

NEWCOMERS TO NUCLEAR INDUSTRY: IS THE IAEA MILESTONES PROCESS ADAPTED TO THE CHALLENGES FACING THOSE COUNTRIES?

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ABSTRACT

IAEA has set, over the last decade, the basis for a large consensus around the way Nuclear Programs should be developed, especially for newcomer countries. The Milestones Process provides a very broad and logical approach with the objective of creating the best practice in terms of feasibility and safety.

The authors would like to present the challenges that most emerging countries are facing in developing nuclear projects, based on real case studies.

It will be shown that the nineteen IAEA issues have not by far the same importance: financing; site selection and public acceptance have become the drivers of such programs, as the economic benefits of nuclear energy are highly contingent upon the pace at which projects are developed.

A review of the IAEA Milestones Process could be required to for a quicker and well planned introduction of SMRs and large reactors on the world market.

1. Introduction

NucAdvisor is a private company which purpose is to provide advice, expertise, technical and financial assistance, training and engineering services for clients planning to build nuclear facilities. It targets countries that have decided, or are considering, the construction of nuclear research reactors and/or civil nuclear plants for power and associated civil infrastructures, in compliance with nuclear international rules and IAEA requirements (or wishing to reach compliance).

NucAdvisor is fully independent, and is not affiliated to any governmental agency, utility or vendor.

Since its creation in May 2009, NucAdvisor has been in contact (prospection and visits, EOI, tenders or contracts) with 36 countries emerging to nuclear energy or willing to develop it. NucAdvisor has been directly involved, or has evaluated the setting up of nuclear power programs in a dozen among these countries which embarked in such a policy during the last three years: Egypt, Libya, Tunisia, Kuwait, UAE, Jordan, Malaysia, Thailand, Vietnam, Saudi Arabia, and Kenya and also Bulgaria, Lithuania and Poland in Europe.

Basically this provides NucAdvisor with an important feedback on the challenges and difficulties faced by these countries in setting up their nuclear programs and on the main drivers of the Nuclear Renaissance as far as it concerned newcomers.

Before the Fukushima accident in the spring of 2011, many countries indicated strong interest to develop nuclear energy as part of their economical development programs. Since then, many projects remained open although they might have been slowed down for a while. It is quite evident that the expected nuclear Renaissance has not really taken place; however Fukushima is not the only reason.

During that period, the interest in renewable energies has also increased, borne both by bandwagon effect and capital expenditure. Competition between renewables and nuclear as separate answers to requirements for carbon free energies, has been shifted in some

countries, mainly European, by the Fukushima accident; in others like the USA, new fossil energies like shale gas or unconventional oil, are overwhelming the competition. But most of the newcomers have already integrated both nuclear energy and renewables in their long term energy mix.

The main issue for them is how to cope with nuclear energy, taking into account the important barrier which constitutes the stringent specificities of nuclear in terms of safety, security, environment and - we will see below - financing.

2. Reminders about IAEA Milestones process

Launching a nuclear power program is a major commitment for a country; it has to be carefully planned for it requires huge resources investments and involves many stakeholders: the Government, regulatory bodies, electric utilities, grid operators, research institutes, universities and the public.

The IAEA has developed the Milestones guidelines process (document “Milestones in the Development of a National Infrastructure for Nuclear Power” No. NG-G-3.1) to help countries work in a systematic way towards the introduction of nuclear power. In particular it serves to mark progress during planning stages, and to demonstrate to the national and international stakeholders their commitment to nuclear safety and control of nuclear materials.

The process is composed of three major phases of development of a nuclear program; the completion of each of these phases is marked by a specific Milestone as shown in Fig 1.

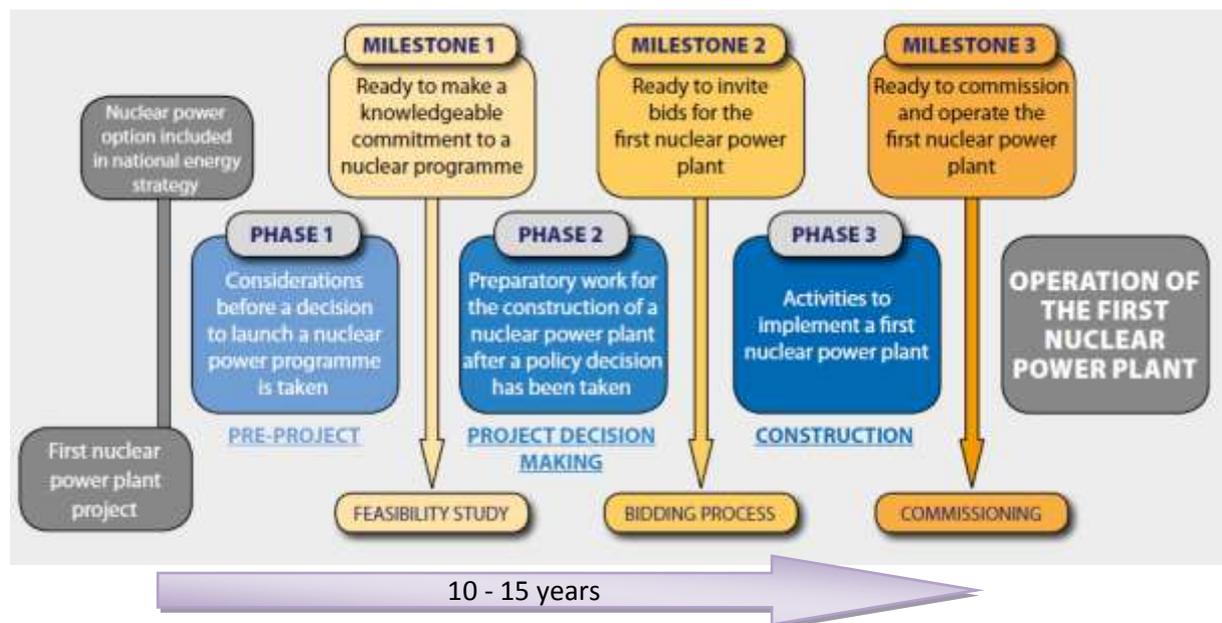


Figure 1. The three Milestones of the Infrastructure Development Program

To be successful, the nuclear program needs to be supported by the required infrastructures which cover a wide range of issues (cf. Fig 2), such as the legal and regulatory framework, the Reactor technology, the electric grid, the strategy for the management of the radioactive wastes, the human resources development, the financing of the project, etc.

During the first phase the Country makes a feasibility study where it considers nuclear power as a possible option for the Country’s energy mix. This leads to make a “knowledgeable commitment to a nuclear program”. Once this decision has been taken, all preparatory works can start (phase 2) thus the national and international frameworks need to be developed as well as all the necessary infrastructures for the construction of a nuclear power plant.

The second phase ends with the selection of a reactor technology and bidders are invited for the construction of a nuclear power plant.

Finally the Third phase consists in the construction activities until commissioning of the plant.

In all, planning the construction of a nuclear energy Unit in a Country could take 10-15 years, from the first pre-feasibility study to the commissioning of the nuclear power plant, according to the IAEA process.

Such duration is extremely long and not at all in synchrony with nowadays investment schedules and investment prospects. Time, and uncertainty which goes with it, are major drawbacks to the development of nuclear energy. Therefore streamlining the IAEA process looks as a prerequisite to a true nuclear renaissance.

Issues	Milestone 1	Milestone 2	Milestone 3
National position			
Nuclear safety			
Management			
Funding and financing			
Legislative framework			
Safeguards			
Regulatory framework			
Radiation protection			
Electrical grid			
Human resources development			
Stakeholder involvement			
Site and supporting facilities			
Environmental protection			
Emergency planning			
Security and physical protection			
Nuclear fuel cycle			
Radioactive waste			
Industrial involvement			
Procurement			

Figure 2. The nineteen issues

3. Who are the newcomers?

Along those lines and before the Fukushima accident in the spring of 2011, many countries had indicated a strong interest to develop nuclear energy as part of their economical development programs. Since then, many projects remained open although they might have been slowed down for a while. We can split them into four groups:

a) Strong and historical nuclear countries

Most of them are going on with nuclear energy (USA, France, UK, Russia, Canada, and Korea). Japan is part of this group but its real nuclear future cannot be clearly described (Germany and Italy clearly phasing out, let us assert that from our point of view, final decisions in Switzerland, Spain, Belgium are not reached yet). These countries are members of IAEA, but they mainly follow their own national guidelines as well as those of the Nuclear Suppliers Group and of the IFNEC.

b) Nuclear countries willing to increase the importance of nuclear in their electricity mix

Almost all of them are countries with large GDP growth and huge needs for electricity; they mobilize all types of energy, and nuclear is an important part of their answer to the needs (China, India, Brazil, South Africa, Finland, Czech Republic, Bulgaria, and Argentina). These countries have a nuclear framework very similar to group a) and do not refer explicitly to the IAEA milestones process.

c) Newcomers to nuclear energy with large financial means, emerging countries or Central Europe countries (UAE, Libya, Saudi Arabia, Poland, Kuwait though its program is temporarily withheld, Algeria, Nigeria, Kazakhstan).

d) Newcomers to nuclear energy without large financial means (Lithuania, Thailand, Malaysia, Indonesia, Egypt, Jordan, Tunisia, Morocco, Kenya, Bangladesh, Turkey, Vietnam, etc.).

Thus it appears that the IAEA milestones process is almost exclusively dedicated to countries of groups c) and d).

Moreover, in the frame light of its numerous contacts and commercial steps, NucAdvisor has consolidated the information which it gathered concerning the nuclear programs of the countries which embarked in such a policy: as already mentioned above, the expected nuclear Renaissance following all the well-recognized milestones has not really taken place.

4. How is the IAEA Milestones Process taken into account?

Most of countries of groups c) and d) have made or make explicit reference to the “IAEA Milestones Process” when launching their new build programs. From evidence the status of nuclear in the country and the existing nuclear activities play a role in the trajectory chosen by the country but from experience the key issues driving the process may be quite different and often totally diverging.

The Phase 1 (pre-project and feasibility studies) is the most “political” and stands mainly at governmental levels (public agencies, ministries) both for diplomatic reasons (NPT, etc.) and national reasons (national energy strategy, setting up of legal and regulatory frameworks, public acceptance). Almost all the newcomers (including the richest ones like UAE) respect the requirements of this phase, even if the implementation can differ: Road map for UAE covering phases 1 and 2, Strategic Nuclear Energy Plan (phase 1) for Kenya, Road map (Phase 1) for Jordan, Strategic Plan (Phases 1 and 2) for Malaysia, etc.

It appears that this phase, which was at the origin considered by many as the most important to assure the compliance with non proliferation, safety and security international regulations, does not present any significant difficulties. Countries are willing to show a total and immediate compliance; their governments sign bilateral agreements with all the “big” nuclear countries and at the end of the day encounter no difficulties during the IAEA audits of Milestone 1.

An exception to this positive picture is related to “stakeholder involvement”; the national authorities often underestimated the need to associate from the beginning the local authorities, organizations or neighboring countries to the setting up of the nuclear program. But this is now improving.

Phase 2 (preparatory works) appears to be the key phase of a nuclear program, for three reasons:

- the work slips from the high level considerations of a program to the practical ones related to the site selection and the preparatory works for building a nuclear facility (NPP);
- the responsibility slips almost in every case from a para-governmental agency (NEPIO) to an owner / electrical utility;
- the main difficult issues come to the forefront: site selection and qualification and financing.

A significant number of projects cannot be clearly related to the Milestones process, because they take place, from the beginning, in the framework of bilateral agreements between the emerging country and a large nuclear country (as of today, mainly Russia but also to a less extent Japan and Korea). These are the cases of Vietnam with Russia (Ninh Thuan 1) and Japan (Ninh Thuan 2), of Turkey with Russia (Akkuyu), of Bangladesh and Belarus with Russia, and of Bulgaria with Russia (until it was stopped and entered a suiting phase).

In all these cases, the existence of a package including the financing, brought by the nuclear country of the vendor, is the dominant issue of the Milestones Process sending all others (such as safeguards, radioactive waste, industrial involvement, procurement, etc.) in a second tier. Nuclear safety in particular will not be independent of the technology, depending itself on the reactor type and consequently on the package. The notable exceptions are related to the site selection, site qualification (though they are partially depending on the

reactor type), the environmental protection and to the licensing regulatory process which must remain independent of the vendor.

Other said, the existence of a financing solution allows an accelerated pace to the project, despite a lot of issues would have needed more time to be correctly addressed (regulations, public acceptance, wastes, safety culture). Establishing a good safety culture in the newcomer country is a major challenge, transverse to several of the 19 issues, which must be adapted when a package exists but not weakened.

In quite all cases, the NEPIO or the Owner asks for support from dedicated consultancy companies or large engineering groups. The scope of these owner's engineer services can vary broadly from one country to another. It is important to note that even if the reference to the IAEA Milestones process is not explicit in the RFP, these companies will generally make reference to it in their proposals, thus demonstrating that it is a shared recognized framework.

5. What are the real drivers of a nuclear project today and how the IAEA milestones process might be reshaped?

All IAEA Milestones Process issues have not by far the same importance. Financing, site selection and public acceptance have become the drivers of nuclear programs, as the economic benefits of nuclear energy are highly contingent upon the speed at which nuclear projects are developed. They take the lead over some issues initially considered as prominent in the IAEA milestones process, such as international and national legal frameworks or capacity building. Explanations have simply to be found in the scarcity of resources offered worldwide concerning the above mentioned first two issues while big nuclear nations have considerably increased their capacities to educate and train foreign nuclear staffs. In the same time, adherence to nuclear treaties became a preliminary requirement endorsed by all newcomers.

While implementing the IAEA methodology, it also turns out that some issues are strongly interrelated, such as technology selection, procurement model, financing and operation. The key point is noticing that each NPP project requires, mainly for safety reasons, the implication of an experienced nuclear power producer; implication very often as financing party but essentially as operator or co-operator. And this power producer will strongly ask to work with a technology it is accustomed to. It is quite evident that these elements induce a deep change in the procurement models when compared to the Milestones Process.

The evolution of project schedules towards more realistic timeframes and of full scope owner's engineers services towards tailor-made services is also a progress; thus enabling nuclear projects to be competitive over other long term projects, such as renewable energy.

As we may conclude from the above considerations, a central core can be extracted from the 19 issues of the Milestones Process, which is not exactly the same than when the Milestones Process was defined.

We think that this central core comprises:

- Site and Environment,
- National and international acceptance,
- Licensing,

and three issues which we consider in fact as totally interdependent:

- Funding and financing,
- Technology (reactor but mainly fuel cycle and wastes),
- Management (operator and capital structure of the Owner).

As a matter of fact, the Milestone 2 ("Ready to invite bids for the first nuclear power plant") appears to be somewhere unrealistic because it is essentially based on separate processes for selecting investors, vendors (e.g. reactor technology) and eventually associated operators. But most of the successful recent examples are not based on that kind of process: they rely on selection of consortium investors / vendor or investors / operators / vendor (Lithuania, UAE, Poland, Bulgaria, Vietnam, Turkey, Jordan coming). The most interesting case is Lithuania which began in 2009 a process for selecting only one investor and changed it one year ago for selecting a vendor / investor (GE-Hitachi). But it is difficult to say whether

this process will go on or not, when taking into account the results of elections and referendum on October 14.

This is why we think that the sentence characterizing the funding and financing (Milestone 2 of the IAEA document): “Having identified and obtained a reliable source of financing and having funded the activities of the national, infrastructure will satisfy the principal aspects required to support the request for bid for the first nuclear power plant” is not really adapted to the present situation. Stress ought to be put more explicitly:

- on the increased difficulties for the countries to finance a NPP project, in equity with national means or in debt with international loans, due to the “crisis” but also to a large extent to the numerous uncertainties (political, safety requirements, public acceptance) characterizing today nuclear activities;
- on the new context for banks due to the international arrangements taken to strengthen the accounting balances (Bale 3 agreements);
- on the fact that the competition between vendors has obscured the stringent necessity to rely on an utility-partner experienced with nuclear operations (and they are not so many on the worldwide market);
- on the fact that the utility-partner-investor will prefer to select the reactor technology it is accustomed to, without competition.

Finally, the reshaping of the Milestones Process must also include new paradigms, and mainly the probable emergence of Small Modular Reactors within the next ten years. The process for ground based SMRs will not be fundamentally different from those of the existing Milestones Process (but probably simpler, for example concerning industrial involvement).

However transportable reactors (floating or immersed) will require significantly different approaches. Firstly they will require an adaptation of the international and legal frameworks to take into account relatively frequent maritime transportations of fresh fuel or spent fuel contained in the plant. Secondly they will induce new sharing of responsibilities between the emerging countries and the country of the vendor (concerning the role of the safety authorities, the waste storage and / or repository facilities international and legal frameworks, the safeguards, the security and physical protection, etc.). Lastly the technical issues related to the site (choice, qualification, environmental protection, involvement of neighboring countries, emergency planning) have to be largely adapted especially for floating systems such as the Russian barge and immersed systems such as DCNS FlexBlue. It must be noticed that these concepts of SMRs which are compatible with leasing solutions could simplify to a large extent the setting up of the safety culture by focusing it on wastes management, environmental protection and emergency planning.

This is why it is important that the IAEA working group on transportable NPPs propose rapidly a Milestone process for TNPPs.

6. Conclusion

The IAEA Milestones Process still constitutes a major guide for all countries that are entering a nuclear program; at least as much due to the consensus with which it has been build than to its pertinence. The experience of the nuclear projects launched these last four years show that this Process would gain in being reshaped and in better putting in evidence the major issues of modern nuclear projects: financing, site and environment, public acceptance. This would allow the countries to focus from the beginning on the solution of the major difficulties they will face, to avoid wasting time on unrealistic solutions and at the end of the day to keep a good momentum in their projects.