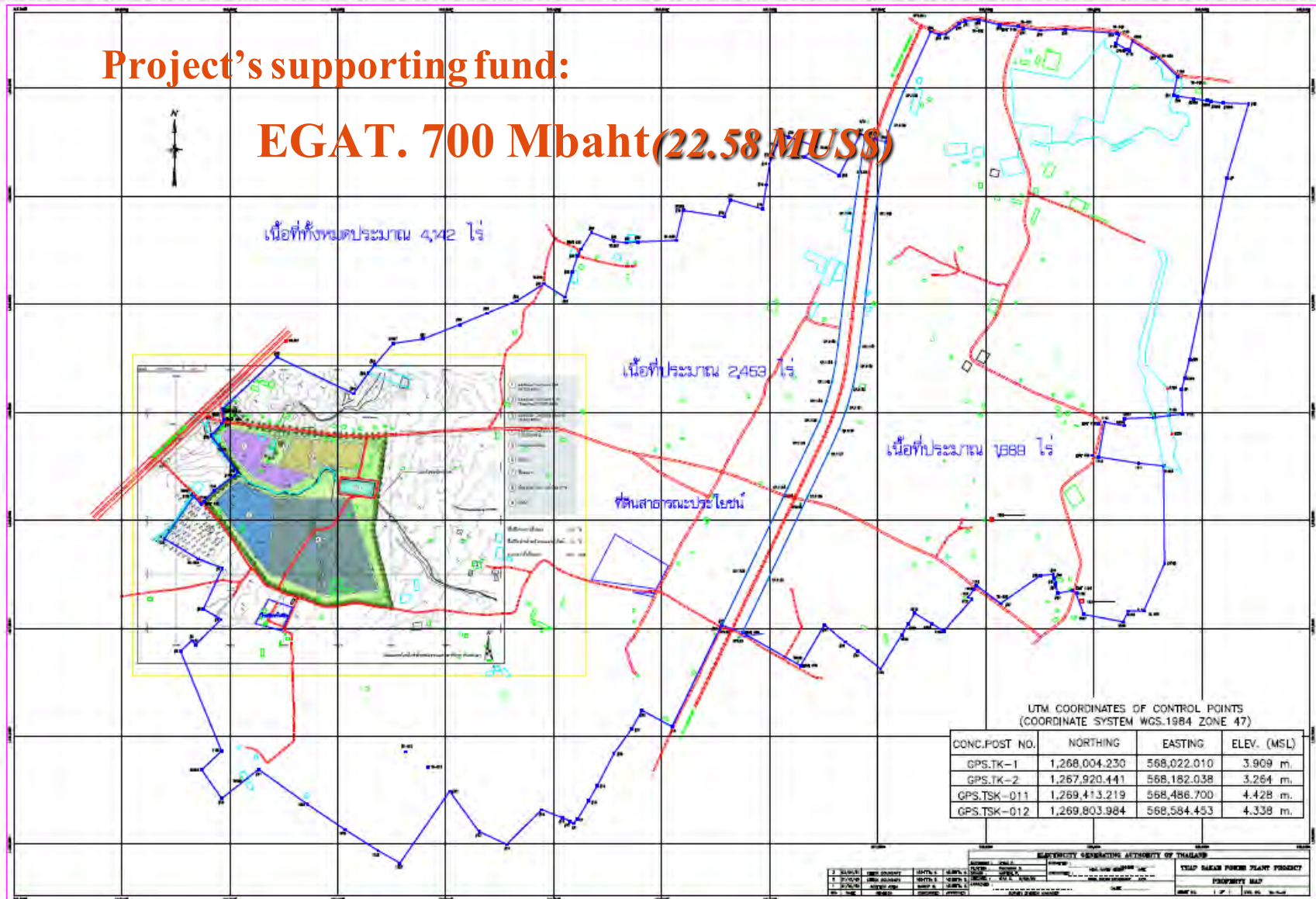
Objectives of the Project

- :- To support the government policy.*
- :- Solar Cell Study Center in southern*

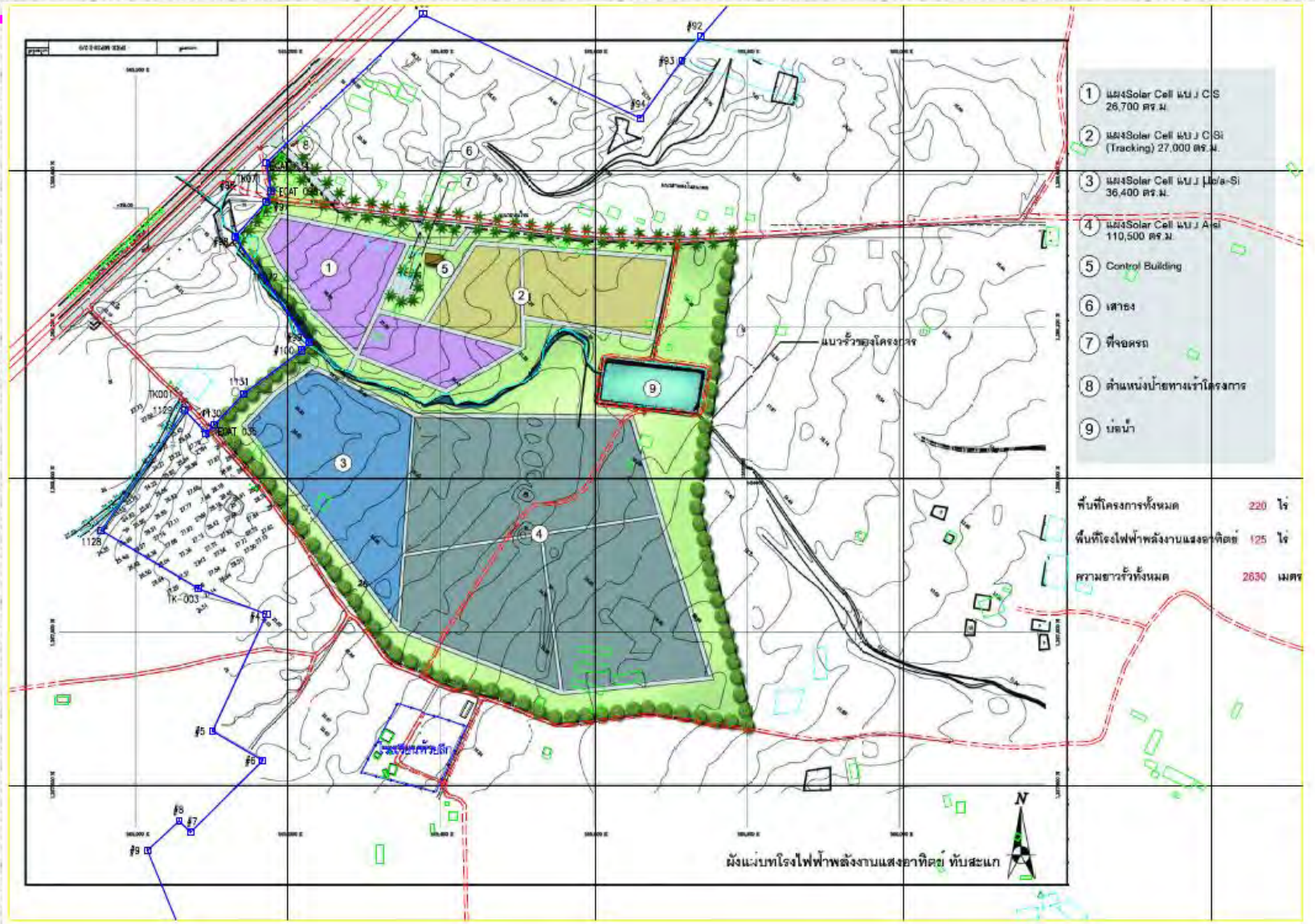
Solar Cell Power Plant 5 MW at Tabsakae District

Project's supporting fund:

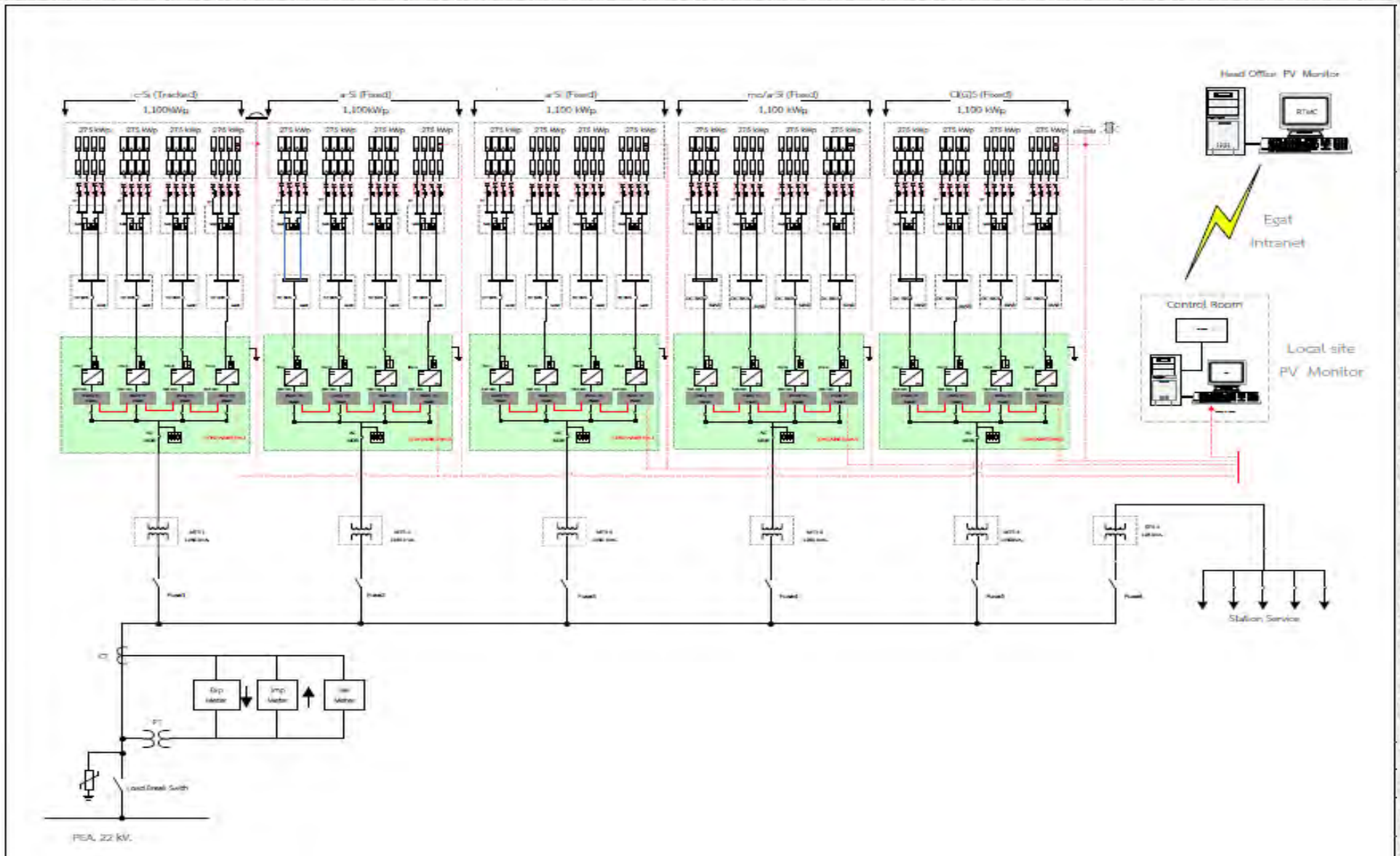
EGAT. 700 Mbaht (22.58 MUSS)



Solar Cell Power Plant 5 MW at Tabsakae District



Single Line Diagram for 5 MW Solar Power Plant



Conclusion for Track and Fix Comparison

- ◆ Net Energy Yield of Tracker more than Fix 12-15 %
- ◆ Installation Cost of Tracker more than Fix 3.87 %
- ◆ Energy Yield 1.714 MWh/Yr.(Estimated 1.45 MWh/Yr.,Fixed 1.3 MWh/Yr.)
- ◆ Energy consumption for all Tracker 0.52 %
- ◆ Performance Ratio (PR) for Solar Tracker System of Srinakarin Dam better than Sirinthorn Dam 16.86 %
- ◆ Performance Ratio (PR) for Solar fixed System of Srinakarin Dam better than Sirinthorn Dam 9.01 %

A scenic sunset over a lake. The sun is low on the horizon, casting a long, shimmering reflection on the water. Several trees are silhouetted against the bright sky, with some in the foreground and others further back. The overall atmosphere is peaceful and serene.

Thank you for your attention

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