ΔΙΑΚΗΡΥΞΗ ΔΑΠΜ – 41604

για την παροχή Υπηρεσίας με αντικείμενο την

«Παροχή Υπηρεσιών Πρόβλεψης και ιστορικών μετεωρολογικών δεδομένων»

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ΤΕΧΝΙΚΕΣ ΠΡΟΔΙΑΓΡΑΦΕΣ

INDEPENDENT POWER TRANSMISSION SYSTEM OPERATOR

Department of Systems and Infrastructure

Technical Requirements

FOR THE PROJECT

«Provision for Weather forecast service and weather historical observations»

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1. Introduction and Project Scope

1.1 The role of ADMIE

ADMIE is the Greek Transmission system Operator (TSO) and has the role of transmitting electrical power at a national level via the power grid. Among the responsibilities of ADMIE is the production of optimal generation schedules on a daily basis (Day Ahead Scheduling and Dispatch Schedules) in the context of the Greek energy market. Those schedules are produced by an optimization engine that takes into account information that typically includes load forecasts, renewable sources forecasts, bid quantities and prices submitted by the market participants, interchange schedules and technical information of generation units.

1.2 The requirement for a weather forecast

The Operation Planning Section (OPS) of the Department of System Operation and Control is responsible for providing forecasting information to the market platform, which produces the optimal schedules.

Among the forecast data provided by OPS is the system load forecast and the forecast of power produced by renewable sources. System load forecast and forecast of power produced by solar renewable sources (for brevity we shall refer to both as load forecast models) are produced by ADMIE utilizing proprietary software tools owned by ADMIE.

Once the market is cleared the system marginal prices are produced. Inaccurate forecasts may lead to sub-optimal schedules and it turns out that this has a significant impact in the economic cost of the operation schedules. More specifically, under-forecasts may lead to purchase of expensive services to deal with peaks and over-forecasts may lead to unnecessary capacity being committed.
In effect, load forecasting is fundamental in utility operation and increasing penetration of renewable sources has caused a significant change in the resource mix making the use of accurate forecasts necessary. These changes have constituted load forecasting to be a dynamic process that should continuously be improved.

Weather conditions are among the predominant factors that affect electrical power consumption, and are therefore used as predictors in short-term load forecasting (the weather variables are used differently in long term load forecasting – many important weather variables are hard to be predicted beyond two weeks) . Large penetration of solar generation at the distribution network has created new challenges for load forecasting, as the negative load from distributed energy sources has to be taken into account. This has created the need to incorporate weather factors such as light intensity or cloud coverage to accommodate for these effects and divert away from the traditional load forecasting models that used only temperatures or humidity.

The accuracy of the weather forecasts affects the load forecasts and it is therefore important for the load forecast to be provided with reliable weather forecasts, which are updated at regular intervals throughout the day.

1.3 Weather variables used currently

Currently ADMIE uses two models for short term forecasting. One model is used to predict the short-term system load forecast and the other is used to predict solar energy production.

The weather variables used by short-term system load forecast are:

1. The daily minimum and maximum forecast temperatures.

2. Historical temperature observations (for the previous day)

Data are considered for 5 specific regions representative of the continental country.

The weather forecast values are aggregated forecast values that correspond to a fixed set of locations in Greece.

1.4 Requirement for a new Weather Forecast

There are four factors that drive the upgrade and reengineering of the requirement according to a new weather forecast engine:

1. The large penetration of solar energy sources both at the system and the distribution. The light intensity measures that are currently available for four areas in Greece, used by the solar energy prediction model are not sufficient to capture the dispersed nature of solar production.

2. The need for a realistic, accurate and integrated consideration in the forecast of all renewable sources, so that, together with the production by the conventional units the actual load demand can be forecasted.

3. Upcoming amendments in the Greek Grid and Exchange Code will require renewable sources to participate in the electricity market. This has significant effects in the load forecast as the power produced by these sources will no longer be treated as negative load.

4. ADMIE is currently in the process of implementing a new EMS, that is expected to be operational at the end of 2016. The new EMS provides a Load Forecast module, the specifications of which require weather variables that are currently not available.

The aforementioned factors impose ADMIE to proceed with a tender in order to purchase a weather forecast service that will provide a reliable and unified weather data source to cope with the new requirements.

The objective of this document is to describe the requirements for the weather forecast in terms of:

1. The weather variables i.e. the meteorological elements that will be required by the load forecast models.

2. Accessibility to the service (API, format of the data).

3. The availability of the weather forecast (service availability, weather forecast updates).

4. Historical information of weather observations.

2. Service API and Accessibility

2.1 Access to Weather Forecast Data

Access to the weather forecast data shall be provided either by an online API or by granting access to a remote FTP repository.

In case an online API is available it will be possible to request data by passing a list of parameters to the API. The list of parameters shall contain:

- A location, specified as a pair of geographical coordinates (longitude and latitude). If the coordinates specified correspond to a location for which a weather station is not available, then the response to the API request should contain data from the closest possible available location or a calculation from a grid of available closest locations.

- A date parameter or a range of dates. In the first case, where a single date is specified, the response should return the weather forecast for that particular date. In case a range of dates can be specified (for instance as a pair of dates indicating start and end) the weather forecasts for the specified date range should be returned.

In case the data is offered via an FTP service in a remote repository the names of the files should be consistent with a specified pattern (e.g. <latitude,longitude><interval><weather forecast execution timestamp>.csv) in order to enable retrieval of the weather forecasts programmatically via FTP.

Information about required geographical locations will be provided by ADMIE, as a minimum requirement. Locations will be specified as geographical areas (prefectures).

Finally, it should be noted that although API is not a requirement, it is the preferred method over FTP.

2.2 Data availability and weather forecast updates

Access to the data is crucial as it will used by the OPS in its daily operations. The base requirement is that a weather forecast shall be available every day, starting next day (day ahead) before 07:30 (Athens time zone). The forecast horizon for the weather variables shall be 7 days. Since the load forecast is executed by OPS multiple times every day, the service provider will be required to make available a forecast updates every hour of the day. The weather forecasts should contain values in 1 hour intervals and daily summaries.

 In the extreme case of loss of service, the service provider shall have the responsibility to deliver the weather forecast by using alternative means, that will be specified (for instance by e-mail).

The data returned by the API call (or contained in the data files in the later case) should be in a structured format (JSON, XML or tabular format – preferably JSON) to facilitate parsing. The weather measurement values should be in SI units

3. List of weather variables and areas

3.1 Weather variables

The following is a list of weather variables the weather forecast is required to contain in hourly time intervals (in SI units):

- Air Temperature (^{o}C)

- Wind Speed (m/s)

- Wind Direction (degrees)

- Relative Humidity (%)

- Dew Point (^{o}C)

- Light Intensity/Solar Irradiation (W/m^{2})

- Cloud Cover (continuous variable as a percentage)

In addition, the following daily summaries should be provided:

- Max/Min Air Temperature
- Sunrise timestamp
- Sunset timestamp

3.2 Geographical Locations

The weather forecasts (and historical information) should be available for all prefectures in mainland Greece and some adjacent islands (see map in the Appendix).

The load forecast models are continuously refined and thus more weather stations will be incorporated in the models in the near future. Accessibility to data from all weather stations available from the service provider will not incur additional costs. In other words, ADMIE shall have the capability to incorporate data from additional weather stations at any given time.

4. Historical Information

4.1 Long term historical data

The successful bidder shall provide historical information of weather observations (not forecasts) for the specified areas and variables.

The purpose of obtaining historical information is to train load forecast models.

Historical data shall be provided from January 2014 up to the date the service is operational for ADMIE. The historical information will contain data in time intervals not exceeding 3 hours (with a preference of 1 hour time intervals) for all the required regions.

The historical data may be provided as a batch file or via the API of the service.

4.2 Short term weather observations

In addition to the long term historical information ADMIE requires access to short term past weather observations. These observations shall be provided in a similar manner to the weather forecast values. In case http API access is provided, if a past date is passed as a parameter then the response shall contain weather observations for the specified date.

In case data are provided via FTP a similar naming convention will be used but the short term historical observations shall be placed in a separate directory.

5. Demonstration of credentials

The bidders shall be required to provide proof of weather forecast enterprise services. More specifically, bidders shall be required to provide for a minimum of 3 letters from enterprise clients (preferably TSOs) in the past five years to whom they have provided equivalent services. The letters should be sent from the clients directly to ADMIE.

6. Duration of Service

The service will be provided for one year with the possibility of an extension of two years, after a written approval by ADMIE.

7. Compliance list

The services offered shall be in accordance with the compliance table below. This table should be completed by all bidders. Each entry in the compliance list corresponds to a section in the document.

Item Number	Description	Section	Requirement	Notes by Bidder	Compliance (Yes/No)
1	Access to weather forecast service will be provided via an API or via FTP access. In the first case the requests to the API shall contain all the necessary parameters to retrieve the forecast (or history) regarding a particular location and time period.	2.1	Required		
2	The weather forecast shall be updated every hour	2.2	Required		
3	The forecast horizon shall be 7 days	2.2	Required		
4	In case of loss of service the provider shall be responsible for delivering the weather forecast to ADMIE by alternative means (e.g. by email)	2.2	Required		
5	The measurements shall be provided in SI units	2.2	Required		
6	The weather forecasts shall contain hourly predictions	2.2	Required		
7	The weather forecasts shall contain daily summaries	2.2	Required		
8	The weather forecasts shall be provided in a structured format (JSON, XML or tabular)	2.2	Required		
9	The following weather variables are provided: • Air Temperature • Wind Speed • Wind Direction • Humidity • Dew Point • Light Intensity / Solar Radiation (W/m^2)	3.1	Required		

	• Cloud Cover (%) • Min/Max temperatures • Sunrise timestamp • Sunset timestamp				
10	Weather forecasts for the regions (mainland Greece and some adjacent islands) shown in the map in the Appendix are provided. ADMIE will have access to data from all weather stations in every area.	3.2	Required		
11	Long term historical data shall be provided to ADMIE from January 2014 and the historical information shall contain data not exceeding 3h, for all required regions.	4.1	Required		
12	Short term historical data will be available via API calls or in a separate folder in case of FTP service.	4.2	Required		
13	Proof of enterprise services shall be provided by means of recommendation letters send directly from the clients of the service provider to ADMIE (at least 3 recommendation letters shall be required).	5	Required		

8. Appendix : Map of Greece

The prefectures of interest for weather forecast include mainland Greece, the islands of the western coast, the island of Euboea and the group of islands named "Cyclades"