ABSTRACT

The final destination of the waste generated in a nuclear power plant remains a big challenge. The question is not only the radiation emitted by the sources, in some cases for many years, but also the public acceptance of this theme. In many countries where a nuclear waste storage facility has to be built, the local population of the chosen site did not accept it at first, and the whole process had to restart including this variable. In the past, the population opinion was considered not relevant but several international experiences showed that in fact it cannot be forgotten. Statistical data show that a significant fraction of the population of the world has many concerns about nuclear energy and its potential impacts. Although many experts state that it has environmental advantages, such as the absence of greenhouse gases emissions, the subject is still the target of never ending discussions. But it is a concrete fact that the sector is growing in many countries. The objective of this article is to summarize several experiences in many countries associated with nuclear energy, mainly those ones that involve nuclear storage facilities, and its acceptance by the public. This task can help CNEN in the studies associated with the RMBN project - Repository for Radioactive Waste with Low and Medium Levels of Radiation.

1. INTRODUCTION

The deposition is the final stage of the radioactive waste management, that includes the nuclear fuel cycle and other types of activities where the nuclear energy and radioisotopes are used. This stage has been object of many programs of research and development, international studies, publications and controversies between the population in general and researchers. The storage practices used in several countries can vary, and the most usual ones are the near surface deposition, boreholes, deposition in intermediate depth caves and in deep geological formation.

Among the countries that have been implanting final solutions for the nuclear waste with low and medium level of activity, most adopted near surface storage facilities, some of them with artificial barriers, as those ones adopted in Spain and France. There are also repositories constituted by galleries built in different depths. Table 1 shows some data associated with this question.
Table 1-Facilities for the deposition of nuclear waste with low and medium activity level in several countries [1]

<table>
<thead>
<tr>
<th>Country</th>
<th>Installation</th>
<th>Type</th>
<th>Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>Morsleben</td>
<td>Deep</td>
<td>Closed</td>
</tr>
<tr>
<td></td>
<td>Konrad</td>
<td>Deep</td>
<td>Under licensing</td>
</tr>
<tr>
<td>Slovakia</td>
<td>Mochovce</td>
<td>Superficial</td>
<td>In operation</td>
</tr>
<tr>
<td>Spain</td>
<td>El Cabril</td>
<td>Superficial</td>
<td>In operation</td>
</tr>
<tr>
<td>USA</td>
<td>Clive, Richland, Barnwell, Hanford, Fernald, Idaho Nat. Lab., Los Alamos Nat. Lab., Oak Ridge</td>
<td>Superficial</td>
<td>Commercial – In operation</td>
</tr>
<tr>
<td></td>
<td>Savannah River, Beatty, Maxey Flats, Sheffield</td>
<td>Superficial</td>
<td>In operation – DOE</td>
</tr>
<tr>
<td></td>
<td>West Valley</td>
<td>Superficial</td>
<td>Commercial - Closed</td>
</tr>
<tr>
<td></td>
<td>Texas Compact</td>
<td>Superficial</td>
<td>Commercial - in licensing</td>
</tr>
<tr>
<td>Finland</td>
<td>Olkiluoto, Loviisa</td>
<td>Cave</td>
<td>In operation</td>
</tr>
<tr>
<td>France</td>
<td>La Manche</td>
<td>Superficial</td>
<td>Closed</td>
</tr>
<tr>
<td>Hungary</td>
<td>Puspokszilagy</td>
<td>Superficial</td>
<td>In operation</td>
</tr>
<tr>
<td>Japan</td>
<td>Rokkasho Mura</td>
<td>Superficial</td>
<td>In operation</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Dounreay, Drigg</td>
<td>Superficial</td>
<td>In operation</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Dukovany</td>
<td>Superficial</td>
<td>In operation</td>
</tr>
<tr>
<td></td>
<td>Richard, Bratrstvi</td>
<td>Cave</td>
<td>In operation</td>
</tr>
<tr>
<td>Sweden</td>
<td>Forsmark</td>
<td>Cave</td>
<td>In operation</td>
</tr>
</tbody>
</table>

The implantation of a radioactive waste storage facility is a process that in general finds strong resistance from the local population. Dialogue with society is considered a vital factor for the enterprise success, because the population see the impacts generated by the nuclear area among the most dangerous ones [2].

2. INTERNATIONAL PERCEPTION

There are some low and intermediate level waste repositories in operation all over the world. Examples that show the public involvement aspects and some government programs in several countries, associated to nuclear waste disposal, are listed below.

Belgium - in 1994, projects made for the implementation of a repository in the Belgian territory failed due to the absence of the public acceptance. In the opportunity, authorities believed that just the technical aspects would be enough for the implementation of the project. However, in all the preliminary chosen places, the local committees refuse the government proposal, although all the international technical recommendations were included in the final report. Since then, questions regarding the environmental and economical aspects of the candidates communities were incorporated to the methodology. The new researches
were limited to the nuclear municipal districts and others that showed an initial interested in receiving the repository.

Starting from 1998, studies began to use this new methodology, considering the interests of the community. There were several encounters in the potential places, involving many work groups, and the public reactions were much different from the previous experience. At the end of these discussions, the Municipal Council should decide the sequence or not of the enterprise and in two municipal districts that were candidates (Mol and Dessel), the Council was favorable to the installation of a repository [3].

**Czech Republic** – the Czech nuclear sector understands that the relationships and the communication with the public are the most important factors of its acceptance. The nuclear energy is recognized by most of the public as a specific industrial branch that does not belong to a pattern accept usually. There is also a distrust on the part of the public that don't have plenty information on the theme, and if they are threatened by the same or don't understand it, this fraction of the population much times harmonizes with antinuclear organizations that know exactly how to communicate with the public.

The authorities consider vital that the public relationships sector of the nuclear area must achieve a more significant role in the future, compared with the current days. Fundamental factors for this conclusion are the constant change of information, trust, tolerance, and understanding, among other factors. Public visits are also considered necessary. The power plant should supply information systematically about its operation, future plans and business activities for the citizens and organizations. The committee of the citizens safety, whose partners are the representatives of villages, public in general and the state administration, that have access to the nuclear power plant, should participate in all the important negotiations and in the investigations of operational events and safety.

The nuclear activities in the place give financial support to social activities that happen in the area, and also to the improvement of the local infrastructure, education, services, culture, health, sports and humanitarian projects, among others. An informative bulletin of the nuclear area ("Zpravodaj EDU") is distributed for all the houses in a ray of 20 km around the nuclear facility, and it is a recognized source of information.

Since 1994, a nuclear area information modern center for the public is in operation. In 1998 more than 30 thousand people visited it. Adults are allowed to access some parts of the power plant and the deposit of radioactive waste. A research accomplished annually by an independent agency, in an area of 20 km around of the plant reveals that the activities of the nuclear area were incorporated to the daily of the region [4].

**Egypt** – according to the nuclear authority, there are many issues and practices that could impact the development of a near surface low and intermediate level radioactive waste disposal facility, beside the radiological factors. These issues may be social, economic, public involvement practices, land use and natural environment. To establish public trust during the development stages of the Inshas Repository, visitor programmes are prepared periodically for school and university students, the local community, press, people in general and other visitors. The objective is also to achieve and maintain the stakeholder confidence, and to facilitate a greater public access to details.
Nowadays, the Inshas repository licensing process is going on, and the government hopes to begin its construction very soon.

**Finland** - in Finland, the site selection process for the implantation of a repository requests political decisions, and an essential parameter for an appropriate decision is the public acceptance. A communication program exists since 1980, to supply information and to create trust in the safety of the facilities that storage nuclear waste.

The public communication has been including presentations for the involved groups, visits to repositories and nuclear power plants, information campaigns in all candidates areas, as well as the publication of announcements in the local and national newspapers. In 1997-99 when the repository of Olkiluoto was being made, several meetings with the local community happened in four municipal districts. The receptivity in the places where already a nuclear power station exists is much larger than in other parts of the country. Nowadays, most of the inhabitants of these municipal districts are in favor of the waste disposition in deep facilities, a geological repository [5].

Researches on the public opinion regarding the nuclear energy are accomplished in Finland with quite regular intervals since 1982. The most recent survey made in 2007 indicates an increase in the public receptivity, although saturation can be seen. In agreement with a recent research, 43% of the population support the increase of the nuclear park, 28% say that the current number of nuclear power plants is satisfactory and 25% want to reduce the nuclear energy production. In the most recent research, as well as in the previous ones, the male acceptance to the theme is bigger. 24% of the women (61% of the men) say that Finland should increase nuclear energy while 36% of the women (13% of the men) think that nuclear energy should be reduced [6].

**Hungary** – a public opinion research from 2007 showed that 75% of the Hungarian population agreed with the operation of the Paks nuclear power plant, and 22% were against it. 60% supported the extension of its useful life and 30% did not [7].

The site selection process driven in Hungary for the installation of a near surface repository for the deposition of nuclear waste with low and medium levels of activity generated in Paks nuclear power plant is an example of the fundamental importance of the public acceptance in the whole process. In 1978 the preliminary studies to find a site for the repository culminated with the selection of a place named Ófalu (in Baranya region). The authorities followed the best practices recommended by international agencies, but only with technical approaches. As result of this methodology, the 1987 selection process was totally rejected by the local communities, and the slogan “not in my back yard” became the voice of the people. Also, a growing antipathy for the government initiatives, whose communication process with the local communities was considered dishonest, created a huge popular pressure, and these facts did not allow the competent authorities to release the construction license for the enterprise, although the stakeholders tried several times to show that it was a safe facility. In 1993, the site selection process was elaborated again and restarted, but this time not only technical, radiological and environmental questions were studied, but also the support of the local population was considered essential besides a honest cooperation with the municipal districts and a information service that the public could trust without restrictions. In 1996, further
investigations seeking to install a deep geological repository in the proximities of Bátaapáti (Tolna County) were done.

In 1997, six municipal districts that were candidates to receive a repository founded own committees for the correct administration of the information associated to the process, and the acceptance level of the enterprise was judged as very good. To maintain contact with the public during the construction, operation, closing and even in the period post closing was considered fundamental by the population and some experts.

In the final report of an international revision about this theme, a special mention was made for the public relationship activities that were done. The published text declared that: "the process that led to the selection site of Úveghuta seems to be reasonable, since considered the local geology and the opinion of the population in an appropriate way. Based on a meeting with the local community representative, a program of transparent communication was established [8]."

In 2005, 90% of the consulted population voted favorably to the construction of the repository, and this decision was accepted later by the local governments. On October 6, 2008, the Hungarian repository was inaugurated [9].

Lithuania – the site selection study made in Lithuania indicated three possible places for the installation of a repository. In two of these, environmental impact studies and public audiences were made. The local Municipal Council from the place with better technical conditions declared that the presence of nuclear facilities would cause great psychological discomfort to the population, would reduce the investments in the place and would affect the tourism and the recreation activities negatively, exactly the pillars of the municipal economy, among other potentials problems. A decision against the construction of the repository was the result of this process.

The government from Lithuania consulted Belarus and Latvia, neighboring countries whose borders would be close to the repository in the case of its construction. These two countries did not agree with the project, and threatened to construct other enterprises considered dangerous, in places close to the border. The Belarus Parliament formally requested the government from Lithuania to abandon the project. The Lithuanian government requested some AIEA experts to better evaluate the situation, and invited the authorities and technicians of the neighboring countries to participate in these meetings [3].

Finally, in 2007, one of the three places initially considered - Stabatiške - was chosen to shelter the repository. In spite of not gathering the best geological conditions, it was accept for the community and, besides, it was the closest site to the nuclear headquarters of the country [10].

Norway - In the late 1960’s, European experts, including Norwegians, investigated the possibility of dumping radioactive waste in Biscaya (ocean disposal). The conclusion was that this was safe and acceptable, but the plan was not accepted by public opinion, although the initial procedures had already begin. No leaks from the first repository built in Norway were ever detected, but the local community was not convinced and started to push for the
removal of the waste. When the preparation for a new repository started, public opinion demanded the removal of the old repository and the transfer of the waste to the new facility.

Nowadays, the Himdalen repository is open for the public and is visited by schools and local social organizations. Normally they combine a regular meeting with a visit to the facilities. People are allowed to walk into the repository and to see where the waste is storage. At the same time the precautions taken to avoid leakages to the surroundings are explained.

Slovakia – in Slovakia the government organizes presentations and visits to nuclear sites. Public information material like brochures, newspapers and advertisements are widely distributed to many people for maximum effect. Public meetings and hearings are organized for each nuclear facility, and are considered very important, in particular for the citizens of cities and villages on the route from the Treatment Centre to the Mochovce repository. Conferences and seminars about nuclear issues happen once a year, and public opinion surveys showed that the population is interested in getting more details about the repository.

The authorities concluded that the transfer of information plays an essential part in the establishment of public trust, but it is not enough. Communication between the public and representatives of the waste management organization is also vital for the success of the enterprise. The issue of compensation to host communities can not be forgotten, and the research in many areas of risk acceptance has shown that people are more willing to accept the risk if it is controllable [11].

South Korea - Four locations in the southern part of Korea have been selected as candidate sites for low level radioactive waste disposal facilities in 2003. After the candidates identification, the government planned to evaluate detailed inspections to see if they are suitable for the facilities, geologically and environmentally. At the same time, the government did consultations with residents and local governments about the project. However, if any other place expresses willingness to host a disposal facility, the government would give it preferential consideration. Based on the outcomes of the inspections and consultations, the government will finally select the location [12].

Switzerland - nuclear energy is a very controversial question in Switzerland. One of the tactics of its opponents is to try to amend the constitution by means of a referendum, and there have been five popular initiatives of this type to date. In 1990, the Swiss voters accepted an initiative banning the construction of new nuclear plant for 10 years. In 1999, opponents organized two new initiatives. The first one aims at an extension of the moratorium on new power plants until 2010. The other calls for the decommissioning of all five Swiss reactors after a service life of 30 years.

The Swiss Parliament adopted the new nuclear energy law on 2003, after more than two years of intensive discussions, with a number of changes of major political significance. The new law allows the possibility of building new reactors (but a referendum against their construction is possible), and also includes a concept of monitored long-term geological disposal of radioactive waste that combines elements of final disposal and reversibility, and a system for funding the costs of decommissioning and of radioactive waste management. It simplifies licensing procedures and allows the general right of appeal. Among the points that the Parliament rejected was the government’s original proposal to ban the reprocessing of
spent fuel. Also defeated was the right of veto by any canton designated to host a geological deep storage facility [12].

**United Kingdom** - in UK, the public acceptance for the construction of a repository is considered essential, but difficult to be obtained due to the uncertainties and inherent risks to this theme, and also the distrust associated to the same. Many interviewees criticize the nuclear industry for not being quite open and accuse Nirex (company created in 1980 by the British nuclear industry to examine economical aspects of the safety and of the environment, of deep geological deposits for storage radioactive waste of low and intermediate level, among other attributions) of refusing frequently to supply relevant data. The British authorities recognized that there is not a uniform public perception, and it changes as time goes by. Frankness and transparency are some of the necessary mechanisms to obtain trust. The last experiences demonstrated that the strategy of decide, announce and defend is not valid, and to overcome the problem of local acceptability, they suggest compensation measures, that would help enough to obtain the acceptance [13].

The original site chosen for the disposal of the low level waste in the UK (Dounreay, Scotland) did not go through a site selection process, what generated negative consequences for the government. Any way, the acquired experience is useful, and now there is a bigger emphasis on local concerns and economic benefit. In the future, the government will launch a national project to discuss the long term management of the intermediate level waste. The site selection process and the characterization will include the participation of the interested parts. The public rejection delays since 1997 the process for the definitive storage of the intermediate level waste in United Kingdom. After the verification that a transparent process is absolutely needed, CoRWM - Committee for the Radioactive Waste Management was charged to find the best place for the enterprise, and the British government will decide which option to implement. The government understands that for the success of whole process, it is necessary to emphasize the public involvement and to considerate the socioeconomic issues.

### 3. CONCLUSIONS

Nuclear option public perceptions vary from one country to another. There is a strong correlation between the concerns of the public and the lack of information about radioactive waste. The concerns are larger in the places where the information is inadequate or insufficient.

However, the nuclear energy does not receive the political priority that it deserves. The public in general and politics of many countries do not agree with the nuclear area expansion, and besides some of them use legal mechanisms to prohibit any correlate activity. A realistic and political discussion is necessary, to debate about the electrical energy provisioning safety, the market competitiveness and the maintainable development. A positive result can be obtained if the authorities adopt since the beginning of the process an open and interactive atmosphere that provides real possibilities for the public to obtain the wanted information in a comprehensible way. Also, the generated impacts must be discussed, and the local community has to participate in the decision making process [14].

The examples studied here show that the population opinion can be a vital factor in the process to select a site for a radioactive waste storage facility. When not considered, the
experience demonstrates that this can generate serious consequences for the enterprise, including the absolute failure of the project.

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