

# AN EDUCATIONAL INITIATIVE BETWEEN THE UNIVERSIDAD POLITÉCNICA DE MADRID AND SPANISH YOUNG GENERATION IN NUCLEAR (JÓVENES NUCLEARES): THE SEMINAR OF NUCLEAR SAFETY IN ADVANCED REACTORS

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## ABSTRACT

Jóvenes Nucleares (Spanish Young Generation in Nuclear, JJNN) is a non-profit organization and a commission of the Spanish Nuclear Society (SNE). The Universidad Politécnica de Madrid (Technical University of Madrid, UPM) is one of the most prestigious technical universities of Spain, and has a very strong curriculum in nuclear engineering training and research.

Finishing 2009, JJNN and the UPM started to plan a new and first-of-a-kind Seminar in Nuclear Safety focused on the Advanced Reactors (Generation III, III+ and IV). The scope was to make a general description of the safety in the new reactors, comparing them with the built Generation II reactors from a technical point of view but simple and without the need of strong background in nuclear engineering to try to be interesting for the most number of people possible.

After a great effort from JJNN with the support of the UPM, the Seminar took place in April 2010 at the Industrial Engineering School (ETSII). The lessons were conducted by young professionals, experts in the field, that belong to the Young Generation of the Spanish Nuclear Society and to companies and institutions related with the nuclear energy.

The Seminar was structured in four sessions. In each of them, a comparison between previous and new technologies was done, regarding safety perspective.

The first day there was an introduction lesson to PWR safety and just after a lesson of AP1000 safety, to clearly see the advances in safety systems in the new technologies. Same comparison took place between the BWR - ABWR/ESBWR and PWR – EPR in the other sessions.

For the Generation IV reactors there were a specific lesson, longer than the others to cover all the specific characteristics of these kind of future reactors. A special lesson about the ADS (Accelerator Driven Systems) took place to emphasize the importance of this new development in the nuclear energy sustainability.

The seminar was very popular, with nearly 70 assistants each day, from the university, nuclear companies and research centers. After each session there were very interesting and animated discussions between the lecturers and the public that demonstrated the interest of the assistants for the subjects taught.

Both, the UPM and the SNE, strongly supported the seminar: the opening session was conducted by the Vice-Chairman and Nuclear Engineering professor of the UPM, Emilio Mínguez and the closing session was conducted by the president of the Spanish Nuclear Society, Mr. José Emeterio Gutiérrez. A really important fact is that in 2011, the Seminar starts to be an official subject of the UPM, which will help to develop the lessons and the materials.

The assistants were asked for a highly detailed feedback of each one of the lessons and those opinions have helped to improve the program for the 2011 Seminar.

## 1. Introduction

Spanish Young Generation in Nuclear (Jóvenes Nucleares) is a commission of the Spanish Nuclear Society (SNE), whose main goals are to spread knowledge about nuclear energy among the society.

One of the scopes of the seminar was to make a general description of the new reactors from the point of view of the safety and in reference with the operating reactors. The course lasted four days and was divided in two lectures of one hour each day, except the last day that consisted of a two hours lecture.

In the first and second lecture a review of the principal systems of a Westinghouse and a KWU PWR of and their design differences was done, including their different behavior against transients. Those characteristics were compared with the AP1000 ones, to clearly seen the advances in the new design.

The same analogy was done in the following two lectures with the BWR of GE and ABWR and ESBWR of GE. The third day two lectures were given, the first one was about operation and the safety systems of the EPR of AREVA. The second one was an introduction to the ADS and the physics of transmutation. In the last lecture of two hours, an introduction to the new Generation IV designs was done from the point of view of the advances in nuclear safety that this new generation incorporates.

The objective of the seminar is to show clearly the advances that have been obtained in the section of safety with the new reactors, from a technical but simple point of view and without needing great previous nuclear engineering knowledge.

## 2. Seminar Development

The opening session was chaired by the Vice-rector of the Universidad Politécnica de Madrid and full-professor of Nuclear Technology Dr. Emilio Mínguez and by the Spanish Young Generation in Nuclear president in that moment, Miguel Millán.



Figure 1. Seminar opening session

The Seminar was highly crowded every day, with more than 70 daily attendees. There was a very active audience participation with animated debates after every lecture. The closing session was presented by the president of Jóvenes Nucleares and the president of the Spanish Nuclear Society, D. José Emeterio Gutiérrez.

After the brief speech of each president, the diploma ceremony started with the documentation given to the audience. To finish the closing act, it took place a Spanish wine, courtesy of the University.



Figure 2. Seminar Closing Session

### 3. Surveys results

The participation filling the surveys was estimated into 50% of the attendees. It is a satisfactory result due to the voluntary aspect of the surveys.

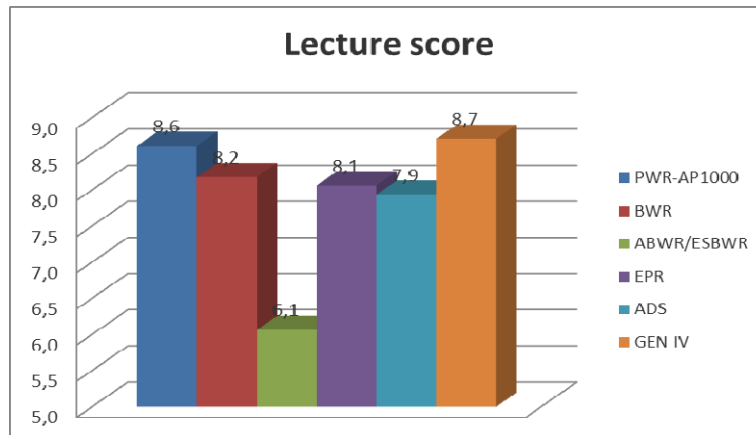


Figure 3. Lecture score

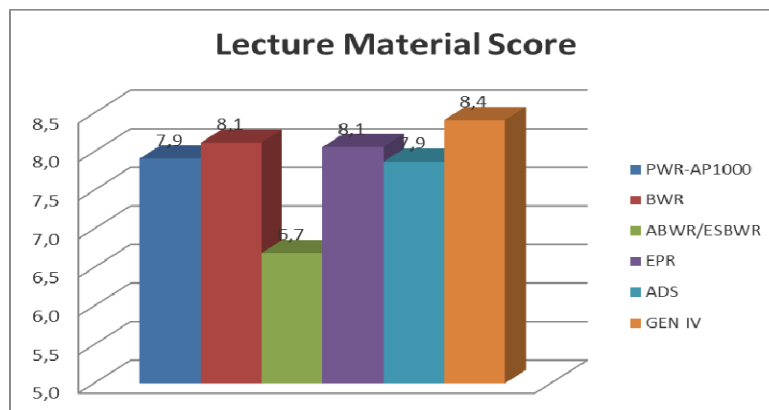
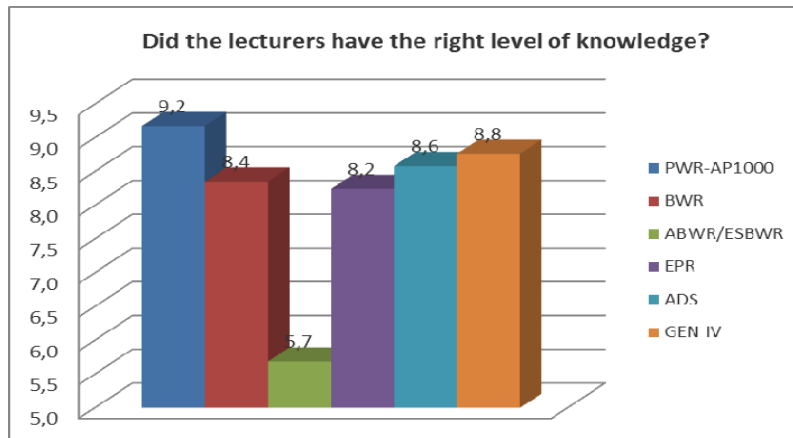
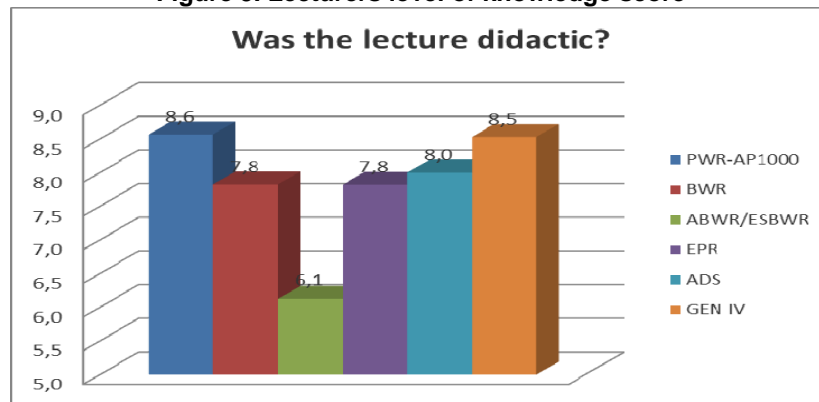


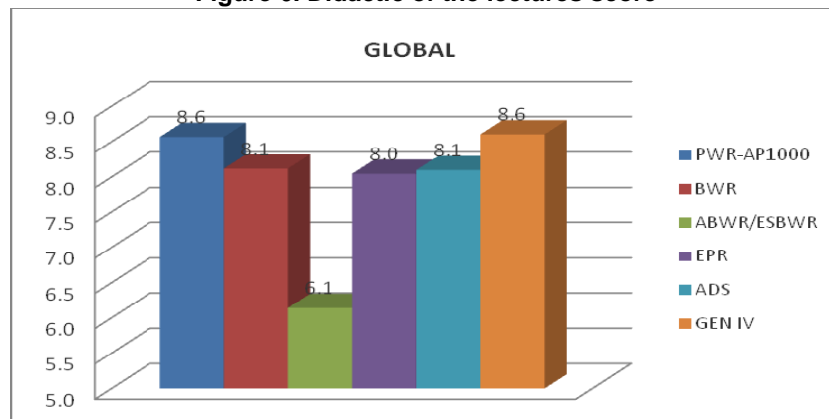
Figure 4. Lecture Material Score



**Figure 5. Lecturers level of knowledge score**



**Figure 6. Didactic of the lectures score**



**Figure 7. Global Score**

The surveys had two different parts: in the first one, some fields were scored from 0 to 10, see Figures 3 to 7, and the second part was a free text one, where the attendees could write down their suggestions and comments about the Seminar.

As a first conclusion of the surveys, the score of the lectures, the lecturers and the lectures material was satisfactory. More important than that, as it was one of the main scopes of the Seminar, the lectures were valuated as didactic. This was highly difficult to get, as the level of knowledge of the audience was very varied.

#### **4. Lessons Learned**

From the multiple and very valuable comments from the attendees, some of them have been extracted, as they are lessons learned for the on forward Seminar sessions. For example:

- The Seminar should last more to describe with more details the lectures.
- The timetable should be respected.
- It is important to have all the material available at the beginning of the lecture, to follow it and take notes during the presentation.
- The Seminar should be valued with UPM ECTS.
- It is recommendable to have a more specific introduction of the PWR of Westinghouse, separated of that one about PWR of KWU, as they are too different from each other.
- ABWR and ESBWR are too different to be in the same lecture.
- The time dedicated to the new reactors should be longer than the old reactor's time.
- The detailed systems drawings are too complex to be seen by the audience.
- It could be interesting to see more images of the reactors under construction.
- The technical videos are very good, but some of them are too corporative.

The following comments describe the most valued aspects of the Seminar:

- The ambient and the subjects were very interesting. It was a good point to present different reactors to compare them during the same session.
- Good quality of the debates answers and questions.
- High attendance and audience collaboration.
- Interesting state-of-the-art subject
- The lectures were clear enough for somebody that did not know all the concepts.

## 5. Conclusions

Once all the surveys were processed and all the comments were classified, some improvements were implemented in the 2011 edition of the Seminar:

- The Seminar lasted more hours (15 h) and it was valued with ECTS
- The structure was changed to 1h of the old reactor + 1.5 h of the new one
- There was one lecture for PWR-W and another for PWR-KWU
- There was one lecture for ABWR and another for ESBWR
- All the documentation was given at the beginning of the Seminar.
- A first day lecture about "Introduction to Nuclear Safety" was created.
- A new lecture of High Temperature Reactors was created.

In this 2011 edition, the Seminar is still alive, open to comments and evaluated with surveys, to make it better year after year.