Project Title: Development of research roadmap in the field of planning and operation of power systems

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Project Necessity

At present, the formation and the management of research in the field of power systems in the country, in accordance with the upstream policies is entrusted to the Niroo Research Institute. Also, Research group of power system planning and operation as a research arm of the organization to management and development of knowledge and research in the field of power systems planning and operation is known. Hence, (1) to eliminate the dispersion of research in the field of electricity industry, and (2) to apply and properly orient them, it is necessary this group to take action by using the internal capacities of the organization and by using experts as well as academic scientists in this field in the national level, to develop scientific topics and Prepare a comprehensive map of the scientific-research movement in this field.

Project Goals

In recent decades, with the rapid changes in power systems in terms of various aspects such as technical, infrastructural, economic, social and environmental aspects, around the world, same as, the restructuring of power systems, the creation and development of smart grids and micro grids, the formation of electricity market and its liberalization, increasing the penetration coefficient of utilization of renewable energy sources (RES) and distributed generation sources (DG), entering the topics of load response and advanced measuring devices, active loads, electric vehicles, the types of storage, etc., planning strategies, management of operation and control of power networks are faced with the new and complex challenges.

In addition, considering the rapid growth of structures, processes and new technologies in power systems, these challenges are increased at a high rate, therefore, the development of a comprehensive strategic document is needed for the development of research in the domain of the planning and operation of power systems. The following achievements are expected to be achieved at the end of the present project:

- ❖ Achieving a comprehensive model and codified and standard structure to determine the topics and fields of study in the domain of planning and operation of power systems (so that these field are as independent as possible and have the least overlap) and define its position to other fields of the power system
- ❖ Determining the field of research in the domain of planning and operation of power systems in accordance with the challenges and needs of the electricity industry and in line with upstream documents in the domain of electricity and electrical energy in the country
- ❖ Identifying the new solution, fields and topics needs the development of knowledge and research in the country based on identified needs, experts opinions and inspired by the situation of developed countries and the activities of rival and developing countries
- ❖ Identifying the internal ability and capabilities in order to activity in line with the fields and issues raised
- ❖ Determining general/grand goals, strategies, executive measures, required projects and vision of research fields of planning and operation of power networks in the country, according to the set of current and future specified needs.
- ❖ Determining influential institutions and actors/players, in line with the advance of the developed study programs

Abstract

The purpose of this project is to develop a research roadmap in the electricity industry in the domain of power systems planning and operation. The study area is the electricity supply chain in sextet dimensions, including the primary source, generation, transmission, distribution, consumption and storage of electricity in the country and the research method has been the standard strategic planning framework. In this project, beginning the research has been done on the necessity and importance of this research. Compiling the dimensions and limitations of the research has been researched and investigated in the continuation of the project activities. Upstream and macro documents of the country are studied and evaluated in order to extract the research keywords of the country's electricity industry in accordance with the policies, programs and goals of the country and the electricity industry To extract which keywords these documents emphasize the most. The most important documents are: the constitution, the 20-year vision document of the country, the strategic document of the Ministry of Energy on the horizon of 1404, the general policies of the system in related sectors, the second to sixth five-year plans of economic, social and Cultural, Budget Program Laws of 82-98, Subsidy Targeting Law, consumption pattern reform law, comprehensive scientific map of the country, Law on Protection of the Electricity Industry, National Building Regulations, cabinet resolutions, high energy council resolutions, special missions Tavanir company, the goals of the energy technology development headquarters, the goals of SATBA and the Ministry of Energy's Research and Technology Management and Leadership Regulations. Then, the projects of the country's electricity industry in the last ten years have been reviewed and keywords related to the field of planning and operation have been extracted. Following, the opinions of industrial and academic experts has been gotten on the future of the electricity industry and research priorities in the field of planning and operation of power systems through questionnaires and interviews. Then, research groups active in the field of electricity industry are introduced and their goals and activities are extracted. Also, the country's prominent conferences in the field of electricity industry have been identified and the scientific axes of these conferences have been introduced. In general, in the five sections mentioned above, the areas of research axes in the field of planning and operation of power systems have been identified with higher priority. In the following, the stakeholders of the research results are introduced. Extracting the strengths and weaknesses of the current situation of research in the field of planning and operation, as well as its threats and opportunities have been other activities of this project. The drawing of current situation is done below. In order to determine the research fields of power systems has been reviewed in the fields of

operation and planning, the latest research from reputable journals and scientific reports of startups, as well as the opinions of experts have been extracted in this field. For this purpose, in this chapter, in addition to the published articles from 2017 until now, have been examined the research fields of prestigious international conferences. In order to find research fields in different countries in the field of power systems, the latest research, were examined reports and achievements of power systems in countries with different economic indicators, both advanced and developing. In addition, in order to expand the subject of affiliated research centers with international agencies, have been reviewed the world's top reference universities as well as independent and reputable research centers to obtain the desired research process from the point of view of these institutions. Then, considering that research in the field of power system in Iran is influenced both by global trends and has its own unique features, capabilities and requirements, and all the issues raised mentioned as a research horizon in the Iranian electricity industry. However, reflective categorizations of international reports and research in the field of power systems studies are as follows:

- ✓ Development of methods, planning tools and simulation software
- ✓ Planing development of the system in the medium and long term by considering different scenarios
- ✓ Asset management optimization
- ✓ Increase public acceptance and stakeholder participation in infrastructure development
- ✓ Focus on increasing the visibility of the transmission and distribution system
- ✓ Provide new tools and methods for monitoring, control and protection of Power Systems
- ✓ Design recovery and defense planning throughout the network to increase network resilience
- ✓ Development of big data management through the introduction of communication protocols to transfer data, business models of power companies as well as support for better decision making
- ✓ Development of infrastructures and appropriate tools for managing big data from various sources
- ✓ Having a portfolio of heat generation units so that these units have maximum participation in providing flexibility as well as maintaining the stability and security of the system
- ✓ Interact with other energy systems
- ✓ Activate actions that lead to the transition to a new model in energy systems

Explaining the vision is the starting point for the management and administration of a (governance) collection and is essential to the development of that collection. The vision is a realistic, achievable and attractive future for the organization. The vision statement is to present wise propositions about the future and interpret the propositions in a way that guides conscious action, collective learning processes, and how to respond to future challenges. The ideal and correct vision must be comprehensive and practical. A narrow vision restricts growth and development, and an ambitious vision is an unattainable dream that undermines the credibility and integrity of the collection. A realistic vision, combined with clear strategies, strengthens the country and strengthens the national economy, provided that supportive measures are taken. In the continuation of this project, after defining the vision of "research in the field of planning and operation of power systems", macro strategies were determined to achieve the vision. The vision statement, strategic issues and strategic goals are the main guidelines for the development and implementation of the next steps of the roadmap (strategies, executive actions and projects). In the following, strategic issues and strategic goals were identified in order to achieve the vision. The collection of strategic issues from macro to micro was divided into five categories, respectively.

Strategic issues, strategic goals, strategies, executive actions and projects were extracted. Strategic issues are in fact the macro-strategic areas of the electricity industry (in terms of planning and operation) and these macro-topics are the main research areas in the field of planning and operation of power systems. Conducting applied and developmental research in support of a collection of strategic issues (including topics, goals, strategies and projects) of the country's electricity and energy industry in three topics (field

) and the following have been extracted. (considering that Niroo Research Institute is the think tank of the Ministry of Energy and its research arm, these strategies are also the strategies of planning and operation group of power systems):

Strategic issues

- **The first strategic issue: reliable electricity supply based on sustainable development**
- **The second strategic issue: economicization of all activities in the field of electricity and energy**
- **The third strategic issue: customer orientation in electricity supply**

Strategic goals are a subset of strategic issues and macro strategies for achieving strategic issues in research and development in the field of power systems planning and operation, which are composed of strategies and projects (to achieve these goals, in the next chapter, strategies and projects are introduced). The following are the strategic goals for each of the strategic issues:

- **The first strategic issue: reliable electricity supply based on sustainable development**
  - The first strategic goal: to improve security, reliability and environmental compatibility in the electricity supply chain
  - The second strategic goal: self-sufficiency in knowledge in the field of the power system planning and operation
  - The third strategic goal: Capacity building of required human resources (specialized knowledge, executive skills and managerial ability) in the field of planning and operation
- **The second strategic issue: economization of all activities in the field of electricity and energy**
  - The fourth strategic goal: to establish democracy and create a competitive environment in electricity supply chain activities The
  - fifth strategic goal: Optimal management of assets in the electricity supply chain
  - The sixth strategic goal: development of international exchanges with emphasis on creating excellence in the field of planning and operation
- **The third strategic issue: customer orientation in electricity supply**
  - The seventh strategic goal: to focus on subscribers in the activities field of electricity and energy
  - The eighth strategic goal: to improve the level of customer satisfaction
  - The ninth strategic goal: to improve the level of satisfaction of other stakeholders in the field of electricity and energy

In the continuation of the project, strategies and projects provided that related to each of the strategic goals mentioned in the previous section. In extracting of these strategies and projects, in addition to using the opinion of experts, strengths and weaknesses of the current situation, future research cases and comparative studies, upstream documents have been used to the maximum so that these strategies / projects are both practical and in line with macro policies and programs of the country. Strategies / projects are divided in terms of achieving strategic goals. That is, the strategies / projects that lead to a strategic goals are listed below that goal. In other words, to achieve that goal, these strategies / projects must be implemented. It should be noted that some strategies / projects may be common, in other words, there are strategies / projects that are effective in meeting two or more strategic goals.

In the following, the projects are prioritized in terms of time horizon. Since the projects are executive and the executing organization must plan for the implementation of the projects (budget, time, human resources, etc.), the researchers prioritize the projects in terms of the time. This prioritization, which is done in three levels (first, second and third priority) and based on the opinion of experts, shows which projects should be in the first row in terms of executive and their implementation takes precedence over other projects (of course, prioritization Sometimes it is actually a kind of prioritization in the implementation of the project for the country / organization, according to the challenges and needs, but it also includes the importance of faster implementation of that project). In other words, this prioritization shows the research roadmap in the field of power system planning and operation. The first priority

means starting the implementation of important projects that should start from the first year. The second priority means the implementation of medium-term projects (2 to 5 years) and the third priority means the implementation of long-term projects (5 to 10 years) (which can start from the fifth year in the absence of budget and human resources). It is true that the plan horizon was seen until 1404, but projects in the third priority (due to their low importance) can be started after that and do not harm the vision. Continuation of these projects means their extension in the period after 1404 (as is the case with the five-year development plans, the annual budget plan, and some other macro-strategic plans, and the implementation of sections of the plan is postponed to the next plan). Then, the focus have been on determining the strategies and titles of research projects in the study area, and its final output have been to earn the topics and titles of the projects study, projects research and executive projects along with the project prioritization program. As it was emphasized before, the approach of provide this document is strategic planning and during it, the policies of the Ministry of Energy and Tavanir Company in the form of "Strategic Plan of the Ministry of Energy 1404" and "Twelve Strategic Goals of Electricity Industry" announced by Tavanir Company has been original. In the process of document development studies, after determining the strategic issues and strategic goals, first the strategies for achieving the desired goals were determined and then the topics and titles of the projects, including studies, research and implementation were identified using an integrated logical process methodology with a goal-oriented approach. It should be emphasized that in compiling this document, only the expected activities and missions in the field of planning and operation have been the criteria for action. The results of this phase of the document, expressing a significant number of existing issues and challenges facing the country's electricity industry, explaining the needs and capacity building needed to manage the impact of emerging technologies, national, global and regional economic policies and approaches is on the current and future electricity grid. Other points of interest in compiling this document are emphasizing the self-sufficiency of knowledge and skills required in the field of planning and operation of power systems, especially new topics such as data science application, big data dissolution, blockchain technology, exchange energy, distributed decision making and etc. Considering that the Niroo Research Institute is the think tank of the Ministry of Energy and its research arm, these strategies are also the strategies of the planning and operation of power systems. Therefore, it is suggested that the names and missions of the specialized sub-groups (Track) of the power systems planning and operation group be adapted and extracted from this project. In total, 3 strategic issues, 9 strategic goals, 88 strategies and 179 projects have been extracted. Finally, the projects are assigned to the research axes (subgroups) of the power systems planning and operation group.

Project steps and methodologies

The first Phase; Compiling the current situation

Output: Review of upstream documents, the current situation of the country in the field of power systems planning and operation, players and role makers in the relevant research field and analysis of their strengths and weaknesses

The second phase; Compiling the desired situation

Output: Review of research axes of planning and operation of power systems and their process in conferences, prestigious journals, international agencies, research centers affiliated with the Ministry of Energy of developed and developing countries, top world universities and peer universities, centers The world's leading independent electricity research

The third phase; Directional elements

Output: Extracting the vision statement, determining the main research axes and determining the semi-main research axes and priorities

The fourth Phase; Strategies and projects

Output: Determining sub-axes (research strategies) and determining semi-sub-axes (research projects)

The main results obtained from the project / project (technical outputs, patents, articles, books, technical reports, etc.)

At present, group of the power system planning and operation of Niroo Research Institute has 10 subgroups (research axis). The projects are assigned to each of the research subgroups, which makes their research axes clearer and more transparent. However, their tasks may not be limited to (or include) proposed projects and research axes (depending on the existing structure, the research institute may define projects that are not related to their field of work, or projects related to their field of work to groups or Referred to other centers). There may also be projects that can be subdivided into two research axes (although these are few, but as far as possible projects related to two or more subgroups are subject to subgroup activities, the predominant aspect of the project being that subgroup. In the remaining cases, the project is assigned to both axes, so it is necessary for subgroup managers to examine the relationship between projects with projects of other groups and subgroups and use the results of each other's reports. The researchers of this project have tried to include the projects (only from a scientific point of view and not other aspects) under the same existing research axes.