

@DERM[™]

•

Distributed Energy Resource Management System

.

An Affiliate of





Table of Content

A. Product Overview	4
ADVANTAGES	4
MAIN FEATURES	4
B. Technical Highlights	5
1. HARDWARE STRUCTURE	5
2. SOFTWARE DESCRIPTION	6
2.1. Software Architecture	6
2.2. Supported Communication Protocol	6
2.3. System Sizing	
2.4. Standard Software Modules	7
2.4.1. Data Acquisition (DA)	7
2.4.2 Realtime data processing (RTDB)	7
2.4.3. Time-series Historical Information System (HIS)	7
2.4.4. Realtime Setpoint Control	7
2.4.5. Human-Machine Interface (HMI)	8
2.5. Advanced Software Modules	12
2.5.1. Report	12
2.5.2. Web-based Monitoring	12
2.5.3. Information Management System	
2.5.4. Bill Payment	
2.5.5. Data analysis and Warning	
2.5.6. Asset Management	
2.5.7. Estimation/Forecasting	
2.5.8. DSM & DR	14



A. Product Overview

@DERM is Distributed Energy Resources Management System which is developed to ensure properly operation of distributed renewable energy resources in accordance to technical requirements of distribution and transmission networks as well as ready to operate as Virtual Power Plant (VPP) for improving the participation and cost-effectiveness of DER sources in the electricity market.

The @DERM along with SCADA/DMS/EMS systems are important monitoring and control facilities for dispatch centers and play key roles in power system operation with high penetration of distributed resources. This is necessary to support dispatching jobs with DER to ensure economical and reliable operation of the power systems.

ADVANTAGES

- Allow dispatching centers to fairly allocate generation output under conditions of system curtailment;
- Allow flexible operation of various DERs to avoid overloading while maintaining power quality for the local grids
- Provide the tool for optimum generation commitment in the market with transparency, safety and national energy security
- Decrease the frequency of generator shut down/start for those units with high start-up cost and long start-up time (coal thermal, gas turbines), enhance system reserves, avoid oil thermal unit commitment for peak load and reduce overall system operation cost.
- Forecasting of power generation output of DERs are more accurate due to the smoothing effect when combining large number of DERs.

- A large number of DERs, storage systems as well as controllable loads can be assembled into a single, adjustable power unit (a Virtual Power Plant) with rated power and performance characteristics equivalent to a traditional power plant.
- Helps DERs flexibly respond to price signals in the electricity market, accurately forecast their own generation schedule, and reduce the imbalance between generating capacity and load demand in the power system.
- Allow participation in the market of providing auxiliary services (such as voltage regulation support, frequency regulation support, power reserves, black start,...).

MAIN FEATURES

- Provide tools for collecting all important data of operation status of renewable equipment, including system data, metered data, status of integrated control devices, alarming,... in real time with standard interconnection protocol as well as for sharing them to SCADA systems at dispatching centers, power companies, and for making necessary control requests.
- The system is not only suitable for roof top solar power management but also ready for integrating other renewable energy sources such as wind turbines, small hydro power plants, etc.
- Manufacturer independence, suitable for controlling power Plant with different Inverter, Turbine,... vendors.
- Ready for future utility interface bus integration.



Figure 1. Overview of @DERM system

1. HARDWARE STRUCTURE

Hardware system is consist of:

- A central system: include main component:
 - A FEP Server for connection management, processing of monitoring / control data from DER systems, SCADA/DMS systems at Power Company, Load Dispatching Center.
 - * Host Servers are served for calculating of dispatched power flows as requested by the operators, configuration of reports, grouping of distributed power sources. These servers are manufactured in accordance to industrial standards and operated with redundancy to ensure system can be operated reliably, stably even when one fails.
 - * Operator Workstation with HMI that allows operators to monitor and control distributed sources.

- * HIS Servers for historical data storage which is necessary for operational reporting as well as production forecast of DER.
- * Cloud Server provides monitoring system for DER on Web platform, allows customers to access remotely via internet.
- @DERM system can be connected with existing SCADA/DMS system to at the Power Company/Load Dispatching Centers for data exchange.
- On-site system: ATS SmartDER device is utilized for data aquisition/concentration and local control at distributed energy sources. Connection and data exchange with cnetral system are implemented with encrypted communicatin channel using Internet/3G/4G or leased line, fiber optic,...



Figure 2. Typical @DERM Hardware System

2. SOFTWARE DESCRIPTION

2.1. Software Architecture

The @DERM system is designed with software modules for flexibility and simplicity in maintenance, expansion, safety and stability. Main software modules of the @DERM system include:

• Standard modules:

- * Data Acquisition (DA)
- * Real-time Database (RTDB)
- * Time-series Historical Information System (HIS)
- * Realtime Setpoint Control
- * Human Machine Interface (HMI)

Advanced modules:

- * Report
- * Web-based monitoring
- * Information Management System
- * Bill Payment
- * Data Analysis and Warning
- * Asset Management
- * Estimation/Forecasting
- * DSM&DR

2.2. Supported Communication Protocol

Supported communication protocols include:

- OPC UA: internal data exchange among system software modules
- IEC 60870-5-104: data exchange with monitoring / control systems at each of distributed sources and with SCADA/DMS/EMS at power companies, power corporations, dispatching centers.
- Modbus RTU/TCP: data exchange from actuator devices at site such as Inverter, Data Logger, Controller...
- IEC 62056-21/Modbus RTU: data exchange with power meters.
- FTP (.xls, .txt): for transfer of power allocation data file
- API/Web Services: data exchange for weather forecast.
- The system is also ready for integrating with other protocols based on industrial accepted standards.

2.3. System Sizing

The PV SCADA & PPC system can support to control and monitor over **512** distributed power sources, as well as **256.000** data points. This capacity can be extended in the future without having to upgrade any of the system software modules.



Figure 3. Typical @DERM Software System

2.4. Standard Software Modules

2.4.1. Data Acquisition (DA)

DA module is utilized for definition and management of real time data channels and data exchange with other devices or systems. DA module acts as a direct connection between central system and on-site monitoring and control module and also is used for gateway connectin purpose to exchange data with other SCADA/DMS/EMS based on IEC 60870-5-104 protocol.

Data collected from DER are:

- Real time monitored data:
 - * Device status: Inverter, Logger, ACB...
 - * Metered value: current, voltage, output power, etc...
 - * Accumulated data: output / input energy...
 - * Alarms
- Control command:
 - * Plant Start/Stop, Inverter Start/Stop
 - Power Setpoint control, power factor of each inverter/turbine/the whole plant

2.4.2 Realtime data processing (RTDB)

The real time database is able to process unlimited amount of data points at both operation level and processing level including data from Logger, Inverter, POI.

This module is a central part of system which connects DA and other application modules, to manage and process all system real time data. Collected data will be processed and converted to archive format or other types in accordance to user request.

The real time database will describe power system status at a specified time instance and all system status change to new status at the next instance. This database support real time data access for applications

2.4.3. Time-series Historical Information System (HIS)

The central @DERM system is integrated with HIS data module. The module utilizes non-SQL data structure for long time storage of all operational time-series data of power system at various conditions (normal or faulty operation).

All operational data is integrated and stored in HIS Server to make unique storage and consistent data retrieval for reporting, network analysis.

The HIS is a database for all historical operational information time series data. The HIS is developed with client-server concept.

Initially the data is stored with initially defined resolution in 5 years.

The HIS is operated with non-SQL, data is generated continuously with processing industry. Such a concept allows to enhance storage capacity and ad-hoc querry while save the memory and CPU workload. The whole database is utilized for other applications via standard protocol (Web Service, ODBC, SQL...).

2.4.4. Realtime Setpoint Control

The central control software will send control commands to Smart Controllers at site to adjust generation parameters smoothly and stably in accordance to operator and dispatching center request.

Function to control distributed power sources:

- Support for distributed source group control:
 - * Controls for entire sites, or for groups of sites
 - * Control the total capacity of the sites, each group of sites, each site separately according to the preset schedule.
 - * Controls for each site.

• Support for control methods:

- * AGC control mode as requested by SCADA/EMS: control is handed over to dispatching centers.
- * Schedule mode: setpoint can be assigned for all sites, group of sited, or individual site as scheduled.
- Manual mode: control individual site according to the set value manually
- Calculation mode: calculate and redeploy distributed sources es in case of capacity limitation of transformers and lines to avoid overload.

Control functions:

- * Active power control: to maintain plant output power at a setpoint defined value or to reduce power with reservation in accordance to operatore request / dispatching order so that the output power is not exceeded required level.
- * Ramp Rate Control
- Reactive power control: to maintain voltage at plant connection point at predefined controlled setpoint.
- Power factor control: to maintain plant power factor at required level. This status is usually achieved with automatic reactive power control based on system acitve power profile.
- * Voltage control: to maintain voltage at plant connection point at predefined controlled setpoint.
- * Control modes according to grid operation requirements (*Grid support*): limit active power and power reserve, voltage profile monitoring and control, adjust reactive power to maintain grid voltage at connection point, grid frequency support, fault-right through support.
- * Start-up and shutdown of the entire plant.



Figure 4. Block diagram for central control commands

2.4.5. Human-Machine Interface (HMI)

HMI provides interaction between users and system monitoring, control applications as well as other functionalities. HMI provides system control and monitoring, accessing to stored data tin the database simply and smoothly. HMI allows users to perform basic actions with just a few annunciations, users do not have to switch between displays during working.

(1). Control Functions

Control functions for distributed energy resources are implemented with operator's actions on control panels of graphical display interfaces. These control commands will be processed with Smart Controller after successful verification. Unsuccessful control commands will be prevented with alarms. These alarms or results of operator's actions are displayed as events without fault-type warnings. Control sequence is conducted with Select and check before operate (SBO) to enhance safe operations.

The control sequence is described below:

- Display the diagram
- Select the system or devices to be controlled on the display. Control request will be ignored upon any of the followings:
 - * The selected system / devices are not assigned for control.
 - * The system / devices are tagged with control prohibition.
 - * The system / devices are faulted or not ready.
 - * Control request does not meet interlocking prerequisites.
 - * Control timer is collapsed (this can be preset)
- Message warnings are issued for operators if control commands are unsuccessful to ensure rapid checking for incidences

	PPC MODE				Tota	POW	Total Setpoint (MI)	Al Setp	olet (MR)	Setpo Inpo		Total	a primi	Total Serpoint (kWkr)	All Selpoint (KID	ki) Se	etpole	
1		AGE	-	BARLAL			668	4510		0	100	0			200			200
	8	HEDULE	-	ALCIUM						ol P Max	54	e			Section	0.0K 0.0H		si a
	Substation Names	Sile Name	Plat	Control	Stan	Second Carbol	POT Table (AN)	After Tales (NII)	Rende Valer BRG		old Tabler - 0001		Results Control	POTVale (WH)	Anther Value (VVIII)	Renado Labor (AVA)		Vale Vili
	56881	THEM BAC 1	7547	14		-	575.1	170	0	0	Set	Sattle	-	40	34	0		
	55851	THEM BAC 2	- Clark	liter -		-	560.0	170	0	0	Set	Settle			н	0	0 <	
	50551	THEAN BAC 1	594	500		-		990	0	0	54	Settle	-		44	0	0	
	56851	THURN BAC 4	- Dat-	5150		-		990		0	м	Serie				0	8	
	56851	THURN BAC S	544	304				990	•	0	54	Selle				0		
	50881	SPAGE	1045	104	0				0	0	Set	Setting				0	0	
	86881	87468	Clark.	-Sie	0				0	0	Set	Settin				0	0	
	84851	574/E	Diet.	Dee	0	-			0	0	Se	Bellin.				0	0	
	56851	SPARE	. Stat.	Site	0	-			0	0	54	Settler	-			0	0	
	56851	SPARE	Stat	Stop-	0	-				0	54	Selle				0	0	
	56851	SPARE	tint.	mop.	0	-			0	0	Set	Settle				0	0	
	86881	SPARS	Plant.	iline.	0	-			0	0	Set	Settle.				0	0	
	10881	BANK .	- Clark	lite -	0				0	0	. Set	Set the				0	0 -	
	56851	SPACE	. Sert.	510	0	-			0	0	S.F.	Settle				0	0	
	56851	SPARE	554	5158	0				0	0	м	54764				0	0	

Figure 5. Setpoint setting screen for all sites

Control functions for all sites / groups of sites can be defined with control options, setpoint setting for all sites or groups of sites.

								NON OR AD						
1014.0	CROWN STATE	815		MOUNTED IN	en toe	NUL .	1	ALC: NO.	Real Providence				100 5454	
000.000	-	-	-	-		-	-	-	-	 ł	-	-		
DAUGT COMP														
1000010-0000														
140011010														
ERGEL RINK														
NUMBER OF BRIDE														
ENDOLUGINE.														
660614316														
EXCELLENCE.														
840014946														
950010000														
NAMES OF BRIDE														

Figure 6. Scheduled setpoint setting screen. Control functions for total power of sites, groups of sites, each site with predefined schedule.



Figure 7. Plant control screen. Control functions for each site: options for various setpoints (P, Q, U, I).

(2). System Access Management

The HMI is designed with system access management with user accounts. That allows simple operator account management, enhance security and optimize system operation.



The HMI is designed with layers with more details are assigned to the inner layer.



Figure 8. Display plant general information

Dashboard for general operation information monitoring: total active power, reactive power, frequency, voltage, with instant values for sites or group of sites, trending graphic for generated power, setpoint.



Figure 9. Display single line diagram

The screen can show single line diagram on the network map with operational parameters.



Monitor main parameters of sites: power, daily generation output, date, voltage, frequency, power factor, number of online inverters.



TS DataServer	E 🕒 🛛 🚺	INSTRUBUTED ENERGY RESOURCE	MANAGEMENT BYSTEM (DERMS)	15:46:56 22:03/2021	🔒 💮 剩 🕂 EVNSPO
TINJAN DAC 1	🕐 Oursiev 🙀 O	neine 👰 (FPC	🖬 kvetes 🌲 Aare	PV Strigs	Contganton
No. of Concession, Name	e www	e wu	e ave	e avai	e eves
-	Involution Status	Inventor Status	Invertor Status	Invotor Status	Involut Status
		HIN	HUN		HUN
	Date Weld	Duty Vest	Daily Weld	Duly Yeld	Duly Yest
365 KW	205.4 KWh	323.8 EV/	748.3 KW	6855 Mit	1070.005
3851/	Total Active Rower	Tate Active Power	Tatal Active Prever	Total Active Power	Total Active Preser
	57.3 W	SK.9 KW	57.7 KW	NE 8 111	6.110
(1)	Total DC Power	Tride DC Power	Total DC Power	Total DC Power	Total DC Power
	55.6 KW	94.8 KW	59.4 KW	46.1 kW	46.2 MV
. 💽 (🏠	. avas	 wvst 	o ave	• ava	
365 kW	Invenier Status	Investor Status	Invertor Status	Investor Status	Inverter Status
21.2KV		10.8	10.04		10.N
Today Energy Generated	Daty Tiest	Daily Vet	Doly Yeld	Daily Yest	Duty Yest
4.788 MWh	COLD EWS	785 170	0.0 KW	••• aves	CO RMS
* Number of PV Panels	Total Active Power	Total Autor Power	Tubil Active Power	Total Active Power	Total Active Power
2230	-46.2 kW	55.6 KW	0.0 KW	6.6 AW	10.8 MW
Number of Inverters	Total DC Pawer	Total DC Power	Total DC Power	Total DC Power	Total DC Power
	41 W	SD.1 KW	0.0 KW	6.6 MV	6.6 AW

Figure 11. Inverter monitoring

Monitor metered values including current, voltage, active and reactive power, power factor, frequency, operating time, output, status of each inverters

ATS	DetaBerver	None	1	DISTRIBUTED ENER	OV REI	CORO	ENANAGEMENT	SMATE	M (1	ERMSI	08:4	1:03	14/03/2021	6	•	• E	EVN	SPC
<u>n</u>	THUNH BAC 1		T				-	RJN		•			- 20	AL 440				
burdh solard							10 A 17 A 17 A	C	23	3		-	ibus vallage ge is indiant. Nigh	8		Grid undervicitage Grid vicitage underla		
			ł			-		INVO	1	•			lege-arbailance well escreechs kinifige	•		blanding Output seering		
	519 kW 388V		t							9 10	-		e leakage careet d abroand	8		Pracentiale Transitive overco		
		_	Ŧ				19 A						verhiquency Inverventage			invited his voliage at	-	
4			F				TA D	-	-	- 2		-	tage in 15 million					
-								SLNG	-				alant oververlage None Trequericy			Span Span		
ne l	519KW						19 A	56110	CX	0						no.P	ede .	
.	21.3kV	2						6(A) M	e w	UE:								
1		Cutere Preve A		ingerties in the grad			Active Power			OMode			BEPT3 Current			MPPTYCareel		
	Today Energy Generated	Court New I		Internal temperature			Reality Pass			G Posset SP			MITT'S Village			MPPT/ Votage		
	0.642 MWh	General Phase C		Outyposer yeads			DCPower			MPP11 Cases			NETTI Current			MANALE CRIME		
	Number of PV Panels	Line Voluge AR		Monthly power pulling			IF Seport			MITTIVOLO			METH Votage			MPYTEVAlige		
	2230	Line Votage DC		Taka power yolds			FLIN ABUL			MITTE Carrier			MPPTS Caret			MIPTS Carlest		
-		Line Vollage (HC		Teld-simility lines			P and Seport			MPTT Village			MPP15 Volume			NETTI Value		
	Number of Inverters	Res Votege		Negative rill.			Plost faster.									MITTER Careed		
AD		(nonequero)		Permitted			Gled Swith						MINTER Vollage			MPP110 Volage		

Figure 12. Inverter detailed parameter monitoring



Monitor current weather conditions: radiation, air temperature, panel temperature, wind speed, wind direction.



ATS Delaterver	Login 🗃 🙆 None	DESTRIBU	TED ENERGY RESOURCE MANAGEMENT SYSTEM (DERMS)	14:08:02 13/04/2021	EVNSPC
ILLIANT AND IN	TORY ALMER				
E THE SAME	and the second se		20 EV	17 anali	
		1	T T		
Description of children and the	NTO ATTA ADD CAME	-	The day light () which dealer Comparison () and	Test	44,9109
	NTN NTNL JT Career	Brank .	TRUNCED LIVERY COMPANY OF	1.4	41.8159
00 2012/04/12 12:06:06:02 2 2012/04/12 10:06:05:07	NYS. ATTRACTOR DECOMPOSITION	B-00	PORTAL AVAILABLE DOTATION	754	
Designation of the select of the	wite when and o'l shaping		Pressure toplater fighted	The	
202010/01/2018 40:07/2019	WIN WINLAWGUT PROVEN	Seattle Sector	PPC Person links	True	THEAM BACK
2002 000 00 K 10 K 10 K 10 K	ATRUSTIC INCOLORS	moon.	Address Private Cardinal State	the	
State of a state of the second state of the se	#34_8789-040-57-90m	and a second	Reaction Fourier Control England	Fue .	and the second se
Delayer, to take state	878_8781.0011.017.0et	in the second se	THURSDAY, 1 - HIVE - Harvey	The	THUAN BAC 2
	\$75.3FT01.9E7627.9U7	Read .	SUBJECT EVEN Autom	704	Internet Decision
A REAL PROPERTY INCOME.	wite print devices have	and a	Travitor Sail 1 - Brild - Burning	Free	
Designed to address the	Wite Wite State 11 June	and a	TRANSING 1 AND Revenue TRANSING 1 TANK Revenue	Test State	THE REAL PROPERTY.
201104 11 2020 11 00	170, 270, 300, 300, 370, 300	100	Sauto BAL 1 - Brote - Renning Sauto BAL 1 - Brote - Renning	1.4	THUMH BAC 1
Designments (and all and	NTH STAL BOOK ST Ave.		TRACINCI AND RUNNY	Tes	
2012/04/11 16:00 13:002	WTH ATTLE AND LATING	arises.	TRAFILIC TVTI - Rainty	The	
characterization of the second	Wite, artist partit printer	and a	majori phi 1 - elver - Auring	100	TRUAN BACH
Jeleter's with a set	with With Annual II days	and a	Theorem and a shared during	Tax	1.100 A 0.2010 A 0000
					-
					THEM BACS
2					
á –					
and the second se					
14 C					
¥-					
201 C					
6					
a					
58.					
100 m					
113					
ladar .					
out					
0					
140 A					

Figure 14. Alarming and alarm management

The system generates 2 types of alarm (critical and non-critical alarms). The operator can assign these types to input signals or devices. Alarms and sequence of events are display chronographically.

Alarms are generated with definition, reason so that the user can rapidly take necessary actions.



Figure 16. Communication net-

Operational trend with U, I,

Other supplement parame-

Graphic parameters are se-

P, Q, Hz, PF...

ter trends

lectable

work monitoring

*

Communication network monitoring:

- Can access to the parameter of connected devices
- Can modify parameters (IP address, Switch configuration, computers,...)
- Track connection errors and restore
- Display graphically the working status of the network and connected devices



Applied Technical Systems Joint Stock Company | www.ats.com.vn

2.5. Advanced Software Modules

2.5.1. Report

- Reports can be built using ATS Data Link tool (an add-in for MS Excel). This add-in can allow data to be retrieved directly from within the spreadsheet program. You can create complex reports and graphs using current or historical data from the HIS (Figure 17).
- Data Link includes a tag search dialog, a dialog for viewing point configuration, a dialog for managing connections to multiple HIS, and support for login security to the HIS.

2.5.2. Web-based Monitoring

The system is equipped with web-based monitoring of data and allows multiple access. The data is acquired, stored and maintained for operational purposes, including planning, maintenance. The system is designed to provide fast access to database with secured connections. Data access is authorized for users based on account privilege.

Main functions are:

- Access management and user authorization
- Monitoring and displaying
- Customer information management
- Alarm/Event configuration and management
- Notice, email
- Ticket management
- Data retrieval



Figure 17. 24-hour operation report







Figure 19. Customer information management

Display location, information of distributed energy sources on geographical map







Figure 21. Configuration for notification





lanh sách nhiệm vụ			
lịnh kỳ bảo trị thiết bị Inverter	rtháng 6		
Tën nhiëm vy	Người thực hiện	Thời gian thực hiện	Trong thái
bits dufing Ihili to Inverter	canh (hacherstandaris <u>(bi</u> gnail.com)	25/06/2021 - 30/06/2021	-cookia la
We with the Pline	canh (hackumiandant@gmail.com)	35093021 - 30/06/2021	Chevreld
ide tra duong ste	santh (hackeentandigenal.com)	25/06/3521 - 30/06/2021	CHOIDIN
task field.	canh Ihachemilandanh@gmail.comi	30105(2021 - 31/05/2021	Chie an U
sober tas also reasy	(anh (hachesmandard@gmail.com)	14093001.30/06/3001	Detail
Holey công	canh Prachensiandant@gmail.com(27105(2021 - 15/05/2021	-mò sà ti
ally Report test 1			
Tên nhiệm vụ	Người thực hiện	Thời gian thực hiện	Trong thái
	Report Nacional Composition (guarantication)	20060021-24060021	Détén -
icket #3			
Ten nhiem va	Nguntri Brans hilen	This gian thys high	Topog that
Giles tra tako hann thiết tự	canh (hackentiandenti@gmail.com)	22/09/2021 - 22/05/2021	Chirak B
icket #2			
Din nhiệm vụ	Người thực hiện	Thời gian thực hiện	Trong thèi
Sem las during truyés internet	fank hadermandardgignaal.com	18/09/2021 - 19/99/2021	Inter Ball

Figure 22. Ticket management

2.5.3. Information Management System

Main functions are:

- Registration: DERs which have enought legal and meet requirements for connecting to distribution grid will be registered and updated in the system.
- Grouping: Registered DERs which are ready to operate can be grouped for power allocation. Groups are created depending on physical connection and management structure.
- Information Publishing: operating data will be continuously recorded, stored and published openly to all Owners.

2.5.4. Bill Payment

Billing is an important function for distributed energy sources. The billing application must comply with power purchase agreement, power tariff, and the process has to be transparent without possible financial conflict.

Main functions are:

CÓNG TY CÓ PHÀN

Dia ch

 Connection and data acquisition from tariff power meters with standard protocols (IEC 62056-21, Modbus) to collect real time

GIẤY THÔNG BÁO TIÈN ĐIỆN

Tén khách hàng: nina	-	Chi số điện hà	123123	11/06/2020		
-		Ngày chốt	O (kiWh)	H (kWh)	L (kWh)	Total (kWih
CN số mới ĐH1 ID1 (Solar sân xuất)	(1)	09/06/2020		0	0	
CN số có ĐHT ID1 (Solar sản xuất)	(2)			0		
Tổng điện năng Solar sên xuất ở DH1 ID1	[A=(1)-(2)]			0	. 0	N
Chi số mói ĐH1 iĐ1 (chế đũ standby)	(0)	09/06/2020			0	
Chi số củ ĐH1 ID1 (chế đô standby)	(4)					
Tổng điện năng Solar hoạt đông standby DH1 ID1	[8=(3)-(4]			0	0	
Chi sõ mái DH2 ID2 (Solar phát lên lưới)	(5)	09/06/2020		0	. 0	
Chi số củ ĐH2 ID2 (Solar phát lên lưới)	(6)	-			. 0	
Tổng điện năng Salar phát lên luới ở DH2 ID2	(C=(5)-00)			0	0	
Tông diên năng liêu thu của khách hàng	(E-A-D-C)		-	0		
Den già (VND)				2		
Thanh tên (vNE)	(Gale (F)			0	- 0	
Tổng Tiên (VND)						
VAT 10%						
Tổng tiên thanh toán (VND)						
Số tiên bằng chữ		Tiên phải là số	inguyên du	ong libn hor	1.640 0	
Note: Chù nhật chỉ có 2 biểu giá (O & L)						
O:of-peak hour (binh thường) (4.00_9430, 11h30 H:high peak hour (bao diềm) (9h30_11h30, 17h_20 L:low peak hour (bhág diễm) (92h_4h) BHI:lip sau biến tản BHI:lip sau đêm thế diễn lực)_17h,20h_22t h)	U.				







Figure 25. Generation forecasting outcome

metered data, total output energy with related tariff.

- Generation of invoices with flexible billing process that meets the owner request, customers and power companies with varied number of connecting points. Billing time is configured in accordance to power purchase agreement.
- The billing process is developed in web services. Only authorized users can access and export the bill. The users can preview bills on webpage or download to their computers in pdf format or send to predefined email addresses.
- Invoices can be generated at current time or at past moments.

2.5.5. Data analysis and Warning

The system can provide list of incidences that supports operators to evaluate devices status, prevent damages in advance. Thus the operators can make maintenance plans effectively to reduce cost while enhance plant reliability.

Incidence analysis and warning functions include:

- Transformer analysis & warning
- Inverter analysis & warning
- PV panels analysis & warning

2.5.6. Asset Management

The system provides ability of asset management and maintenance based on CIM data model (IEC 61968/61970).

2.5.7. Estimation/Forecasting

The system can precisely estimate generated power of solar power plants including roof top solar sources to make correct operational plans.

For virtual power plants (VPP), load forecasting plays a particularly important role, together with generation forecasting of DERs to aggregate into a single generation characteristic representing the combined capacity of all DERs in the VPP. This is the basis for bidding in the power market.

2.5.8. DSM & DR

Demand Side Management and Demand Respond (DSM&DR) functions help monitor and manage load data, manage power outages, and adjust controlable loads which are connected to VPP to appropriate response with different price signals.



Figure 26. Load forecasting outcome



Head Office

Suite #604- VNA8 Building, 8 Tran Hung Dao Str., Hanoi, Vietnam T. +84-24-3825 1072 F. +84-24-3825 8037 E. contact@ats.com.vn

Factory

Lot No. A2CN6, Tu Liem Industrial Zone, Hanoi, Vietnam T. +84-24-3780 5053 F. +84-24-3780 5060

HCM Office

13-15 Nguyen The Loc Street Ho Chi Minh City, Vietnam T. +84-28-3948 3548 F. +84-28-3948 3549