NON-INTERCONNECTED ISLANDS SYSTEM & MARKET OPERATOR

Project Implementation of the Athens Central Energy Control Center (ECC) and the Local ECC for the Electrical Power System in Rhodes

TECHNICAL AND FUNCTIONAL REQUIREMENTS

PART A: GENERAL

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List of Acronyms

AGC	Automatic Generation Control
CC	Combined Cycle
DC	Data Concentrator
DS	Dispatch Scheduling
DW	Data Warehouse
ECC	Energy Control Center
EMS	Energy Management System
FAT	Factory Acceptance Tests
HIS	Historical Information System
ICE	Internal Combustion Engine
IT	Information Technology
MIS	Management Information System
MMS	Market Management System
NII	Non-Interconnected Island
NII SMO	Non-Interconnected Islands System and Market Operator
PPC	Public Power Corporation
PV	Photovoltaics
RES	Renewable Energy Sources
RTD	Real-Time Dispatch
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
TFD	Time-Frequency Device

1 Introduction

The Code for the management of the Greek Non Interconnected Islands (NII) power systems requires the development of a Central Energy Control Center (ECC), and of Local ECCs, to support the role of the NII System and Market Operator (NII SMO). This role is assigned to HEDNO S.A., a 100% PPC S.A. subsidiary.

The Central ECC will be located at HEDNO premises in Athens, and will include several systems to perform the implementation of the market operation, and settlement as well as supervision and monitoring of the system operation.

The Local ECC constitutes the infrastructure for the management of the NII power system and communicates with the Central ECC, which generally supervises and monitors its operation.

The scope of this Project is the implementation of the Central ECC in Athens and the Local ECC for the electrical power system in Rhodes.

This Tender refers to the infrastructure of the Local ECC in the island of Rhodes. The Local ECC shall be hosted in a dedicated space at the existing premises of the Control Centers in Rhodes. Infrastructure will also be installed at substations in the island, as required. It also includes the related infrastructure at the Central ECC in Athens.

This Tender seeks the services of a qualified Contractor to implement the IT systems required for the market and system operation, as well as the necessary corporate systems, for the NII SMO to perform the functions described in the Code. It is noted that market settlement functions are not within the scope of this project.

The project includes all necessary hardware, software and services for the detailed design, implementation, customization, installation, commissioning and any other service, needed to put the ECCs in full operation.

The main IT systems of the NII SMO, which will be procured as part of this project, referred to as NII IT Systems, are listed below:

- Energy Management System (EMS); this is detailed in Part B of the Technical Tender Technical and Functional Requirements.
- Market Management System (MMS); this is detailed in Part C of the Technical Tender Technical and Functional Requirements.
- Corporate Systems (DW/MIS and Helpdesk); they are detailed in Part D of the Technical Tender Technical and Functional Requirements.

The main Deliverables of the Project, including hardware, software, services, training and documentation, are listed in Part E of the Technical Tender Technical and Functional Requirements.

Project Execution details, including the Project Phases, are presented in Part F of the Technical Tender Technical and Functional Requirements.

Testing, Availability and Performance requirements for the NII IT Systems are listed in Part G of the Technical Tender Technical and Functional Requirements.

Maintenance requirements for the foreseen warranty and maintenance periods are presented in Part H of the Technical Tender Technical and Functional Requirements.

All NII IT Systems should be operated and communicate over a NII Telecommunication backbone that will be provided by the NII SMO.

The remainder of this Part is organized as follows:

Section 2 presents general characteristics of all Greek NII Electical Power Systems.

Section 3 presents the main characteristics and data for the island of Rhodes.

Section 4 presents a high-level architecture of the ECCs and the NII IT Systems.

Section 5 lists the systems to be implemented in the Central ECC (Athens) and the Local ECC (Rhodes) within the scope of this project.

2 Description of the NII Autonomous Electrical Systems

To date, electricity in the NII is generated mainly by thermal (oil) stations that belong to PPC, as well as by RES stations, mainly Wind Farms and PV stations, which in general belong to private producers. It is noteworthy the rapid development of the RES stations and the continuous increase of the RES penetration rate in the NII. In some NII, RES generation reaches about 18-20% of the yearly demand. In addition, in the next five years, the development of RES stations of modern technologies is promoted with storage systems, which will result in achieving even greater RES penetration rates.

The thermal units operate with heavy fuel oil or diesel and are steam units, ICE, and gas turbines. Depending on their technology, the daily demand profile and the RES penetration, the thermal units are occasionally operated as base units or peak units.

Currently, the installed capacity of the thermal power Stations in all the NII amounts to 1758 MW and of the RES stations to 453 MW. It is also estimated that new RES stations, of modern technology, such as hybrid stations with storage systems pumped storage or batteries, solar thermal stations, geothermal stations and biomass stations will be developed. In 2014, the total yearly generation in the NII amounted to 5433 GWh, 16.8% of which originated from RES generation. In the following Table, the main characteristics regarding the installed capacity of the generation units in the 32 NII and the power peak electricity demand are listed, to provide the Contractor with an overview of the NII autonomous power systems in Greece.

Table 2-1. Main Characteristics of the 32 Greek NII Power Systems

No.	NII Systems	Installed Capacity of Thermal Units (8/2015) (MW)	Peak Power Demand (2014) (MW)	Installed RES Capacity (MW)	
				Wind	PV
1	CRETE	819.25	601.70	194.36	78.29
2	RHODES	232.61	198.50	49.15	18.16
3	LESVOS	92.50	63.69	13.95	8.84
4	KOS-KALYMNOS	120.05	95.30	15.20	8.78
5	LIMNOS	21.58	14.00	2.88	1.89
6	MILOS	20.60	12.00	2.65	0.62
7	PAROS	73.72	70.00	12.96	5.17
8	CHIOS	69.93	43.30	9.08	5.18
9	SYROS	39.70	20.60	2.84	0.99

10	SAMOS	47.75	29.95	8.38	4.37
11	KARPATHOS	17.90	11.30	1.23	1.16
12	MYKONOS	49.84	42.00	1.20	1.04
13	AGIOS EFSTRATIOS	0.76	0.30	0.02	
14	AGATHONISI	0.51	0.18		
15	AMORGOS	5.22	2.97		0.29
16	ANAFI	0.80	0.54		
17	ANTIKYTHIRA	0.36	0.10		
18	ARKIOI	0.36	0.14		
19	ASTYPALAIA	3.60	2.28		0.32
20	GAVDOS	0.32	0.11		
21	DONOUSA	0.50	0.36		
22	EREIKOUSA	0.53	0.30		
23	THERA	77.92	40.30		0.25
24	IKARIA	13.56	7.50	0.99	0.40
25	KYTHNOS	4.90	3.14	0.67	0.24
26	MEGISTI	1.82	0.90		
27	OTHONOI	0.53	0.30		
28	PATMOS	6.60	5.48	1.20	0.15
29	SERIFOS	5.60	3.58		0.10
30	SIFNOS	8.80	6.35		0.20
31	SKYROS	6.90	4.45		0.32
32	SYMI	8.20	4.11		0.19

The following figure presents the evolution of the RES installed capacity for the years 2013-2015.

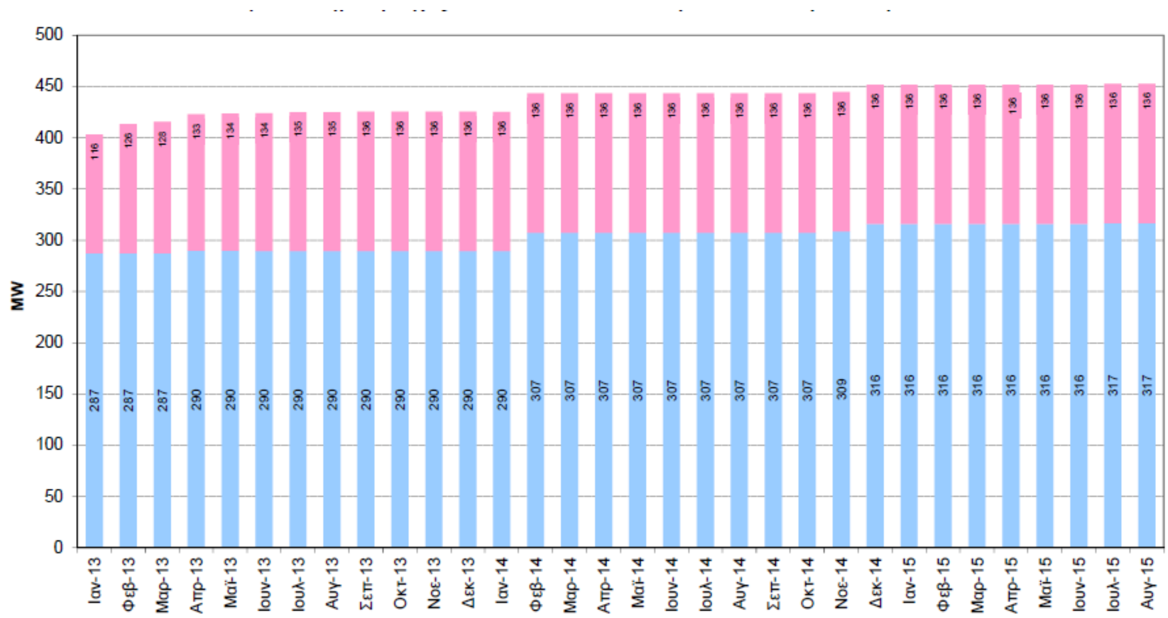

Figure 2-1. Evolution of RES Installed Capacity (MW) in the NII for the years 2013-2015 (blue: wind; magenta: PV)

In Section 3, a detailed description of the NII autonomous system in Rhodes is presented. The Contractor can use the following information for his proposal on the design and implementation of the EMS system. More detailed data will be made available by the NII SMO upon request in the Detailed Design Phase of the Project.

3 Rhodes

The island of Rhodes is the second largest island power system in Greece. Electricity generation system is based mainly on oil-fired thermal power units.

3.1 Generation

3.1.1 Conventional Generation Units

In Rhodes, the installed capacity of conventional generation units reaches 186 MW. There is currently one power Station on the island of Rhodes, with 11 generators. There is also often the need for small ICE generators, which are temporarily installed and produce energy during the summer period (about 20 generators). These are listed in the following Table.

Table 3-1. Generation Units in Rhodes

No.	Generic Name	Type of Unit	Fuel Consumed	Technical Maximum (MW)	Technical Minimum (MW)	Remarks
1	SORONI_ATM1	STEAM	MAZOUT_RHODES	14.5	10.00	
2	SORONI_ATM2	STEAM	MAZOUT_RHODES	14.5	10.00	
3	SORONI_D1	ICE	MAZOUT_RHODES	10.5	4.30	
4	SORONI_D2	ICE	MAZOUT_RHODES	10.5	4.30	
5	SORONI_D3	ICE	MAZOUT_RHODES	18	14.00	
6	SORONI_D4	ICE	MAZOUT_RHODES	18	14.00	
7	SORONI_D5	ICE	MAZOUT_RHODES	18	14.00	
8	SORONI GT1	GT	DIESEL_RHODES	17.5	5.00	
9	SORONI GT2	GT	DIESEL_RHODES	20	5.00	
10	SORONI GT3	GT	DIESEL_RHODES	18	5.00	
11	SORONI GT4	GT	DIESEL_RHODES	26.5	5.00	

A new thermal power station is under commission and final acceptance tests in the south part of the island, amounting about 119.5 MW. It consists of 7 ICE units, with technical characteristics as shown in the following Table.

Table 3-2. Generation Units in Rhodes

No.	Generic Name	Type of Unit	Fuel Consumed	Technical Maximum (MW)	Technical Minimum (MW)	Remarks
1	SRHODES_D1	ICE	MAZOUT_RHODES	17.08	6	To be comminssioned in 2018
2	SRHODES_D2	ICE	MAZOUT_RHODES	17.08	6	To be comminssioned in 2018
3	SRHODES_D3	ICE	MAZOUT_RHODES	17.08	6	To be comminssioned in 2018
4	SRHODES_D4	ICE	MAZOUT_RHODES	17.08	6	To be comminssioned in 2018
5	SRHODES_D5	ICE	MAZOUT_RHODES	17.08	6	To be comminssioned in 2018
6	SRHODES_D6	ICE	MAZOUT_RHODES	17.08	6	To be comminssioned in 2018
7	SRHODES_D7	ICE	MAZOUT_RHODES	17.08	6	To be comminssioned in 2018

3.1.2 RES Units

The installed capacity of RES in Rhodes reaches 68 MW. These include about 49 MW of wind and 19 MW of PV. There are about 215 small PV parks of about 18 MW (none exceeding 100 KW) and about 1 MW roof PVs (<= 10KW) installed.

The following Table lists the Wind Parks in Rhodes.

Table 3-3. Wind Parks in Rhodes

	Name	Licenced Capacity	Installed Capacity	WTs No
WA	ATTAVYROS	11.7	12	13
DI	DIETHNIS AEOLIKI	11.05	11.05	13
AE	AEIFORIKI RODOU	3.3	3.3	5
DA	PPC Renewables.	4.95	4.95	
EW	Eurowind	17.85	20.7	9

Note:

The total number of signals for the wind parks in Rhodes are about 135: 14 digital inputs, 14 double digital, 107 analog measurements. PVs also have 70 digital inputs, 35 double digital, 65 analog measurements.

Based on available data, the applications for hybrid and biomass RES in Rhodes reach a guaranteed capacity of 36 MW (3 stations) for the hybrid stations, and 8 MW (28 stations in Rhodes) for biomass.

The following Figure presents the monthly thermal and RES generation in MWh for the year 2014.

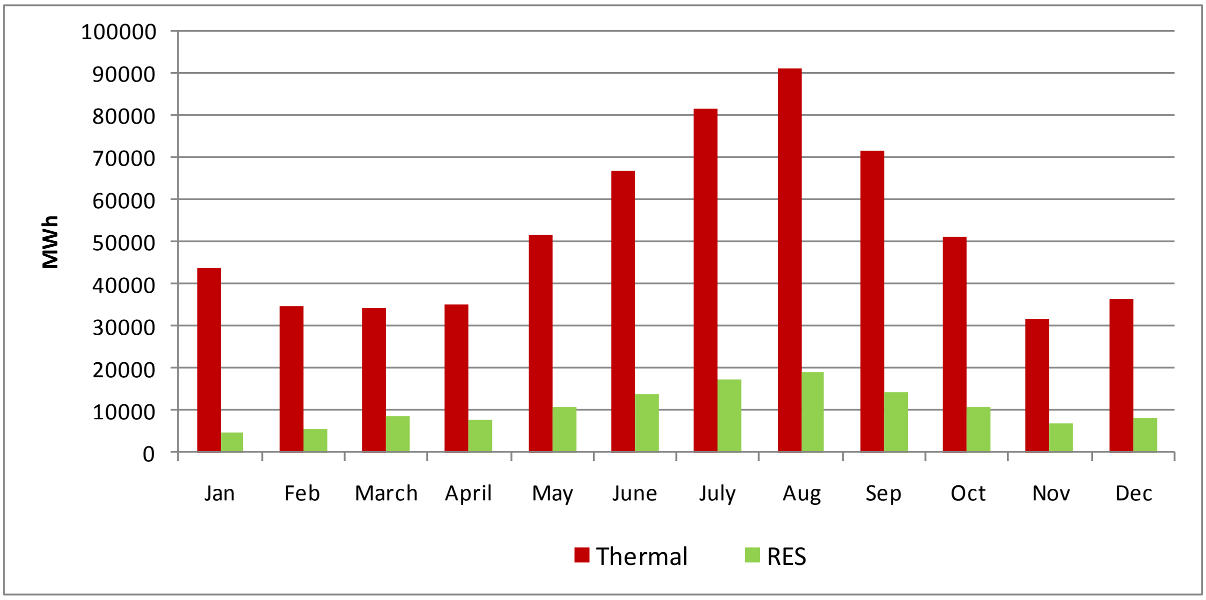

Figure 3-1. Monthly Thermal and RES Energy Generation (MWh) in Rhodes (2014)

3.2 Transmission System and Substations

In the following Figure, a map of the Rhodes power system is provided, which includes the main power stations and the transmission network (150 KV) including 5 substations and about 87 km of overhead lines.

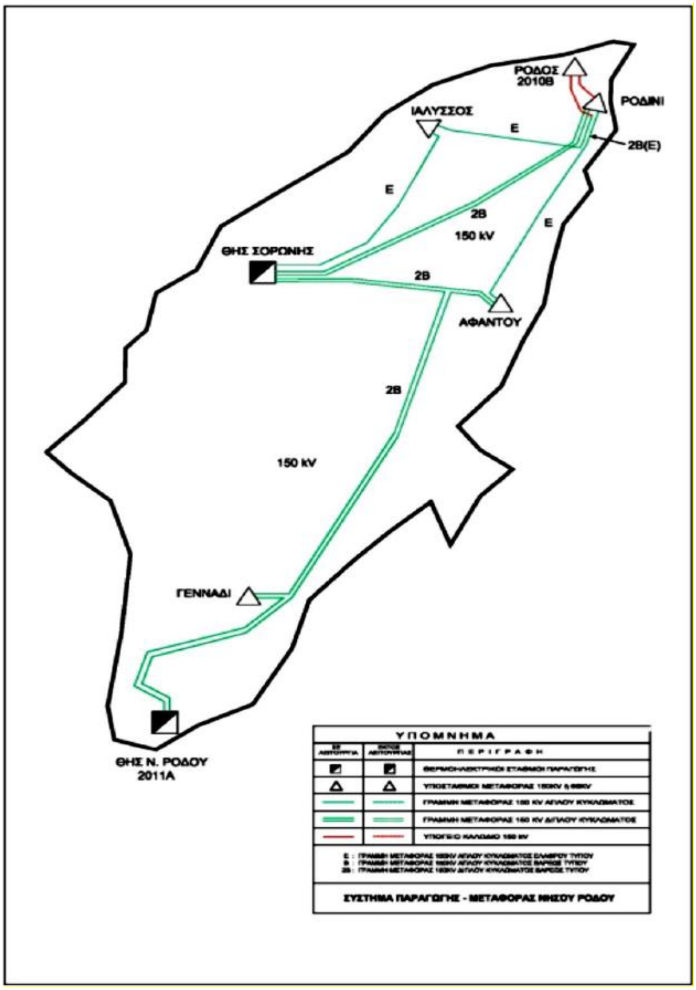

Figure 3-2. Transmission Network in Rhodes

The 5 RTUs to be replaced will be procured within this Project. In addition 2 RTUs will be procured for the new South Rhodes power station and the Rhodes (Ag. Nikolaou) substation.

The total number of signals for the 4 substations, which contain 5 of the 7 RTUs above, are about 1281 (713 digital inputs, 173 double digital, 337 analog measurements, and 58 commands).

In the following Table, the signals are listed per substation. The list is provided for information purposes and is subject to updates. Bidders may use this list for the purposes of submitting their bid, but the exact list will be provided to the Contractor at the beginning of the Detailed Design Phase of the Project.

Table 3-4. List of Signals per Substation (RTUs with no protocol) in Rhodes

					S1	S2	S3	S4
					GENADI	AFANTOY	IALYSOS	SORONI
COMMANDS (OPERATION)	DOUBLE DIGITAL OUTPUTS	1	"ON" - "OFF" Command		13	17	15	6
		2	"ON" - "OFF" -Auto-reclose Circuit Breaker Command Status		2	3	2	0
STATUS INDICA-TIONS	DOUBLE DIGITAL INPUTS	1	"ON- OFF" Status indication		27	28	29	67
		2	Circuit Breaker Auto-Reclose, "ON- OFF" Status		2	3	2	0
		3	Circuit Breaker Trolley Status "Decoupling- Operation"		0	0	0	0
		4	Bay Control (Circuit Breaker) by Substation-Control Center		5	5	5	0
ANALOG MEASURE-MENTS	MEASURE-MENTS	1	Current in all three (3) phases		30	10	36	35
		2	Voltage in all three (3) phases		24	8	30	27
		3	Active Power (MW)		8	8	10	27
		4	Reactive Power(MVAR)		8	8	10	27
		4	Fuel Measurements (lt/sec)					11
		6	Bus Frequency		2	1	2	11
		7	Bus Voltage		1	1	1	1
BAYS INDICATIONS	TRANSMISSIONLINE	1	Generic Activation of Distance Protective Relay	Distance Relay	2	3	2	1
		2	Distance Protection Relay Operarion 1st Area Zone	Distance Relay	2	3	2	0
		3	Distance Protection Relay Operarion 2nd Area Zone	Distance Relay	2	3	2	0
		4	Distance Protection Relay Operarion 3rd area Zone	Distance Relay	2	3	2	0
		5	Distance Protection Relay Operarion Back Zone	Distance Relay	2	3	2	0
		6	Trip Command due to Carrier input to DISTANCE RELAY	Distance Relay	2	3	2	0
		7	Distance Protection Relay - trip command to the Bay Circuit breaker	Distance Relay	2	3	2	0
		8	Distance Protection Relay - Failure	Distance Relay	2	3	2	0
		9	Line Voltage Control –DISTANCE RELAY MCB trip		2	3	2	0
		10	Line Voltage Control and Busbar Voltage Control Synchronization –MCB trip		2	3	2	0
		11	Emergency Protection Trip		0	0	0	0
		12	Auto-Reclose Operation		2	3	2	0
	GENERIC BAYS INDICATIONS	13	OverCurrent Protection Relay - trip command to the Bay Circuit Breaker	OverCurrent Protection Relay	13	15	15	0
		14	OverCurrent Protection Relay - Failure	OverCurrent Protection Relay	5	5	5	8
		15	SF6 low pressure Level 1		5	5	5	0
		16	SF 6Low Pressure BLOKING Level 2		5	5	5	0
		17	Unloaded spring		5	5	5	0
		18	SwitchBoard 110 V DC – DC Supply for Bay Control,protection and indications, Circuit Breaker trip		5	5	5	0
		19	SwitchBoard 110 V DC – DC Supply for Motors,Circuit Breaker trip		5	5	5	0
		20	Bay Protection and Control SwitchBoard – Bay Control DC Supply MCB Trip		5	5	5	0
		21	Bay Protection and Control SwitchBoard– Bay protection DC Supply MCB Trip		5	5	5	0
		22	Bay Protection and Control SwitchBoard –Bay indications DC Supply MCB Trip		5	5	5	0
	HV side of T/F	1	T/F On-load tap changer -Upper position		3	2	3	0
		2	T/F On-load tap changer lowest position		3	2	3	9
		3	T/f Alarm Bouchholz Relay		3	2	3	9

					S1	S2	S3	S4
		4	T/f Alarm Bouchholz OLTC Relay		3	2	3	0
		5	T/F Alarm -Oil Temperature		3	2	3	0
		6	T/F Neutral Node Overcurrent Relay -Earth Fault Alarm		3	2	3	0
		7	T/F Neutral Node Overcurrent Relay -Earth Fault Trip		3	2	3	0
		8	T/F Neutral Node Earthing resistor High Temperature Alarm		3	2	3	0
		9	T/F boucholz trip command		3	2	3	0
		10	T/F trip- Bouchholz OLTC		3	2	3	0
		11	T/F Oil Temperature Trip		3	2	3	0
		12	Temperature X1-x3 T/F Alarm		3	2	3	0
		13	Temperature X1-x3 T/F Trip		3	2	3	0
		14	T/F pressure relief valve Trip		3	2	3	0
		15	Dfferential Protection Relay - Failure		3	2	3	0
		16	T/F Differential Protection Relay Bay Circuit Breaker trip command		3	2	3	0
		17	T/F Neutral node Overcurrent Relay -Failure		3	2	3	0
		18	MCB TRIP For T/F FAN CONTROL		3	2	3	0
	MV SUPPLY BSwitchBoard	1	OverCurrent Protection -Circuit Breaker Trip Command		3	2	3	0
		2	Arc-flash detection relay- Circuit Breaker Trip Command		3	2	3	2
		3	T/F Differential Protection - Circuit Breaker Trip Command		3	2	3	2
		4	Overcurrent Relay Failure		3	2	3	2
		5	Arc-flash detection relay- Failure		3	2	3	2
		6	Bay Protection and Control SwitchBoard /Bay Control DC Supply – MCB trip .		3	2	3	2
		7	Bay Protection and Control SwitchBoard / Bay Protection DC Supply – MCB trip		3	2	3	2
		8	Bay Protection and Control SwitchBoard / Bay Indicators DC Supply – MCB trip		3	2	3	2
GENERIC ALARM substationSIGNALS	SYNCHRONIZATION	1	Synchronization Operation		1	1	1	2
		2	Reason of Synchronization failure - "ΔΦ"		1	1	1	1
		3	Reason of Synchronization failure - "ΔU"		1	1	1	1
		4	Reason of Synchronization failure - "Δf"		1	1	1	1
		5	Synchronization Voltage Comparison Scheme -"Active line and active bus"		1	1	1	1
		6	Synchronization Voltage Comparison Scheme -"Inactive line and active bus"		1	1	1	1
		7	Synchronization Voltage Comparison Scheme -"Active line and Inactive bus"		1	1	1	1
		8	Synchronization Voltage Comparison Scheme -"Inactive line and Inactive bus"		1	1	1	1
	SUB STATION PROTECTION	9	Differential Protection Bus I 150 kV - BLOCK		0	0	1	1
		10	Differential Protection Bus II 150 kV - BLOCK		0	0	1	1
		11	Differential Protection Bus I 150 kV - ALARM		0	0	1	1
		12	Differential Protection Bus II 150 kV - ALARM		0	0	1	1
		13	Differential Protection Bus I 150 kV TRIP		0	0	1	1
		14	Differential Protection Bus II 150 Kv TRIP		0	0	1	1
		15	U/F Relay Activation-Stage 1		1	1	1	1
		16	U/F Relay Activation-Stage 2		1	1	1	1
	SUBSTATION GENERIC	17	Battery Charger 110 V No1 & No2 – Output overvoltage / undervoltage		1	1	1	1
		18	Battery Charger 110 V No1 & No2 – failure/malfunction		1	1	1	1
		19	110 V DC SwitchBoard – DC Leakage Relay		1	1	1	1
		20	110V DC SwitchBoard – SwitchBoard Supply Automatic Circuit Breaker trip		1	1	1	1
		21	110V DC SwitchBoard – Switchboard bus DC Loss (supervision auxillary Undervoltage Relay)		1	1	1	1
		22	110V DC SwitchBoard – Generic Indications DC Loss (Supervision with auxillary AC Relay)		1	1	1	1
		23	110V DC SwitchBoard – Carriers MCB trip		1	0	1	1
		24	400/230 V AC SwitchBoard – SwitchBoard Supply Circuit Breaker trip		1	1	1	1
		25	400/230 V AC SwitchBoard – SwitchBoard bus Phase A Failure (supervision με auxillary Undervoltage Relay)		1	1	1	2

					S1	S2	S3	S4
		26	400/230 V AC SwitchBoard – SwitchBoard bus Phase B Failure (supervision with auxillary Undervoltage Relay)		1	1	1	1
		27	400/230 V AC SwitchBoard – SwitchBoard bus Phase C Failure (supervision with auxillary Undervoltage Relay)		1	1	1	1
		28	400/230 V AC SwitchBoard – Switchboard Automatic Changeover Switch status "input from Distribution Feeder"		1	1	1	1
		29	00/230 V AC SwitchSwitchBoard – Switchboard Automatic Changeover Switch status "input from Auxillary Service Transformer"		1	1	1	1
		30	Operations Voltage loop Disturbance		1	1	1	1
		31	Fire Detection SwitchBoard -Fire Detection System failure of lack of Voltage		1	1	1	1
		32	Fire Detection SwitchBoard – Fire Detection Activation		1	1	1	1
		33	Building Security System (Alarm) - Activation		1	1	1	1
	Generation Units Protection	34	Over-frequency protection					11
		35	Under frequency protection					11
		36	Loss of Excitation					11
		37	Overvoltage protection					11
		38	Undervoltage protection					11
		39	Pole slip protection					11
		40	Overcurrent protection					11
		41	Islanding protection					11
			SUM OF SIGNALS					
Digital Inputs			713	**Partial Sum**	185	171	193	164
Double Digital			173	**Partial Sum**	34	36	36	67
Analog Measurements			337	**Partial Sum**	73	36	89	139
Commands			58	**Partial Sum**	15	20	17	6

In addition to the above, the following Table lists the signals for the substations that communicate with protocol.

Table 3-5. List of Signals per Substation (RTUs with protocol) in Rhodes

Substation	COMMANDS	DOUBLE DIGITAL	DIGITAL INPUTS	ANALOG MEASUREMENTS
SORONI	73	189	213	220
RODINI	28	64	190	124
SUM	101	253	403	344

Furthermore, the following Table includes future substations.

Table 3-6. List of Anticipated Signals per Future Substation Expansions in Rhodes

Substation	COMMANDS	DOUBLE DIGITAL	DIGITAL INPUTS	ANALOG MEASUREMENTS
S. RHODES Substation	26	26	95	52
RHODES (Ag. Nikolaou)	26	26	95	52
S. RHODES (Power Station)	60	160	280	425
SUM	112	212	470	529

Detailed single-line diagrams will be provided to the Contractor during the Detailed Design Phase of the Project.

For clarity, the following map shows the geography of the substations and wind parks in Rhodes.

Figure 3-3. Wind Parks and Substations in Rhodes

3.3 Demand

The peak demand for the year 2014 in Rhodes was 199 MW. The annual electricity consumption for the year 2014 has been about 800 GWh.

4 ECC Systems Overview and Architecture

This Section presents a high level architecture of the NII IT Systems for the ECCs. The detailed architecture and requirements are provided in the relevant parts of this Tender. This Section is intended to provide an overview of the systems to be implemented, and guide the Contractor through the parts of the technical and functional requirements.

4.1 High-Level Architecture

The key features of the ECC architecture are:

- The Local ECC (in Rhodes) is a separate domain with an individually scaled hardware configuration.
- The Local ECC will be fully redundant; i.e., the island of Rhodes will maintain a main Local ECC and an identical backup Local ECC, preferably in a different location for maximum security.
- The main Local ECC will host two servers; one application server and a database server.
- The application server will host both the EMS applications and the MMS applications.
- The database server will host both the EMS database and the MMS database.
- The backup Local ECC will have exactly the same configuration as the main ECC. It is anticipated that the backup Local ECC be hosted in a separate location for maximum security, if possible.
- This configuration will maintain the database of both Control Centers up-to-date.
- Further, it will distribute supervisory control commands, manual updates, tagging, and alarm acknowledgements and will provide global availability of data.
- It will also maintain, transmit and distribute engineering data.
- All RTU data from the island are collected in a Data Concentrator (DC) located in the local ECC.
- The configuration features a fully redundant DC in the island.
- The Local ECC will process the information from its local RTU only.
- The configuration will support temporary shift of operational tasks from main to backup in case of disturbances and failures (emergency strategies).

- It will also support an automatic recovery scheme - transmit missing data after communication failures.
- It will support a uniform data model for both Control Centers.
- The Athens Central ECC will have the capability to monitor the EMS and MMS operations in the island of Rhodes.
- The Athens Central ECC will have MMS server (main and backup) to run the market functions, namely RDAS, DS and RTD.
- The Athens Central ECC will have a (non-redundant) development server for development purposes of the RDAS, DS, and RTD.
- The corporate infrastructure will be installed in the Athens Central ECC.

4.2 Main Systems

The main NII IT Systems, which will be procured as part of this project, are listed below:

1. Energy Management System (EMS); this is detailed in Part B of the Technical Tender Technical and Functional Requirements.
2. Market Management System (MMS); this is detailed in Part C of the Technical Tender Technical and Functional Requirements.
3. Corporate Systems; they are detailed in Part D of the Technical Tender Technical and Functional Requirements.

Brief descriptions are provided next.

4.2.1 Energy Management System (EMS)

The monitoring, operation and control of NII Electrical Systems will be implemented from the Control Centers of the NII by the use of the EMS infrastructure. The organization of the NII SMO Control Centers is as follows:

- <u>Central ECC</u>: The Central ECC will basically have a monitoring role with respect to the NII system operation; hence only remote displays will be installed in the Central ECC (not actual EMS systems).
- <u>Local ECC</u>: A Main EMS shall be installed in the Local ECC, which will be backed up by a Backup System. It will also include the application of a Dispatchers Training Simulator.

A development EMS System will be provided for the Central ECC in Athens. The development system shall be non-redundant.

The EMS architecture consists of a main and backup structure located on the island. Both the Main and Backup EMS consist of fully redundant hardware and software infrastructure that hosts the Applications of the EMS; the applications are summarized as follows:

- SCADA;
- Historical Information System (HIS);
- Automatic Generation Control (AGC);
- Power Advanced Applications:
  - State Estimator;
  - Power Flow;
  - Optimal Power Flow;
  - Contingency analysis;
  - Short Circuit Analysis;
  - Outage Scheduler;
  - Automatic Voltage Control;
  - Load Shedding.

The Main EMS is fully duplicated with the Backup EMS. The Main and Backup EMS should operate as complementary systems for the NII (only one should be active at a specific point in time while the other should be in monitor status). They should be always updated with the status of the electrical system and in full synchronization to each other in order to be ready to change their operational status when needed.

The EMS will be fully integrated with the NII IT Systems. The EMS is also communicating with the MMS. The EMS should directly communicate with the Electrical System Infrastructure (network, customers and power plants), through a centralized data exchange infrastructure of a Data Concentrator (DC) and a Time Frequency Device (TFD). The purpose of the TFD is to synchronize all island functions and to calculate the NII time deviation that has to be considered for correction by the AGC application. Both DC and TFD will be located in the Local ECC. The Main and Backup EMS is directly communicating with the DC to exchange real time data and to issue controls to the NII Electrical System.

The DC implements all data exchange between the EMS and the NII Electrical System through the RTUs, IEC protocols, Protocol converters, and Digital Control Systems (DCSs) installed in the assets (Substations, Powers Plants Renewable Generation). The DC directly communicates with the Main EMS, and with the Backup EMS, for the exchange of real time data. The DC communicates through the telecommunication network (to be implemented by the contractor) with the RTUs, protocol converted or DCSs which are installed in Substations, Power Stations, Wind Farms, PV and other RES.

The DC should be redundant, in active-active configuration, in order to avoid any single point of failure. The DC configuration shall allow for failure of a single DC without loss of communications to any RTU.

RTUs should be installed where necessary. They are intended to replace old RTUs that are not communicating via a protocol (5 RTUs), and also for the new Power Station in South Rhodes and the Rhodes (Ag. Nikolaou) Substation (2 RTUs).

Existing SCADA infrastructure that is not directly replaced shall remain operative.

The Control Center in Rhodes should also have an appropriate display wall infrastructure to provide an overview of electricity generation and island's network in sufficient clarity and detail.

It should be noted that the EMS functional design should be scalable, expandable and adaptable, in order to accommodate possible modifications (updates).

Detailed requirements of the EMS are presented in the Part B of the Technical Tender Technical and Functional Requirements.

4.2.2 Market Management System (MMS)

This Section presents a general and brief overview of the requirements for the MMS.

- Central ECC: The Central ECC in Athens will have a redundant MMS platform installed, with a capability to run the Rolling Day-Ahead Scheduling Application, as well as the DS and RTD. The system should be expandable to support running the RDAS, DS, RTD for the 32 NII. Forecasting applications will be included in this platform.
- Local ECC: The Local ECC in Rhodes shall host redundant MMS platforms of full capability, as described in the following sections.

Each of the two (2) MMS platforms (Athens, Rhodes) shall have a Main and Backup and should operate as complementary systems for the NII (only one should be active at a specific point in time while the other should be in monitor status). They should be always updated and synchronized to each other in order to be ready to change their operational status when needed.

The MMS installed in Rhodes is also communicating with the EMS.

A development system shall be provided for the Central ECC in Athens, which will be a replica of the production system, and, in addition, will have, apart from the RDAS capability and related forecasting, the capability to run DS and RTD, with the related forecasting applications. The development system shall be non-redundant.

The MMS of Rhodes communicates with active EMS, for the cost-based RTD-AGC data exchange. Market operators, internal and external users shall access the system through dedicated interfaces.

It should be noted that only one dispatch system (RTD application) is foreseen in the project, which is included in the MMS platform, and which passes the information to the EMS platform for the AGC.

Briefly, the MMS platform contains the following applications:

- Common Services:
  - MMS User Interface;
  - Validation System;
  - Market Publishing System;
  - Market Reporting System;
  - Market Communications System.
- Applications:
  - Master File;
  - Rolling Day-Ahead Scheduling;
  - Dispatch Scheduling;
  - Cost-based Real-Time Dispatch;
  - Real Time Data Recording and Logging System.

It should also include load and RES forecasting applications, to support RDAS, DS, and RTD.

It should be noted that the MMS platform functional design should be scalable, expandable and adaptable, in order to accommodate possible modifications (updates), in accordance with the regulatory framework in-force at each time period.

Detailed requirements of the MMS are presented in Part C of the Technical Tender Technical and Functional Requirements.

4.2.3 Corporate Systems

The Corporate systems shall be installed at the Central ECC in Athens and briefly include the following:

- **Datawarehoure (DW) / Management Information System (MIS)**: In general, this system should keep properly related up-to-date, aggregated, accurate and critical information to provide the capability to monitor, analyze and report the main corporate business processes and to support the management decision processes.
- **Helpdesk**: This system implements helpdesk support of both internal and external users.

Detailed requirements are presented in Part D of the Technical Tender Technical and Functional Requirements.

Notes:

It should also be noted that the Market Settlement will be performed by a System developed by HEDNO, and is not part of this Project. It is also noted that the Metering System for the metering data collection and management will be performed by a HEDNO System and is not part of this Project.

Accounting and billing will be performed by the existing corporate ERP (SAP CORE ERP SYSTEM).

In addition, a corporate portal will be provided by HEDNO for the communication between market participants, internal and external users.

The Contractor shall integrate the systems provided within the scope of this Project with the corporate infrastructure of the NII SMO and implement the functions described in this Tender.

4.3 General Requirements

For the implementation of the NII IT systems the following are foreseen:

- Standardized and uniform system architecture and infrastructure;
- Uniform application operation environment and user Interface;
- Adaptable solution according to the operational requirements and special conditions and particularities of the island;
- Modular structure of functional units that consist of basic "function" autonomous units (modules);
- Easily expandable structure with the addition of basic function modules;
- Each island function is represented and modeled in its own module that is operating autonomously and is not affected by the conditions of other islands' modules.
- Each module has its own package of applications, which is defined and configured according to the operational requirements of the island.
- Each module supports the communication and data exchange with the island's network and power plants.

5 Overview of the NII IT Systems and Equipment

The following Table provides an overview of the IT Systems to be implemented with the related as part of this project, including their location (Athens, Rhodes).

Table 5-1. List of NII IT Systems and Equipment

Systems	Central ECC Athens	Local ECC Rhodes	Remarks
EMS (Production)	-	1 (redundant)	Central ECC will have access via Web UI. EMS includes Dispatchers Training Simulator.
EMS Development System	1 (non-redundant)	-	
MMS (Production)	1 (redundant)	1 (redundant)	
MMS Development	1 (non-redundant)		
Corporate (DW/MIS & Helpdesk)	1 (non-redundant)	-	
RTUs	-	7	
DC	-	1 (redundant)	
TFD	(GPS)	1	
Display Wall	-	1	

In summary, specific and detailed requirements are provided in the relevant documents - Parts of the Technical Tender Technical and Functional Requirements- per system, as follows:

- Part B: Energy Management System;
- Part C: Market Management System;
- Part D: Corporate Systems;
- Part E: Deliverables;
- Part F: Project Execution;
- Part G: Testing, Availability, and Performance;
- Part H: Maintenance Requirements.