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A Sample Application of Nuclear Power Human Resources Model

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Abstract. One of the most important issues for a new comer country initializing the nuclear power plant projects is to have both quantitative and qualitative models for the human resources development.

For the quantitative model of human resources development for Turkey, "Nuclear Power Human Resources (NPHR) Model" developed by the Los Alamos National Laboratory was used to determine the number of people that will be required from different professional or occupational fields in the planning of human resources for Akkuyu, Sinop and the third nuclear power plant projects. The number of people required for different professions for the Nuclear Energy Project Implementation Department, the regulatory authority, project companies, construction, nuclear power plants and the academy were calculated.

In this study, a sample application of the human resources model is presented. The results of the first tries to calculate the human resources needs of Turkey were obtained.

Keywords: Human Resources Development, New Comer Country, NPHR Model

1 Introduction

Due to the increase in energy demand and lack of natural resources (such as high quality coal, natural gas and petroleum) in addition to increasing public resistance to hydroelectric power plants, building nuclear power plants in Turkey became an attractive alternative to obtain a new source to produce electricity.

For this purpose in year 2010, an agreement between the Turkish Republic and Russian Federation was signed and the necessary procedures for Akkuyu Nuclear Power Plant which will include 4 VVER-1200 reactors were initiated. The Akkuyu Project is the first Build-Own-Operate project for building and operation of a nuclear power plant in the world. One important note about the project is that the site for the plant was licensed in year 1979, however, the new data and new analysis were required for the site due to new issues raised on after Chernobyl and Fukushima-Daiichi accidents.

In year 2013, another deal to build Turkey's second nuclear power plant project was formed to build 4 units of ATMEA-1 reactors in the Sinop region. In this project a consortium of Japan, French, Belgian and Turkish companies was established.

Since the two nuclear power plant projects are conducted almost concurrently in some stages of the projects and consecutively in a short time period for many stages, Human Resources Development (HRD) planning issue (listed as part of the 19 infrastructure issues addressed by International Atomic Energy Agency (IAEA) for the newcomer countries) becomes a challenging one to deal with.

In addition to timing of the project stages, having two nuclear power plant projects with two different approaches with two different technological backgrounds makes HRD planning complicated. For example, the supply chain management for the two projects will be different: it is observed that the Sinop consortium is more willing to have local suppliers involved. Licensing and therefore making HRD plans for licensing authority is not a simple one either due to two different technologies involved. The need of the regulatory body to a technical support organization adds another dimension to HRD planning.

As expected from all newcomer countries (in reality, it is tough to call Turkey a newcomer country in many areas of nuclear projects) different targets for localization (which of course aim more and more local involvement) were set for the nuclear power plant projects. The ultimate target was set as building the third nuclear power plant with very high localization rate. This naturally requires high amount of local workforce for the third project.

The issues such as times required for education, training and competence building, determining the needs for outsourcing, involving Turkish citizens getting education and training abroad (such as about 600 Turkish citizens supported by the Akkuyu Project Company), finding out the number of young people that can be involved in the projects (to find the gap between the needs and supply), calculating the retirements or drop outs makes the HRD plan a crowded picture.

By taking into account all the issues listed above, IAEA obtained a very useful tool from Los Alamos National Laboratory in USA called Nuclear Power Human Resources (NPHR) model that can be used to calculate the needs and supply of workforce for nuclear projects for different time periods involving different organizations and different project models.

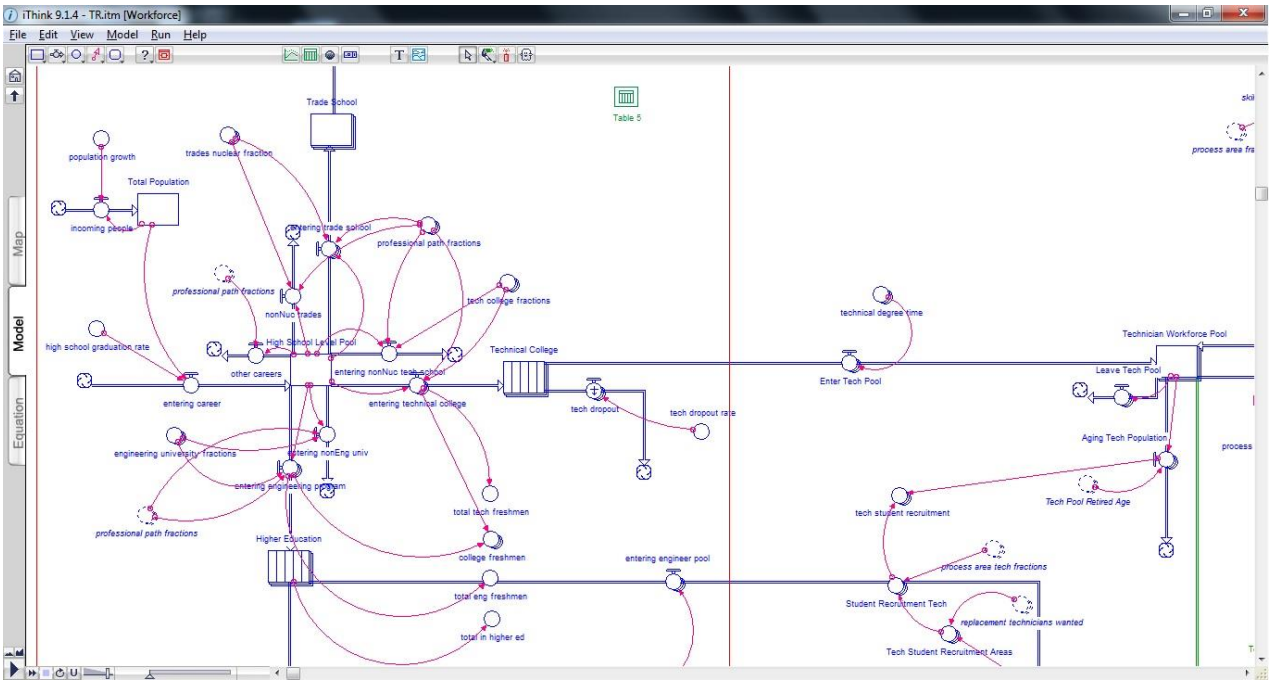

Figure 1. A sample view of the NPHR model.

In this study, the first attempt in using NPHR model to make necessary workforce calculations for Turkey's three nuclear power plants projects is described. The model is introduced first and how it is used for this study is listed. Sample results of calculations are presented (the results are not the final ones, the modeling is ongoing by taking the IAEA's revisions and new data into account).

2 The Nuclear Power Human Resources (NPHR) Model

The NPHR model has been created using iThink, which was developed in accordance with the dynamic modelling objectives of large systems and is a commercial software tool [1]. The model simulates the flow of manpower within the related organizations or stages of the projects similar to the flow between pools which are connected to each other by pipes and valves. An accumulation can be obtained in the pools at determined periods as defined by the user, or the opening and closing of the connections between the pools can be defined based on time. The mentioned connections and a sample view of the model are presented in Figure 1.

To present the results, the model has the ability of reporting numbers in graphics and it is very easy for users to generate proper graphs. Figure 2 shows an example of the results presented by the model.

The model requires data for both nuclear projects and workforce. In summary, the input data required for the model are the details for power plant projects (the number of reactor units, duration of construction etc.), demographic data, education and training data and the data on the construction and operation of the plant, regulations and outsourced workforce.

The initial NPHR model used in this study was prepared by using reactor data for operation, construction, licensing and regulations of the nuclear power plants mainly based on data supplied by IAEA or USA based data. Since the construction data is old due to new construction projects and since the US nuclear sector is rather large and well established for a new comer country, already established model requires a lot of new data.

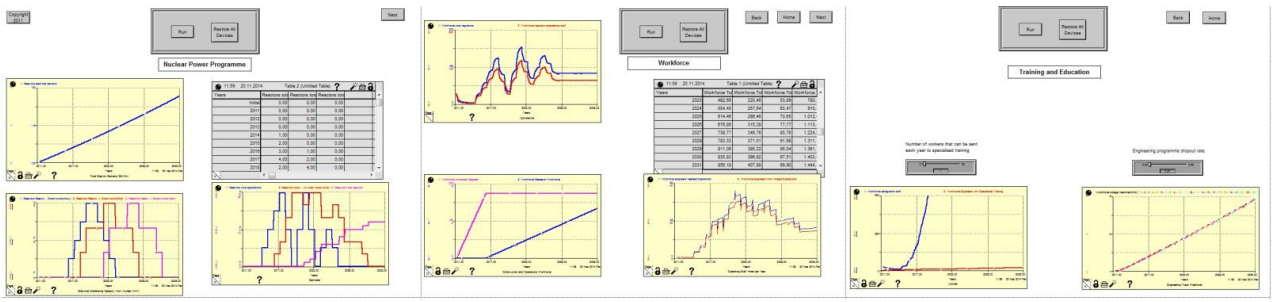

Figure 2. A sample view of results for the NPHR model.

Table 1. The assumptions made for nuclear plant project stages

Plant	Unit	Preparation for construction – start	Preparation for construction – end	Start of construction	End of construction	Commissioning
Akkuyu	Unit 1	2014	2015	2015 (last quarter)	2020	2021
	Unit 2	2015	2016	2016 (last quarter)	2021	2022
	Unit 3	2016	2017	2017 (last quarter)	2022	2023
	Unit 4	2017	2018	2018 (last quarter)	2023	2024
Sinop	Unit 1	2016	2018	2018	2023	2024
	Unit 2	2017	2019	2019	2024	2025
	Unit 3	2020	2022	2022	2027	2028
	Unit 4	2021	2023	2023	2028	2029
Plant 3	Unit 1	2020	2022	2022	2027	2028
	Unit 2	2021	2023	2023	2028	2029
	Unit 3	2024	2026	2026	2031	2032
	Unit 4	2025	2027	2027	2032	2033

3 Sample Model of this Study

In the study reported here, the numbers of personnel for the required workforce for Nuclear Energy Program Implementing Organization (NEPIO), the regulatory authority, the project companies, the plant operations and the academy (the researchers at universities, national laboratories and companies) were calculated for three nuclear power plant projects of Turkey. The model was used to simulate the workforce till year 2035. Table 1 shows the assumed dates for the licensing, commissioning and operations for the reactor units.

For the model, assumptions were made for the percentage of outsourcing especially for the project companies and plant operations and the level of education for people with certain competences (assuming that being overqualified for a certain job does not create problems in Turkey, i.e. a personnel who got education and training to work for nuclear projects accept to work at other industrial projects). In addition, no technical support organization was modeled. It was assumed that 58% of the total workforce for plant operations will be technicians and qualified laborers (large number of engineers).

The NEPIO of Turkey is rather a special organization which is different than the ones in other newcomer countries. Therefore it required special attention to model. The NEPIO model was prepared by working very closely with the experts from Turkish NEPIO.

4 Sample Results of the Model

Only the results of calculations performed with NPHR model for the NEPIO and academy simulations are presented here (since other calculations of the first attempt in modeling require a lot corrections).

Figure 3 shows the distribution of the fields of activity in 2019 for NEPIO (a total of 181 personnel). Figure 4, on the other hand, shows this value for year 2021 (years really depend on the dates presented in Table 1).

This study has also calculated the numbers of the doctorate holding engineers who may be employed at the research laboratories to be established at universities and

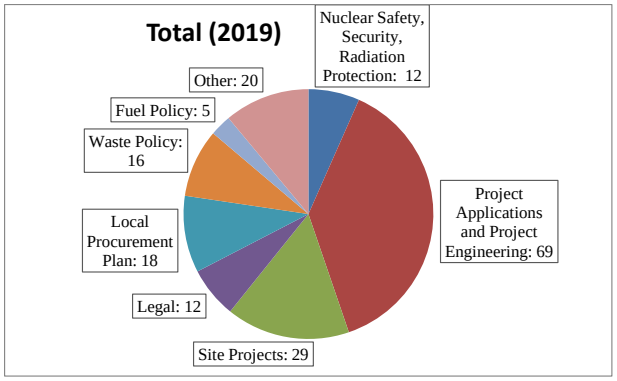

Figure 3. The totals of the fields of activity in 2019 for NEPIO (other: administrative personnel).

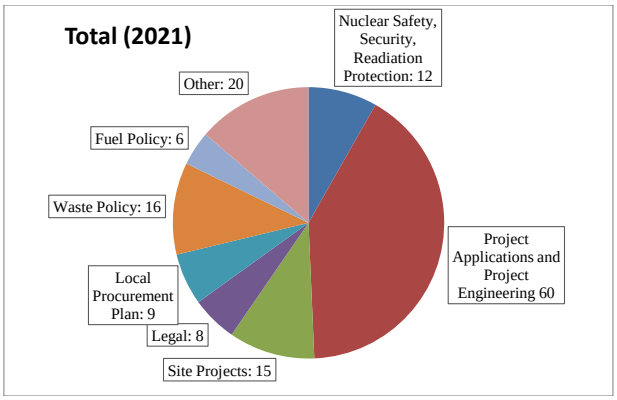

Figure 4. The totals of the fields of activity in 2021 for NEPIO (other: administrative personnel).

the R&D areas of the nuclear industry. It has been envisaged that 304 doctorate holding engineers will be employed at the universities. Figure 5 presents the fields of work of the doctorate holding engineers (in nuclear science and technology) who are to be employed in universities.

The numbers of personnel calculated for academy (as presented for universities above) is high. Once the brain drain and loosing PhD holding engineers to other areas of the sector is taken into account, realistic figures for the university workforce can be calculated.

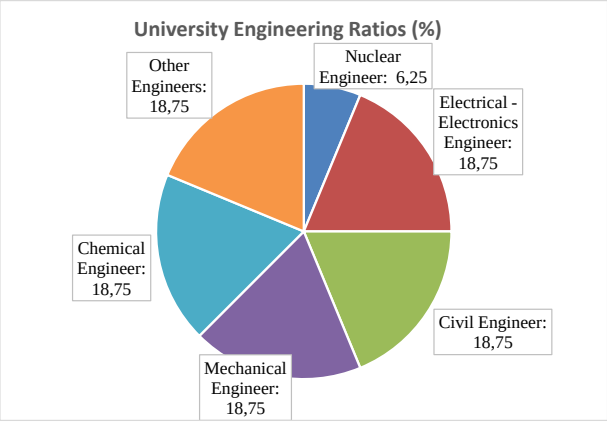

Figure 5. The fields of work of the doctorate holding engineers (in nuclear science and technology) who are to be employed at universities.

5 Conclusions

The study presented here showed that the NPHR model is an easy to use and user friendly method to simulate workforce for newcomer countries. The study and analysis performed by using NPHR model showed that the HRD planning really requires many assumptions and input data to model the nuclear power plant projects.

As the first attempt of HRD planning by using NPHR model, it was calculated that 5381 engineers would be employed in the projects and 4967 technicians and 1140 skilled workers would be employed in the operation of the plants. In addition more than 12000 people would be employed during the years when the nuclear plant construction was at its most intensive, and there would be a need for more than 300 engineers with doctorates for the university.

Currently, the number of personnel required for construction (about 12000 seemed low) is re calculated. In addition, the model for suppliers is being added to the model. The project companies and number of personnel required for plant operations will be corrected. The model for technical support organizations will be added to simulations.

Once the new models and corrections are prepared, the model will be used for different scenarios for project dates and for different assumptions in the near future. In parallel to the calculations, gap analysis will be performed.

References

[1] LOS ALAMOS NATIONAL LABORATORY, mUser Guide for the Nuclear Power Human Resources (NPHR) Model, LANL, USA (2013).