



# ELECTRIC TRANSMISSION AND DISTRIBUTION POWER

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THE WORLD'S BIGGEST TRANSMISSION  
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Approach to  
Developing PAM  
Maturity Model  
for Rosseti

Development of Monitoring  
and Control Systems  
in UES of Russia

Pilot project for  
grid energy storage  
application in Russia

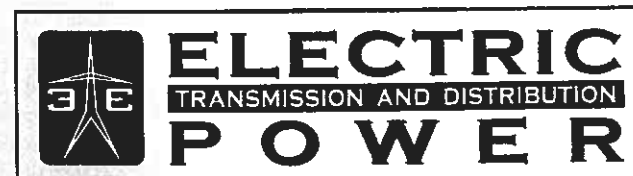


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6 Yelektrodny proezd  
Moscow Russia 11123  
Tel/ fax: + 7 (495) 645-1221  
world@eepr.ru info@eepr.ru  
www.eepr.ru

### EDITED BY:

**Chief Editor:** Ekaterina Guseva, e-mail: info@eepr.ru

**Deputy Chief Editor:** Elena Stavtseva,  
e-mail: stav@eepr.ru

**Director for the strategic planning:**  
Alexander Pavlov, e-mail: pavlov@eepr.ru

**Head of the PR department:** Marina Efremova,  
e-mail: reklama@eepr.ru

**Manager:** Mikhail Petrov, petrov@eepr.ru

**Art and Design:** Elena Ermakova, e-mail: erm@eepr.ru

**Edited by:** Mikhail Goroshcenko

# Approach to Developing the Physical Asset Management Maturity Model for JSC “Russian Grids”

Evgenia KORNIENKO (Евгения КОРНИЕНКО),  
JSC “Russian Grids”  
Irina VOLKOVA (Ирина ВОЛКОВА),  
National Research University

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## Abstract:

At present, development and integration of uniform principles and mechanisms of physical asset management (PAM) in all subsidiaries of JSC “Russian Grids” is one of priority directions of the company’s activities. Assessment of PAM organizational maturity level is a tool which enables estimating the maturity degree of PAM components in Subsidiaries. At JSC “Russian Grids” the given tool was suggested as an auxiliary method of shaping PAM development plans of subsidiaries based on common logic. The approach for developing the asset management maturity model is based on quality analysis of conformance of Subsidiaries’ PAM to the upper-level PAM model of JSC “Russian Grids”. PAM maturity organizational level assessment model was developed with reference to the international standard PAS 55 and materials of international companies accredited for PAS 55-based qualification, with account for the nature of currently implemented projects in transmission and distribution companies. The results of the conducted work were used for choosing main directions of PAM development at JSC “Russian Grids” and its subsidiaries.

## COMPANY INTRODUCTION AND PROBLEMS OF PAM DEVELOPMENT IN AN ELECTRIC GRID SECTOR

The problem of development of common principles and rules for asset management for the electric grid companies arose at the start of power industry reformation process. Inhomogeneity and conservatism of methods cause complications in assessing results of separate companies’ activities and in decision-making in cases of lower efficiency rates. Besides, the problems of improving efficiency came to relate to rising demands of consumers, shareholders, investors, other companies in the industry, regulatory authorities and the state, which required transition from management of separate processes within

an organization to system management, formation not only of balance performance and efficiency within companies and their affiliates, but also of the balance of reliability, risks and costs at the level of all stakeholders.

JSC “Russian Grids” was established in 2012 within the framework of global structural reforms in power industry. It united main electricity grids of JSC “FGC UES” and distribution grids of JSC “IDGC Holding”<sup>1</sup> [1].

The aim of consolidation of the companies was to form a uniform body in the power grid sector for solving tasks of improving operating and investment efficiency, increasing quality and reliability of services on power transmission and distribution, availability and security of the grid infrastructure, as well as solving general tasks of optimizing mechanisms of industry regulation within the framework of activities under jurisdiction.

In accordance with the Order of the Government of RF of April 3, 2013 №511-р “On approval of the Strategy of Russian power grid sector development”:

- Main priority activities of main power grid sector is maintaining and developing grid infrastructure (lines and transformers), which enables power generation by power plants and power transmission to distribution grids, as well as providing state’s energy security;
- The aim of operation of the distribution grid sector is long-term provision of reliable, high-quality and affordable power supply of consumers in the whole territory of the respective region at the stage of electric power distribution by organizing infrastructure of maximum efficiency [2].

JSC “Russian Grids” Group of companies operates 2.2 million km of power transmission lines, 473 thousand of substations with transformer capacity of more than 60 тее 748 GW. In 2013 the net electric power supply to consumers amounted to 706 billion kWh. The personnel number is 222 thousand people.

<sup>1</sup> Main electricity grids of JSC “FGC UES” - Unified National Energy Grid (UNEG), distribution grids of JSC “IDGC Holding” - distribution grid companies (DGC).

JSC “Russian Grids” is also one of the most prominent infrastructure companies in Russia, being under state control and acting as its agent for Russian power grid sector management.

Formation of a uniform transparent system of managing assets of JSC “Russian Grids” and its subsidiaries is at present a way to solve the set tasks of meeting reliability standards and improving tariff-making transparency.

PAM is systematic, regular and coordinated activity on optimal management of technical condition, reliability, costs, risks and performance of equipment (assets) throughout its life cycle with the aim of achieving strategic goals of JSC “Russian Grids” Group of companies.

The asset management system is interconnected and jointly used process diagrams, indicators of their efficiency, rules, methods, algorithms, regulatory and reference information, information systems and databases for exerting systematic impact on assets, reliability of their use, risks and costs throughout the life cycle with account for the Company’s strategic aims [3, 4].

In 2005—2010 a number of asset management concepts were developed in companies of the distribution grid sector of JSC “IDGC Holding” and JSC “FGC UES”, and some of them are partially implemented now.

Main prerequisites for development of a uniform asset management system at JSC “Russian Grids” are the following:

- need in meeting requirements of RAB-regulation as regards conformance to standards of power supply reliability with simultaneous reduction of costs for modernizing and renovating power grids and restricting growth rates of end consumer electricity tariffs;
- impossibility of using the existing asset management principles — impact with the standard periodicity rates due to limited resources. Thus, it causes the need in choosing priorities of activities;
- need in assessment, analysis, regular monitoring of operating performance and optimal distribution of financial resources for improving quality of management-related decision-making along the whole organization vertical.

JSC “Russian Grids” and its Subsidiaries face the following external and internal factors that make it impossible to simultaneously set identical target goals for all subsidiaries within a short time period:

- imperfection of the regulatory base in the field of equipment operation, repairs and replacement. Absence of fully implementable methods and rules for assessing equipment condition, risks, criticality and consequences of equipment failures, as well as methods of equipment repair and replacement planning with regard to the enumerated characteristics;
- inhomogeneity of asset management methods used in different affiliates of DGC and UNEG;
- need in developing a uniform system of goal-setting, organization, fulfillment and assessment of PAM efficiency in new conditions;

- incompleteness of the balanced scorecard system of PAM efficiency, use of plan/actual analysis based on separate cost and physical parameters;
- insufficient level of asset and consumer information adequacy, which makes meaningful strategic and operational planning, monitoring and asset management efficiency assessment impossible;
- inadequate development of the uniform information exchange model, which would encompass all company’s management levels.

All the above mentioned features and complications represent relevant issues that, according to the international practices, can be solved within the framework of a uniform PAM model of grid companies.

The upper-level PAM model was suggested at the initial stage of formation and refining of the uniform PAM model of JSC “Russian Grids”, conforming to the requirements of the international standard PAS 55.

While forming plans of prospective development and changing PAM approaches, it is necessary to take into account presence of strategic aims of main and distribution grid companies, as well as levels and special features of technical and economic conditions of all Subsidiaries, organizational peculiarities and the level of understanding of the need in changes within the company by its workers.

With the aim of setting realistic tasks in each company, further gradual development in PAM uniform logic and coherent transition to asset life cycle management, the stage of planning integration of results of PAM-related activities carried out by 15 companies is preceded by the stage of development of PAM maturity model of JSC “Russian Grids” and estimation of maturity level of each Subsidiary.

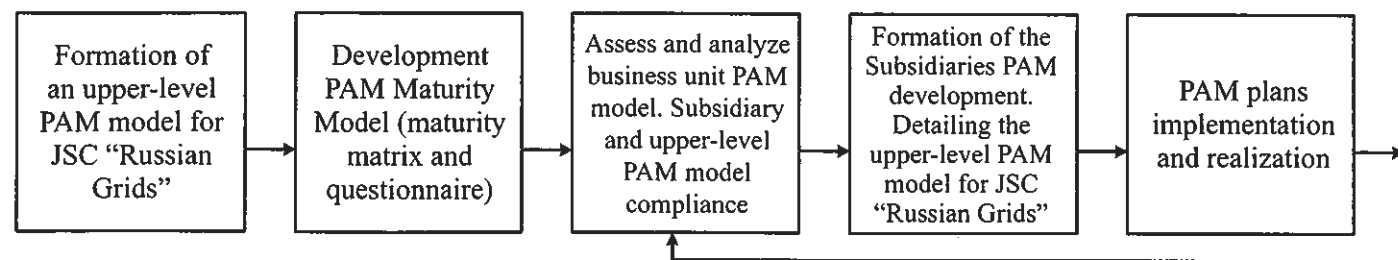
## DEVELOPING THE ASSET MANAGEMENT MATURITY MODEL FOR JSC “RUSSIAN GRIDS”

There exists quite a number of approaches to assessment the maturity level of the management, information system and software (business processes, quality management, people capability maturity model, knowledge management, system engineering, software acquisition or integration capability maturity models etc.) [6—10]. Basic principles of the PAM maturity assessment for infrastructural companies are described in the international standard PAS 55 [11].

The PAS 55 conventional model suggests determining of the company’s PAM system conformance to one of 5 maturity levels (Learning, Applying, Embedding, Optimizing and planning, Beyond PAS 55) and making conclusions about gaps and unconformities based on 28 PAS 55 criteria. The assessment is conducted on the basis of internal audit of business processes, regulatory and standard documentation, PAM information system and surveys of key workers.

Taking into account that quite recently Russian companies have started thinking about transformation of approaches to PAM and integrating separate components described in PAS 55, and the fact that the power grid

Fig. 1. Process of use of PAM maturity model at JSC “Russian Grids”



sector structure underwent significant organizational changes during the industry reformation period, and, as a consequence, the vision of the sequence of steps in transition to risk-, performance- and cost-based asset management changed, at present it is important for JSC “Russian Grids” not just to compare the level of PAM conformance to international requirements, but to assess and compare the PAM development levels in Subsidiaries to find the best way of PAM development at JSC “Russian Grids” and its subsidiaries.

With this aim, an approach to determine the organizational PAM maturity level in subsidiaries of JSC “Russian Grids” based on upper-level PAM model was suggested.

Figure 1 shows the process of use of PAM maturity model at JSC “Russian Grids”. Figure 2 demonstrates the PAM upper-level model at JSC “Russian Grids” [3, 4, 5, 12].

Materials of PAS 55, of international companies accredited for PAS55 qualification [13] and internal sources of data about the results of integration of current PAM projects in RGC and UNEG<sup>2</sup> were used to develop a PAM maturity model for JSC “Russian Grids” (Fig. 3), which is described below. A questionnaire was made based on the description data, and a survey of experts of JSC “Russian Grids”, its subsidiaries and affiliates was conducted. Analysis of quality characteristics of PAM upper-level model components (Fig. 1) shows conformance of the existing PAM model in a Subsidiary to PAM maturity level of JSC “Russian Grids” with account for companies’ peculiarities and special implementation features of certain projects.

Experts, accountable for integration of the asset management system in Subsidiaries, are assessed by each questionnaire item according to 100-point scale. The final

indicator of maturity organizational level is calculated as the average value of answers to twenty questions.

Figure 3 can be used to follow the evolution of PAM model to be integrated in JSC “Russian Grids”, while the results of expert surveys and final assessment of maturity organizational level can be used to estimate the actual PAM condition in DGC and UNEG.

PAM maturity organizational level assessment model can be used to describe the best practices and targets for JSC “Russian Grids” group of companies, to describe the sequence of changing PAM components with the aim of stable development and benchmarking of Subsidiaries.

**Description of maturity model for PAM of JSC “Russian Grids” (Fig. 1, 2):**

Section 1 includes a survey to understand the general requirements for asset management system, approved by common documents for all utility companies at a certain level of development. This section contains 6 general questions.

Section 2 defines the requirements for PAM Policy and Strategy. The section contains 5 positions corresponding to each issue.

Position 2.1 reflects the need to develop and implement uniform policy for PAM in all Subsidiaries.

Position 2.2 explains PAM Strategy coordination with power grid Policy and Strategy and requirements of external stakeholders, as well as determines the strategy effects on equipment, which adheres the Company to a certain level of development and an impact strategy that actually realized.

Position 2.3 shows, whether life cycle of assets are considered in the planning of network development?

Position 2.4 defines the necessity of existence in Subsidiaries and “Russian Grids” PAM development plan conditioned by the level of maturity of PAM.

Position 2.5 defines operational and investment methodology at a given level of maturity of PAM.

Section 3 defines the requirements for processes and asset management methodologies. The section contains 5 questions.

Position 3.1 reveals features performing maintenance and repair (MR) processes.

Position 3.2 reveals features executing retrofitting and upgrading processes, new construction and expansion of existing facilities (renovation and new building process).

Position 3.3 reflects technical condition assessment methods, asset performance, power supply reliability and the costs.

Position 3.4 explains how the company assesses the effectiveness of asset management, whether effectiveness of subsidiaries and affiliates are compared to identify best practices in implementation?

Position 3.5 shows whether the results of planning and execution of production programs in prior periods are taken into account to justify the cost in the formation

of tariffs in accordance with the opportunities that the company is developing at a certain level of PAM maturity risk assessment and prediction of reliability and cost?

Section 4 defines the requirements for resource management (PAM enablers). The section contains 4 questions.

Position 4.1 generates for each PAM maturity level characteristic properties of databases on equipment, consumers, and financial and economic activities of Subsidiaries and “Russian Grids”?

Fig. 2. Asset management upper-level model at JSC “Russian Grids”

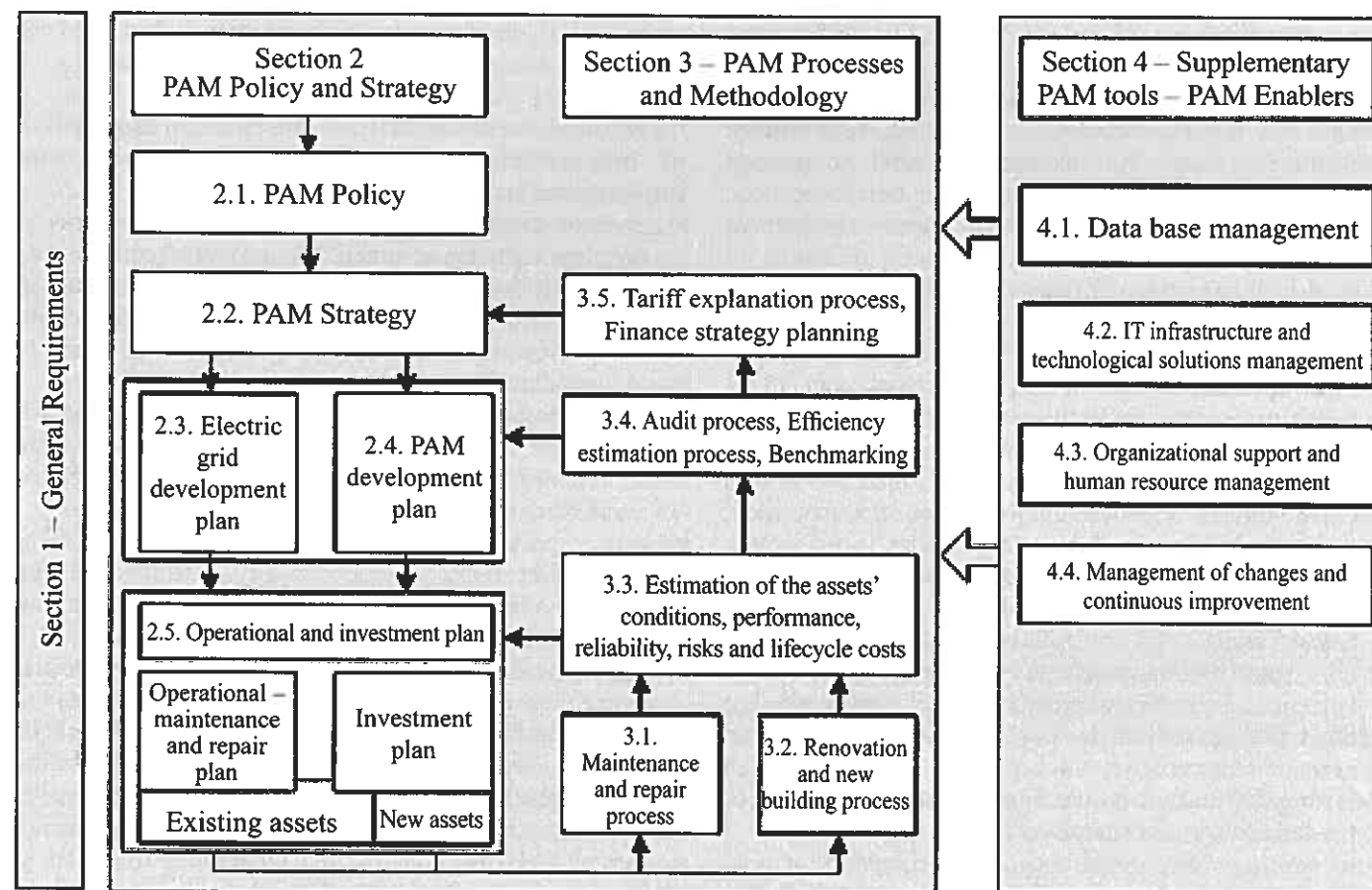


Fig. 3. — Physical asset management maturity model for JSC “Russian Grids” [11]

	Maturity level 0 Learning (0–20)	Maturity level 1 Applying (25–40)	Maturity level 2 Embedding (45–60)	Maturity level 3 Optimizing and Integrating (65–80)	Maturity level 4 Beyond PAS 55 (85–100)
Section 1 General Requirements	The elements required by PAS 55 are not in place. The organization is in the process of developing an understanding of PAS 55 and an upper-level PAM model.	The organization has a basis understanding of the PAS 55 requirements and develops an upper-level PAM model. It is in the process of deciding how the elements higher-level PAM model will be applied and started to apply them	The organization has a good understanding of the upper-level PAM model elements arrangement. It has decided how to apply them and how they will work in progression of implementation.	All elements of the upper-level PAM model are in place and are integrated.	Using processes and approaches that go beyond PAS 55. Pushing the boundaries of PAM development. The organization needs to create new concepts and ideas related with the Smart Grid concept implementation.
Section 2 PAM Policy and Strategy					
Section 3 PAM Processes and Methodology					
Section 4 Supplementary PAM tools - PAM Enablers					
	Awareness	Development	Competence	Excellence	

<sup>2</sup> Projects now implemented in DGC: a project of 2011–2013 on integration of a comprehensive asset management system [4], a project on development of a geoinformational system of distributed resource management, integration of a system for recording and analysis of technological disturbance investigation results, etc. Projects now implemented in UNEG: integration and development of a system of equipment maintenance and repair management, creation of a regulatory budget system, etc.





Position 4.2 reflects characteristic properties of the IT infrastructure of Subsidiaries and “Russian Grids”?

Position 4.3 describes the process of organizational support and personnel management within the Asset Management.

Position 4.4 provides a definition of the change management process and continuous improvement at different levels of maturity of the PAM.

**LEVEL 0 (Learning):**

**According to the PAM maturity model at the level corresponding to the initial phase of learning:**

- common PAM Policy as a high-level document is missing while companies begin to realize the need for the development and implementation of common approaches;
- impacts on the assets are made at standard periodicity and accidents, mainly considering periodicity. Sufficient funds for maintenance and renovation of the network determines the absence of the need to introduce new approaches to asset management regarding technical condition;
- grid development plans are formed without a long-term asset management Strategy;
- asset management system development plan is missing;
- development of operational and investment plans is taking into account the periodicity of the works; consolidated feasibility planning operating and costs investments (upgrade, new construction and expansion of existing facilities) is not provided, decision-making level at grid facilities (operational, functional, short-term planning) is carried out at sites, integrated plans are agreed in the branches and in Subsidiaries;
- concepts of maintenance and repairs (overhaul, medium, current) are fixed in standard technical documents, but the actual amount of work on each type of operational and maintenance activities are not allocated, which leads to difficulties in the implementation planning of the facilities to the necessary extent;
- retrofitting and upgrading, new construction and expansion of existing facilities are not included in uniform asset management package;
- structural assessment is carried out by experts, risk assessment is not carried out or carried out by experts at sites, there is no opportunity to forecast technical condition, risk, reliability and cost;
- PAM effectiveness is performed in terms of plans implementation — plan-to-fact analysis in physical and financial terms, there is disunity and heterogeneity of the KPI: no PAM balanced scorecard, there are no uniform methods for calculating “Russian Grids” and Subsidiaries key performance indicators;
- financial planning is based on extrapolation of data from previous periods;
- branches and companies databases are scattered, overlap, there are no common regulatory information directories, information is incomplete and inadequate, historical data at facilities is maintained in volumes necessary only for the operation;

- data acquisition is on paper or in various IT systems not integrated with each other, data processing is automated partially, facilities are incompletely and insufficiently equipped with technical means for data transmission;
- availability of methodologies and regulations for individual processes, documentation independently developed by companies, there are no uniform methodology, the actual execution of regulations is not complete;
- lack of staff with simultaneous head cutting and the absence of training, the staff is not intended to change the logic of PAM, comprehensive work on training and staff development in asset management is not conducted.

**LEVEL 1 (Applying):**

**At this level of maturity — the phase of application of international approaches to development and implementation of the PAM target model:**

- uniform asset management Policy is in the process of development, it is assumed that corporate requirements to asset management defined by certain documents in force at “Russian Grids” level are not worked enough, companies and their branches could have possible independent interpretations;
- companies are aware of the need to develop uniform high-level documents, the impact on the equipment is actually held by standard rate and frequency of accidents, mostly - upon an accident;
- grid development plan is made excluding long-term asset management Strategy but there is an understanding of the need to consider when planning the cost of risks and assets lifecycle;
- asset management development plan is in the initial stage of development or is only valid at subsidiary level, but is not consistent with “Russian Grids” plan, does not cover all required PAM directions, responsibility, authority are not clearly assigned, evaluation of results is carried out at the level of company and “Russian Grids” formally and irregularly because the need in systematic understanding to work in this direction is still emerging;
- plan for development and investment activity is conducted taking into account the periodicity of the works; asset management package includes MRO process, Upgrade and new construction are not included; consolidated technical and economic MR and investment planning is not available; planning is conducted at sites, the branches have the possibility to monitor plan implementation, the asset management balanced scorecard is in its initial stage of development it does not embrace all the required asset management directions in a common package, companies have their own methods for calculation of individual indicators;
- concepts of MR are fixed in standard technical documents, but the actual amount of work on each type of operational activities are not allocated, which leads to difficulties in the implementation planning of the facilities to the necessary extent; companies



independently form their own master-production scheduling;

- structural assessment is carried out by experts, risk assessment is not carried out or carried out by experts at sites, possibility to forecast technical condition, risk, reliability and cost are at initial stage of elaboration is not available;
- PAM effectiveness estimation is based on plan-to-fact analysis of operational and investment volumes and cost, performance evaluation is carried out by individual processes not organized in a common asset management package, there are difficulties in establishing a system of benchmarking for PAM in branches due to the fact that building a balanced scorecard of asset management is absent or is in the stage of development;
- financial planning is based on extrapolation of data from previous periods;
- databases of Subsidiaries are not structured properly; they are formed locally for individual projects and overlap; handbooks of the common reference data are composed by physical characteristics of the equipment, financial and economical activities and budgeting of grid companies, customer data; the data integrity level is low, data management processes are under formation, contents of data flows is being précised;
- data acquisition is carried out in different non-integrated IT-systems, many processes are not automated (middle automation level), no target model of Subsidiary IT-infrastructure development is available or it is under elaboration, definition of access rights and formation of data flow maps are being worked out;
- Subsidiaries develop individually elaborated documents, there is no common methodology for different workflows is available in JSC “Russian Grids” for its Subsidiaries, partial — in a Subsidiary for its branches; regulatory document statements are executed partially; the organizational structure of the company and the personnel involved into the asset management process — special asset management departments monitor implementation of asset management components; the personnel training and competence — irregular; the personnel understands the need to change existing workflows, targets and objectives of PAM are explained to the whole personnel;
- targets of continuous improvement and changes are defined; however, correlation between the overall corporative Strategy and the PAM strategy is not properly defined.

**LEVEL 2 (Embedding):**

**At the maturity level “Embedding” of the target PAM model:**

- JSC “Russian Grids” has to elaborate and to approve the common PAM Policy; basic correlations between the strategy, the strategic targets of JSC “Russian Grids” and Subsidiaries with regard to PAM are documented; PAM objectives and development plans may correlate with other policies of the company;
- the Strategy contains correlations of PAM short-

term and long-term targets and objectives with assets lifecycle components; asset management is based on time and risks (with consideration of the assets condition and performance);

- they elaborate approaches to planning of grid development with consideration of financing resources and risks;
- PAM development plans in Subsidiaries are elaborated and approved in terms of uniform PAM approach, the people responsible for plan execution on Subsidiaries and branches are assigned; however, responsibilities and authorities for individual works are not properly defined; assessment of plan execution is performed regularly in Subsidiaries and “Russian Grids”;
- PAM includes MR, retrofitting and upgrading; there is a possibility of long-term planning of total operational and investment costs; new construction and existing capacity enhancement workflows are now being worked out;
- PAM is treated as a tool of long-term and short-term planning, production program planning is carried out in branches; Subsidiaries and “Russian Grids” supervise this process. The key performance indication system is properly defined at all management levels;
- PAM methodologies and principles enable to estimate the scope and the cost of work execution for individual equipment, complex sites, grid sections within the controlled object, transfer to calendar-scope planning based on common principles;
- company use expert-analytical procedures for the technical condition estimation; such procedures with regard to risks, consequences and critical failures are being elaborated and tested; no forecasting procedures for technical condition, risks, reliability and costs are available or they are being worked out;
- common reference data system is being established that includes data on the equipment, customers, financial and economic activities; data integrity level is middle; though the databases are sufficient for required analytical calculations, they are continuously reviewed, information management processes are refined, archive data required for forecast purposes are maintained;
- data acquisition and processing are carried out in different IT-systems, the target IT-infrastructure model is being reviewed and implemented; it enables integration (automation level — sufficiently high), definition of data access rights and data flow map formation at the initial stage of elaboration;
- common PAM principles, methodology and procedures are approved for all companies (except for low level processes); actual execution of regulatory document statements — partial; characteristics of the organizational structure and the personnel involved into asset management processes — special asset management departments that do not combine production program execution and planning/ monitoring functions are available; regular training of the personnel; PAM change logics is accepted;

sufficiently high level of understanding PAM targets, objectives and methods;

- targets of continuous improvement and changing are correlated with Subsidiary strategy and PAM targets at all management levels; based on such correlation they carry out a detailed review of requirements to PAM.

#### LEVEL 3 (Optimizing and Integrating):

##### At the third maturity level:

- PAM requirements are specified in detail in the Common Policy and applicable documents related to activities of JSC "Russian Grids" branches and Subsidiaries; qualitative and quantitative correlations between low level and higher level documents are defined properly; PAM Policy along with other policies are updated and reviewed regularly;
- documents that define short-term and long-term PAM targets and objectives are applicable; asset management is carried out with consideration of the risks during the whole asset life cycle;
- principles of the grid development process and the grid accessibility are documented and applicable with consideration of the asset life cycle cost;
- PAM development plans are elaborated, approved and executed within the scope of a complex approach to PAM; they are continuously updated with consideration of the results obtained at previous maturity levels and correlated with key parallel activities (development of situational and operational control processes, grid accessibility and connection process, etc retrofitting and upgrading, new construction and existing capacity enhancement workflows are included into the complex asset management; procedures of investment project portfolio formation are approved and applicable);
- planning of operational and investment costs is provided with consideration of risks during the whole life cycle of the equipment; PAM is treated as a tool of long-term and short-term planning as well as quick decision-making; planning is carried out in Subsidiaries; estimation of the scope and the cost of work execution is carried out for individual equipment, complex sites, grid sections within the controlled object with consideration of the technical conditions, risks and the costs of asset life cycle;
- expert-analytical procedures and diagnosis are used to estimate the technical condition and risks; forecasting procedures for technical condition, risks, reliability and costs are available;
- PAM balanced scorecard that correlates basic production and financial workflows is elaborated and implemented; benchmarking system that enables comparison of Subsidiaries and its branches by PAM efficiency is implemented;
- long-term (5–10 years) financial planning is carried out with consideration of data on grid development, risks and the cost of grid site life cycles; plans are précised annually;
- common reference data system is applicable in JSC "Russian Grids" and Subsidiaries that includes data

on the equipment, customers, financial and economic activities; data integrity level is high; the reference data is continuously updated, information management workflow is properly defined at all management levels, archive data required for forecast purposes are acquired and available;

- target IT-infrastructure model is being implemented; it defines the position of PAM systems, enables integration of IT-systems and platforms, defines data access rights and data flow map formation; automation level - high, level of equipment provision — sufficient but not excessive;
- uniform PAM principles are applicable in all companies of "Russian Grids", common methodological and regulatory documents cover key processes (except the low level); actual execution of regulatory document statements — sufficiently full; There are special asset management departments that do not combine production program execution and planning/monitoring functions are available; regular improvement of qualification, consultations and technical support are available; specialists have both technical and economical skills, understand well PAM targets and objectives;
- targets of continuous improvement are defined and correlated with PAM targets, continuous change and supplement of PAM requirements at all management levels is being carried out.

#### LEVEL 4 (Beyond PAS 55):

At the development level not covered by PAS 55 PAM system changes are provided by Smart Grid concept:

- PAM Strategy is based on life cycle management and combination of new approaches (including consideration of Smart Grid technologies, active consumer behavior, market price signals, etc.);
- grid development plan and grid connection processes principles are documented and applicable with consideration of the asset life cycle cost, integration of the distributed generation into the network, demand response, active consumer behavior, etc.;
- PAM development plans are regularly reviewed with consideration of the results obtained, future-proof trends of grid infrastructure development are considered and correlated with parallel key processes, online monitoring and estimation of results are supported;
- overall technical and economical planning of operational costs and investments into the fixed capital is provided with consideration of risks during the whole life cycle of the equipment, change of consumer behavior and forecasts of power transmission costs; a well-balanced key performance indication system enables proper distribution of responsibilities at all management levels;
- component-wise scope and MR cost planning is possible for the whole life cycle;
- retrofitting and upgrading, new construction and existing capacity enhancement, operational and

situational control processes are included into the uniform PAM;

- technical condition and risk estimation can be carried out in real time by using analytical methods, possible forecasting of risks, reliability and costs with consideration of active consumer behavior, grid self-healing and self-supervision capabilities, market signals, etc.; asset management balanced scorecards and benchmarking are implemented; PAM efficiency assessment model helps the company to respond to changes of the environmental conditions to improve the decision-making efficiency;
- long-term financial planning with consideration of grid development and correction of plans with consideration of Smart Grid technologies;
- common reference data system is established and applicable, it is subject to regular update and supplement, no data redundancy, the data scope is sufficient, data management process is reviewed following the requirements of data display in real time systems;
- high level of IT-system integration, sufficient amount of equipment for data exchange and processing, possible online data receipt;
- monitoring/planning of productivity/reliability and work execution are different activities;
- specialists have both technical and economical skills, understand transformation of PAM targets and objectives according to smart energy technologies;
- PAM is treated as a key tool of efficiency improvement.

#### CONCLUSION

To evaluate the organizational level of company's maturity we performed the study of qualitative characteristics of higher-level PAM model components based on expert conclusions. The results show that today the majority of companies have the level of maturity "Application", and some companies are transferring from the first to the second level "Embedding".

JSC "Russian Grids" Subsidiaries understand PAM properly, they work on developing different PAM model components under the common concept, the established methodological, organizational and informational base is available for elaboration of complex solutions and formation of the common asset management system intended for short-term and long-term reliability and cost management in operational and investment activities during the whole life cycle of the assets.

To achieve permanent efficiency of its activities and to provide successful transition to a higher level, JSC "Russian Grids" has to consider the most critical issues:

- elaboration of the Common PAM Policy;
- detailed elaboration of the higher-level PAM model;
- formation of PAM target-setting model and the PAM efficiency monitoring and balanced scorecard system;
- elimination of difference in PAM approaches of distribution companies with regard to common methodology and Standard documents, unification of PAM approaches in JSC "Russian Grids"

Subsidiaries related to non-documented processes with consideration of peculiar features of distribution and transmission grids;

- elimination of automation imbalance in individual Subsidiaries, improvement of the data exchange model and the target architecture of the information systems that enables actual and future PAM development.

The main aim of creation and implementation of a complex PAM system is to change existing processes and provision of successive transition from conventional cost planning by the rate of maintenance to asset life cycle cost management beginning from design till de-commissioning and utilization as well as to risk management, financial and production efficiency management of JSC "Russian Grids" and Subsidiaries.

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