

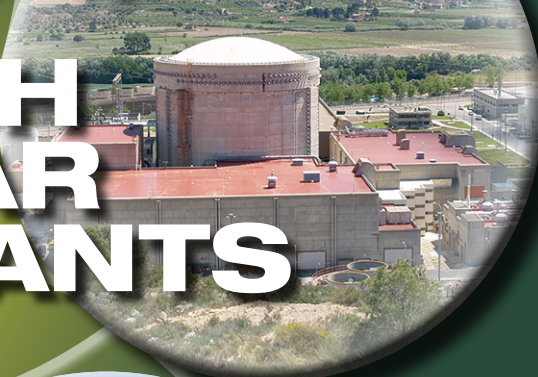
Almaraz I & II



Vandellòs II



Ascó I & II



**SPANISH
NUCLEAR
POWER PLANTS
2021**

Trillo



Cofrentes





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SPANISH NUCLEAR POWER PLANTS 2021

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AN EXTRAORDINARY EDITION FOR A SPECIAL YEAR

The special issue of NUCLEAR ESPAÑA dedicated to the traditional session of the Spanish Nuclear Society on the operating experiences of nuclear power plants joins, in this extraordinary paper edition, the celebration of the 40th anniversary of the magazine, whose first issue was launched in July 1982. The Operational Experiences Session was held, once again this year, as two separate sessions. The limitations set by the pandemic made it advisable to organize the first session, scheduled for March 3, in an online format. The directors of the plants presented the experiences from their facilities during 2021; the session also included the participation of the CSN Board Member, Javier Dies, and the Deputy Director General for Nuclear Energy, José Manuel Redondo, as well as the President of the SNE, Héctor Dominguis, and the Vice President, Emilio Mínguez. For the tenth consecutive year, nuclear energy has produced more than a fifth of the electricity generated by the Spanish electricity system, 21 %. This activity made it possible to prevent the emission of more than 20 million tons of CO₂, producing 30% of electricity without emissions in our country.

The second part of the Operational Experiences Session took place on September 6 in the auditorium for the Higher Technical School of Industrial Engineers at the UPM. On this occasion, a special session was held with the participation of the President of the SNE, the President of the Spanish Nuclear Industry Forum, and the guest speaker, Javier Targueta, President of Atlantic Copper.

This session also included the traditional SNE awards ceremony which closed this Session on Operational Experiences. All the information about the Session is included in this special issue of NUCLEAR ESPAÑA.

In addition, the paper version includes the edition dedicated to the 40th anniversary of the magazine. Both issues can also be viewed in the "Special Publications" section of the revistanuclear.es portal Editorial Committee



Opening Session



HÉCTOR DOMÍNGUIS
PRESIDENT OF THE SNE

I would like my first words to be of support and solidarity for the entire population of Ukraine.

From the Spanish Nuclear Society, we deeply regret the war unleashed by Russia, and we can only wish that human rights are respected and that hostilities cease as soon as possible.

Our thoughts today are with all the people affected by this conflict.

Now yes, welcome to the Spanish Nuclear Society Thirty-Third Session on Operational Experiences, one of our classic meetings that, once again, we have decided to keep in virtual format, because as we all know, in our industry, safety always comes first.

However, thanks to technology, and even if it is through our screens, we meet again to learn about the keys to the operation of our plants in 2021 from the directors of each facility.

And as we did last year, in a few months we will get back to the face-to-face meeting that gives continuity to this conference, with a guest speaker. Of course, we will inform you all promptly so that we can meet again in person.

To begin, on my own behalf and on behalf of the Board of Direc-

tors of the Spanish Nuclear Society, I would like to acknowledge the efforts of all those who have made this event possible despite the health circumstances. And especially, to the members of the Programs Commission who have worked intensely in recent years so that we can be here today.

My thanks also to José Manuel Redondo, Deputy Director General of Nuclear Energy for the Ministry for the Ecological Transition and Demographic Challenge, for accompanying us in this opening ceremony.

And of course, thanks to all the directors and plant managers who participate today as the main protagonists of this meeting, for telling us about the experiences of their respective facilities.

Before giving way to Jose Manuel Redondo, I would like to give you an overview of our results in 2021

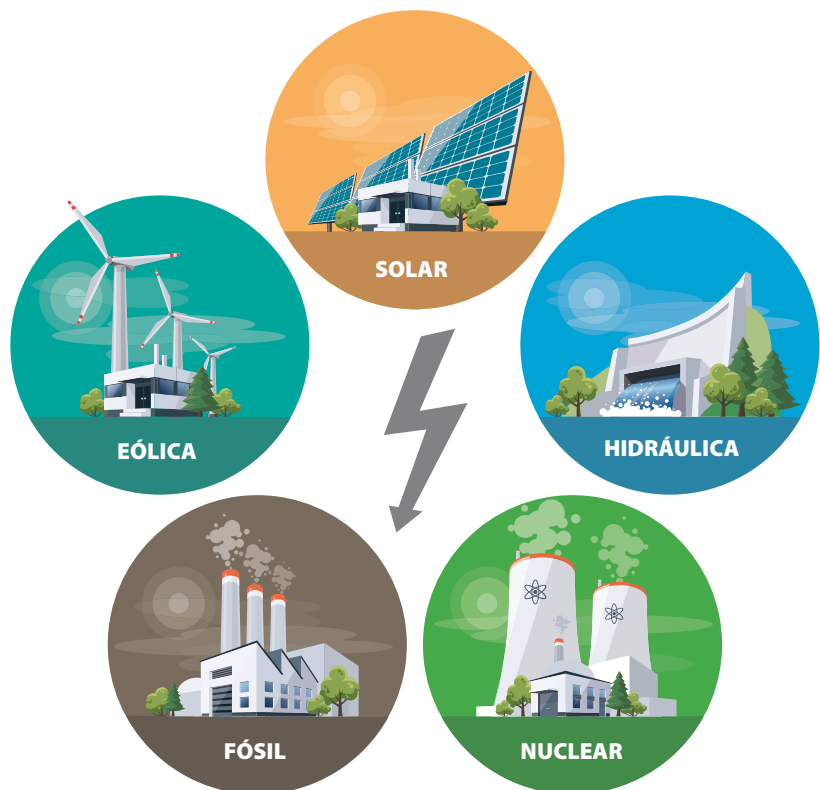
and share with you some reflections on our industry:

In Spain, nuclear energy has been providing more than 20% of the electricity consumed in Spain for ten consecutive years.

In addition, it has once again been the technology that has operated the most hours: 7,597 of the 8,760 hours of the year, which represents an operating factor of 86.72% in a year with six stops for refueling and with work shifts adapted to CoVid-19, which, fortunately, have not had an impact on our operation, a fact that highlights the management of the pandemic that has been carried out at the plants.

These figures confirm that for another year, in 2021, the nuclear industry has been a basic pillar of the stable and continuous operation of the electricity system in Spain.

We have produced 54,066 GWh net, which has accounted for 30.4%





The figures ratify that for yet another year, in 2021, the nuclear industry has been a basic pillar of the stable and continuous operation of the electricity system in Spain

of the emission-free electricity in Spain, preventing more than 20 million tons of CO₂.

All this highlights the importance of the nuclear industry for the decarbonization of the economy and for the fulfillment of energy sustainability objectives. Not only in Spain, but also globally.

The figures provided by the World Nuclear Association in its latest study confirm that we are facing a historic moment with the highest number of reactors under construction since 1986.

There are currently 55 new reactors under construction, representing an estimated investment of €275 billion, and another 100 reactors are planned.

According to data from the International Energy Agency, all this will mean an increase in installed nuclear capacity of 26% by 2050.

The energy transition towards a zero-emissions model along with

temporary factors such as the increase in the price of electricity and the fear of energy scarcity in some regions of Europe are generating a change in public opinion which increasingly considers nuclear energy as a valid and efficient resource to achieve environmental sustainability, guarantee of supply, and energy independence.

In addition, we must add the plan announced by France to strengthen its nuclear industry, the European Commission's proposal to include nuclear energy in the green taxonomy, technological advances around long-term operation, modular reactors, fusion...

And it is that, if we step away a little from our sad national panorama and take a little global perspective, it is easy to see that a paradigm shift is taking place with respect to the world energy model.

A change that we must take advantage of by strengthening our

outreach work for nuclear science and technology.

With all this, I also want to send you a positive and optimistic message in the face of that supposed "expiration date" that we have set and that, in my opinion, should be reviewed without delay.

It is time to demand that an adequate economic, fiscal, and legal framework be created, which allows for the continuity of the nuclear park in Spain. It is time to rethink the inertia inherited from the past and act with pragmatism so that scientific and technical reason prevail over ideologies.

All this, with the hope that Spain will be able to value an industry of great international prestige and take advantage of facilities in perfect operating condition capable of continuing to provide energy for many more years.

And who knows if in the not-too-distant future we may still be able to consider new investments in nuclear technology.

Thank you very much, and now I would like to give way to Jose Manuel Redondo who once again honors us with his presence at this Operational Experiences Session.



JOSÉ MANUEL REDONDO

DEPUTY DIRECTOR GENERAL
FOR NUCLEAR ENERGY FROM
THE MINISTRY FOR ECOLOGICAL
TRANSITION AND DEMOGRAPHIC
CHALLENGE

First of all, I would like to thank the Spanish Nuclear Society for the invitation it has given me to participate for yet another year, on behalf of the Ministry for the Ecological Transition and the Demographic Challenge, in this Session on experiences and perspectives of Spanish nuclear power plants.

As always, in addition to being a pleasure, it is an honor for me to participate in this Session where the plant Directors will tell us how their plants did last year. Unfortunately, we continue in this health situation from which we have not yet emerged, which prevents us from hosting this Session in person as we should.

As the data confirms once again,

in 2021, something has been fulfilled that, it can be said that since the end of the 1980s, has become a tradition, which is the fact that the energy generated by nuclear power plants has once again become a basic pillar in supplying Spanish society with something as fundamental as electricity, generating 20.8% of the electricity produced in our country.

As I have already pointed out on previous occasions, we must not forget that this percentage of energy has been supplied in the form of synchronous power; synchronous power that does not emit CO₂, something that is rarely emphasized.

If we talk about the Peninsular Electricity System, in 2021, the renewable component in the production mix reached 48.4%, which



meant that the percentage of production free of CO₂ emissions was 71.3%, obviously including nuclear generation, which, at the peninsular level, accounted for 21.8%, surpassed this year by wind energy with 24%.

Undoubtedly, these levels of production at our nuclear power plants, taking into account that their installed capacity is 6.3% of the total, are, once again, the result of the excellent work being done by the professionals who are part of the Spanish nuclear industry; I am referring to both those who are in charge of operating the plants and those who carry out their activity in the field of engineering and service supply companies.

I will now make the usual reference to the most relevant issues that have been carried out in the Sub-Directorate General for Nuclear Energy since the last Session on experiences and perspectives.

During this time, by means of an Order from March 17, 2021, the renewal of the Cofrentes operating license was authorized, which was granted until November 30, 2030, that is, for a period of 9 years and 8 months.

Likewise, through two Orders of September 27, 2021, the renewal of the operating license for Ascó I was granted until October 1, 2030, that is, for a period of 9 years, and for Ascó II until October 2, 2031, in this case, for a period of 10 years.

As you know, with these renewals, the provisions of the Protocol signed in March 2019 between Enresa and the owners of the plants, which is based on the Integrated National Energy and Climate Plan 2021-2030, are being complied with.

Once the renewals of the licenses for Almaraz I and II, Vandellós II, Cofrentes, and Ascó I and Ascó II have been approved, the next renewal will be for Trillo, whose license expires on November 17, 2024.

Regarding this plant, it should be noted that, in accordance with the provisions of the 2014 Order, by which the renewal of its license is granted until November 17, 2024, in theory, its owner had to submit the request for renewal 3 years in advance; that is, before last November 17.

However, as this date was approaching, on October 29, CNAT requested that the Ministry, taking into account the precedents regarding

the rest of the plants in terms of the periods between the presentation of the renewal request and the license expiration date, that the necessary provisions be adopted so that the application for the license renewal could be presented "only one year in advance." Likewise, CNAT referred to the uncertainties that were raised regarding the economic viability of the plant for the period for which the renewal was sought.

Taking this request into account, by means of an Order dated November 15, it was established that CNAT could submit the renewal request at the same time as the presentation of the Periodic Safety Review for the plant, established by the Nuclear Safety Council on November 31 March 2022, that is, a little more than one year and seven months before the expiration date of the current license.

On the other hand, with regard to the 7th General Radioactive Waste Plan, the draft of which was presented by Enresa in March 2020, the next procedure ahead of us is that of public information and consultation with interested parties in relation to its Strategic Environmen-



The production levels of our plants are, once again, the result of the excellent work carried out by the professionals who form part of the Spanish nuclear industry

tal Assessment, which is expected to be launched soon. If these expectations are met, this 7th GRWP could be approved in just over a year.

Regarding the decommissioning of Garoña, last May Enresa submitted a request for authorization of phase 1 of this decommissioning to the Ministry. Given that the plant's spent fuel is currently in the pool, to apply the alternative provided for in the Regulation on nuclear and radioactive facilities, Enresa has submitted a Spent Fuel Management Plan which must be approved by the Ministry, following a report from the Nuclear Safety Council.

This phase 1 of decommissioning has an expected duration of 3 years and the main activities that will be carried out in it will be: the loading of the spent fuel in containers and their transfer to the ITS, and the dismantling of the turbine building to be converted to an auxiliary decommissioning building, necessary for the execution of phase 2.

The public information and consultations for the Environmental Impact Assessment for phase 1 began on March 16 and, after receiving the evaluation report of the observations presented on October 22 from Enresa, we sent the file to the General Directorate for Quality and Environmental Assessment to issue the corresponding Environmental Impact Statement.

Subsequently, phase 2 of the decommissioning must be authorized, which will also have an associated Environmental Impact Assessment, and which is expected to start in 2026. This phase has an estimated duration of 7 years and in it the dismantling of the reactor will be carried out as well as of the rest of the buildings with radiological implica-

tions, continuing with the activities for decontamination, declassification, and demolition of buildings, concluding with the environmental restoration of the site.

On the other hand, within the actions related to the transposition of Directive 2013/59/Euratom which es-

tablishes basic safety standards for protection against the dangers arising from exposure to ionizing radiation, the two most important standards that we are working on are:

- the Royal Decree approving the Regulation on Health Protection against risks arising from exposure to ionizing radiation, which will repeal the current regulation approved in 2001, and
- the Royal Decree approving the Regulation on nuclear and radioactive facilities and other activities related to exposure to ionizing radiation, which will replace the





The European Commission's position is that, with current technology, without the participation of gas and nuclear power, the transition to carbon neutrality that has been set as a goal for 2050 cannot be achieved

current Regulation on Nuclear and Radioactive Facilities, approved in 1999.

We tentatively expect to have the Health Protection Regulation approved before next summer and the revision of the current Regulation on Nuclear and Radioactive Facilities before the end of this year.

I would not like to conclude without referring to a term that has recently acquired particular relevance when talking about nuclear energy: I am referring to "taxonomy."

From my point of view, I do not think that it makes much sense to dwell on the idea of whether nuclear energy is green and renewable or not. For me, it is evident that it is not, since, if it were,

among other things, it would not be necessary to have a General Radioactive Waste Plan, nor would we have spent the time we have spent without revising the plan that was approved in 2006.

Perhaps someone could think that, in the future, nuclear energy could be considered renewable if technological advances are made that allow for the development of advanced nuclear fuel cycles where more fissile material is produced than is consumed and even substantially reduce the radiotoxic load of the waste that is generated, but, today, I think that those of us who work in the nuclear sector are aware that there is still plenty of time to make these developments commercially viable.

What is clear to me is that today, if we are talking about achieving the objectives of decarbonization of the economy in the European Union that have currently been set, then nuclear energy is a strategic technology, since I am of the opinion that, unless there is a disruptive technological development in terms of massive electricity storage or hydrogen generation through renewable sources, nuclear energy will continue to play this strategic role in the supply of electricity in the European Union.

In short, what the European Commission is proposing is not that gas and nuclear energy should be green and renewable, but rather that, with current technology, without the participation of gas and nuclear energy it is not possible to make the transition to that carbon neutrality that has been set as an objective for 2050. In this regard, and as a more recent reference, it should be noted that last February in Spain, nuclear generation was the energy that contributed the most to production with 22.6% of the total while combined cycles supplied 22.5% and wind power supplied 22.1%.

However, although as far as gas is concerned, I do not have to remind you which are the countries that you have to go to in order to dispose of it because, for the very sad reasons that are on everyone's mind, this is something that is constantly being talked about in the media, as far as uranium is concerned, I have to tell you that, in terms of foreign dependency, European countries do not have much left over, since, as I am sure many of you already know, specifically, as far as Spain is concerned, Russia supplies us with around 30% of the enriched uranium consumed by our plants.

And to conclude, I can only reiterate my appreciation to the professionals who over the past year have contributed with their work, their knowledge, and their dedication so that nuclear energy has maintained the leading role it has had in recent years in the Spanish electricity supply.





First Session



RAFAEL CAMPOS
DIRECTOR OF THE ALMARAZ
NUCLEAR POWER PLANT

2021 ACTIVITIES

The Almaraz Nuclear Power Plant units generated a total of 15,838 million kWh during the year 2021, with two stops for refueling. Between both units, they accumulated a gross production of 577,364 million kWh at origin. Almaraz Nuclear Power Plant continues to provide electricity for yet another year, accounting for more than 6.16% of national electricity consumption.

During 2021, there were no accidents with sick leave or without sick leave at the Plant, neither among its own personnel nor from collaborating companies, closing the year with the best accumulated historical data of 865 days and 5.7 million hours worked without accidents with sick leave, having undertaken three refuelings during this period.

By Unit, the main activities included the following:

Unit I

The most notable activity was the stop for the twenty-eighth refueling and maintenance, carried out from November 21 to January 9, 2022, with a duration of 48 days. During this stop for refueling, more than



13,000 preventive maintenance activities were carried out and 23 design modifications were implemented, most of them linked to requirements and commitments with the Nuclear Safety Council. During this period of maximum work activity at the Power Plant, more than 1,100 additional workers joined the plant, most of them from the municipalities in the area closest to the facility, a large part of the protection measures against COVID-19 that had already been implemented in previous refuelings to protect people from the risk of contagion by coronavirus were maintained and enforced.

As for power reductions to be considered, there was a single load reduction in February to 65% at the request of the Central Delegate Generation Office due to flexible operation.

On the other hand, it should also be noted that May 1, 2021 marked



Moderated by
ENRIQUE GONZÁLEZ
VOCAL of the SNE

the 40th anniversary of the first connection to the electrical grid for Unit-I, reaching the second-best record of 513 days of uninterrupted connection to the grid.

The gross electrical energy generation for U-I was 8,008.86 million kWh, with the accumulated production at origin of 290,416.67 million kWh.



Unit II

Unit II was operating stably throughout the period, except for the automatic shutdown of the reactor on July 8 as a result of a ground signal that caused the opening of a switch, and the next day it was reconnected to the electrical grid.

During the first two days of February, at the request of the Central Generation Office, the load was lowered to 75% due to flexible operation.

On March 13, the 26th refueling began until April 24, with a duration of 42 days.

Gross electrical energy generation was 7,828.13 million kWh, accumulating 286,948.79 million kWh at origin.

OTHER ACTIVITIES

- During the week of September 20 to 24, 2021, the joint Emergency exercises with the UME at the Almaraz Nuclear Plant took place. 150 troops, 17 mobile units, and 2 helicopters were mobilized with the assistance of the Chief of Staff of the UME and the Chief of the

Emergency Intervention Battalion, and the exercises were performed in 6 simultaneous scenarios.

- It should be noted that, during the last cycle of Unit-I, the second-best record was achieved with 513 days of uninterrupted connection to the network and during this year there were no occupational accidents with sick leave or without sick leave at the Power Plant, both for its own personnel and for personnel from collaborating companies.
- During this year 2021, a total of 1 container of fuel elements were loaded into the ITS. On April 6, the sixth ENUN 32P container loaded with 32 spent fuel elements was transferred from the Unit I Fuel Building to the Individualized Temporary Storage facility.

TWENTY-EGTH UNIT-I REFUELING

As previously mentioned, this stop for the twenty-eighth refueling and maintenance took place between November 21 and January 9, 2022

with a small shift in the initial calendar to try to minimize the overlap with the refueling of Ascó 1 and Cofrentes, thus contributing to the sustainability of the electrical system in a complicated environment such as the one existing at that time.

To a great extent, it was affected by the availability of the specialized personnel that usually participate in the execution of the activities, and for this reason, it was necessary to adapt and replan because, for safety reasons, it was necessary to have a smaller number of contracts to guarantee the protection of workers against possible contagion by coronavirus, reinforcing all prevention measures, distributing workers in shifts to reduce the number of people with simultaneous presence in the plant, limiting capacity in shared areas, providing them with the protection necessary to carry out tasks safely (respiratory protection, face shields, etc.).

The most notable activities carried out during the refueling stop included the following:





- Loading of fuel elements for the reactor core.
- Implementation of the design modification consisting of the installation of the permanent cavity sealing ring.
- UT inspection of welds in nozzles for hot and cold branches of the reactor vessel.
- Remote visual inspection of the welds for the penetrations and the lower interior of the vessel.
- Inspection by induced currents of the three steam generators.
- Maintenance of diesel generators 1 and 3.
- Replacing the residual heat pump motor assembly A.
- Installation of the new passive seals for the three main pumps.
- Replacement of stop valves C and D for the high pressure turbine.
- Connection of the new Taprogge system for the CC/SW changers
- Replacement of the three pressurizer safety valves.
- General checking of motor pump A with auxiliary power AF.
- General checking of the main feed water turbopump A FW.
- Implementation of 23 design modifications.

TWENTY-SIXTH UNIT-II REFUELING

As previously mentioned, this stop for the twenty-sixth refueling and maintenance of Unit-II took place between March 13 and April 24. During it, a smaller number of contracts than usual was carried out and all prevention measures were

reinforced to protect people from the risk of contagion by coronavirus, distributing work in shifts to reduce the simultaneous presence in the plant, limiting the capacity in shared areas, and bunkering the control room.

The most notable activities carried out during the refueling stop included the following:

- Loading of fuel elements for the reactor core.
- Execution of more than 16,000 work orders, compared to the usual 11,000.
- UT inspection of the vessel bottom penetrations
- Ultrasound inspection of 50% of the threaded areas of the vessel.
- Visual inspection of the welds for the hot branches of the vessel and steam generators.
- Induced current inspection of 33% of the pipes for the three steam generators.
- Checking the seals for the three main cooling pumps.
- Replacement of the radial bearing and checking of the main pump shaft number 2.
- Replacement of the three pressurizer safety valves.
- Checking the stop valves and loop C control for the high pressure turbine.
- Implementation of 23 design modifications linked to requirements and commitments with the CSN.

REPORTABLE EVENTS

In 2021, the regulatory body (Nuclear Safety Council) was notified

of 2 24-hour events for Unit-I and 1 24-hour event and another 1-hour event for Unit-II, all level zero on the INES scale (without significance for safety). The list of these events show below.

INTERNATIONAL MISSIONS

From November 23 to December 2, the Corporate Peer Review took place at CNAT where an external and independent team of specialists from various countries identified areas for improvement and also strengths in CNAT's corporate organization with the aim of continuing to improve the safety and reliability of facilities.

CHALLENGES 2022

During this year 2022, the main challenges to be undertaken by the Plant are to continue with the actions associated with the most outstanding Project for the facility (ZERO ACCIDENTS), the execution of the 27th Refueling for Unit II during the months of September-November, the Refueling Reliability program, the Forecast Plan for the operational experience program, continuing to load spent fuel containers at the ITS, the implementation of design modifications associated with the renewal of the Operating License, as well as the Wano Follow Up Mission for the Peer Review that took place 2 years ago.

All this will be achieved thanks to the work and commitment of the excellent team of professionals that make up the Almaraz Nuclear Power Plant and CNAT.

UNIT I			
REFERENCE	DATE	TYPE	DESCRIPTION
ISN1-21/001	08/03/2021	ISN 24 HOURS	Presence of borated water in the surrounding shell of the ENUN-A1-03 (AFK6) container
ISN1-21/002 (COMÚN)	26/04/2021	ISN 24 HOURS	Identification of fraudulent documentation from Yokogawa Spain registrars
UNIT II			
REFERENCE	DATE	TYPE	DESCRIPTION
ISN2-21/001 (COMMON)	26/04/2021	ISN 24 HOURS	Identification of fraudulent documentation from Yokogawa Spain registrars
ISN2-21/002	08-07-2021	ISN 1 HOUR	Automatic action of the SSPS (automatic shutdown of the reactor)



FRANCISCO JAVIER VALLEJO

DIRECTOR OF THE TRILLO
NUCLEAR POWER PLANT

OPERATIONS SUMMARY 2021

The Trillo Nuclear Power Plant generated a total of 7,929 million kWh in 2021. It accumulated a gross production of 271,953 million kWh with a total of 260,589 hours connected to the Spanish electricity grid until December 31, 2021. Trillo Nuclear Power Plant continues to contribute more than 3% of the national electricity consumption and 32% of the electricity generated in Castilla-La Mancha during 2021.

The Trillo Nuclear Power Plant operated stably during 2021.

However, on January 30 and February 1, the power of the Plant was reduced at the request of the load dispatch; from February 16 to 27, it was necessary to stop the Plant to repair the TF30S014 valve. On May 16, the reactor was shut down to repair the AT02 transformer.

On May 18 at 7:00 am, the R433 Refueling began. During the month of June, the Plant continued to stop for refueling until the 23rd, operating at 100% power as of the 26th of June.

OTHER DATA OF INTEREST

The heavy snowfall that fell in the province of Guadalajara on January 8, 9, and 10 as a result of the Filomena storm tested the protocols provided for in these cases at the Trillo Power Plant. Thanks to the op-



eration put in place, the Plant operated normally and no personal or material damage was caused.

In 2021, there was one accident with sick leave.

In 2021, no ENUN32P containers were loaded into the ITS. As of December 31, 2021 there were 36 containers in the ITS, of which 32 are DPT and 4 are ENUN32P. In 2022, the loading of 2 containers is planned.

33RD REFUELING

On May 18, the Trillo Nuclear Power Plant began its thirty-third shutdown for Refueling and General Maintenance. After 36.4 days of work, the Plant reconnected to the network on June 23.

To support the regular workforce in carrying out the work, the services of more than forty specialized companies were contracted, employing more than a thousand workers, most of whom come from the area around the Plant. To minimize the staff at the Plant due to

COVID19, they were organized into different shifts and work schedules.

The most notable activities carried out during the refueling stop included the following:

- Replacement of 40 fuel elements.
- Inspection by induced currents of the control bars.
- Replacement of the main pump motor 10 for preventive maintenance.
- Redundancy battery capacity test 1/5
- Electrical and mechanical review of redundancy 3/7.
- Replacement of the TA11B001 high pressure cooler.
- Containment enclosure integrity test.
- Valve inspections were carried out in the turbogroup for preventive maintenance.

RELATIONS WITH THE CSN

The data from the SISC Integrated System (Integrated Power Plant Supervision System) shows that the Trillo Power Plant has all the indicators



in green and no finding detected in 2021 was above green.

In 2021, the regulatory body (Nuclear Safety Council) was notified of 7 events, all at level zero on the INES scale (without significance for Safety) with the exception of the one referred to ISN-21/005 classified as INES 1.

INTERNATIONAL MISSIONS

From November 23 to December 2, the Corporate Peer Review took

place at CNAT in which an external and independent team of specialists from various countries identified areas for improvement and also strengths in the corporate organization of CNAT with the aim of continuing to improve the safety and reliability of facilities.

CHALLENGES 2022

During this year 2022, the main challenges that the Power Plant is going to undertake are to continue with the actions associated with the most

outstanding projects: ZERO ACCIDENTS, the Plan for the Future of the Trillo NPP, the execution of the 34th Refueling during the months of May and June, the Refueling Reliability program, the large equipment upgrade plan, continuing to load spent fuel containers at the ITS, and the WANO Peer Review.

All this is intended to be achieved thanks to the work and commitment of the excellent team of professionals that make up the Trillo Nuclear Power Plant and CNAT.

Second Session



JAVIER SALA

DIRECTOR OF THE COFRENTES
NUCLEAR POWER PLANT

2021 RESULTS AND MILESTONES

I will comment on the most important results and milestones for 2021 at the Cofrentes plant.

We will begin by talking about the nuclear safety results provided by our regulator, the Nuclear Safety Council.

Both the indicators and the findings remain in a green status, that is, the best status for nuclear safety.

It is important to highlight the trajectory of Cofrentes in this regard, since, for more than ten years, it has systematically remained in the green, in the Integrated Plant Supervision System owner's response column.

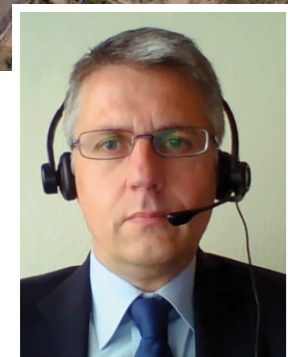


EVENTS REPORTED

In the area of Events Reported in 2021, Cofrentes reported eight events.

Four of them correspond to momentary unavailability of systems considered as a single issue, which were resolved immediately.

In the month of May, we reported the activation of the fire detection system due to the overheating of a contactor in the E51F078 valve



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LAURENT BROCHET

VOCAL of the SNE



Vessel internals inspections and dry pipe replacement.

motor panel. Immediately our fire brigade went to the area and confirmed that there was no fire, that it was simply a contactor that was slightly blackened.

The incident was reported, and it was subsequently verified that this valve could have been actuated manually, but not automatically. The incident was categorized as an anomaly or Level 1 on the INES Scale.

OPERATIONAL EXPERIENCE

Cofrentes had a very good streak, twelve years and four months without automatic shutdowns of the reactor.

On September 9, 2021, while carrying out maintenance work on some valves for the Feed Water System, there was a slight decrease in the level of the reactor and the protections were triggered, causing it to automatically stop.

On September 11, during the start-up process and with the reactor still subcritical, the reactor protection was activated on the intermediate-range monitors.

On December 15, after refueling, it was necessary to manually shut down the reactor to resolve an

anomaly when the plant was at 26% power during the startup process.

The summary of events reported in the year was seven at level 0 (no safety significance) and one as an anomaly at level 1 on the INES scale.

OCCUPATIONAL SAFETY

In the area of occupational safety, the first thing is to congratulate the Almaraz nuclear power plant for the results it has shown, which are truly magnificent, and which we would like to achieve for Cofrentes at some point.

At Cofrentes, in 2021, if we compare ourselves with any industry outside nuclear power, the accident rate data would be magnificent, with a **Frequency Rate of 1.61 and a Severity Rate of 0.22 in the year**, but at Cofrentes we want to achieve zero accidents.

During the year, we had three accidents with sick leave, two without sick leave, and 46 incidents. We came from three years ago where our results were unbeatable, and yet now we are seeing that there is a small adverse trend. In this regard, we are taking action, and we are going to try to reverse this

trend, focusing on monitoring and being vigilant to prevent all unsafe situations.

RADIOLOGICAL PROTECTION

When referring to Radiological Protection, I always like to focus on three aspects: the protection of workers, the protection of the public, and the protection of the Environment.

In the area of the protection of workers, we are observing a very good trend thanks to our Dose Reduction Master Plan, with which we are achieving lower collective doses both during operation and when refueling.

In 2021, the target set for the plant in normal operation was 295 mSv, and we achieved a result of 193 mSv. For the Refueling, we had set 1,930 mSv per person and we reached a result of 1,550, without exposures or contaminations.

In the area of impact on the environment and impact on the public, we must highlight the normality of our processes. Our Environmental Radiological Monitoring Program, ERMP, verifies that year after year the impact of Cofrentes on the environment is negligible.

We also calculated the dose that, due to our activity, an individual living near Cofrentes would receive, and in this case, compared to the legal limit of 1,000 μ Sv, a real person would have received 0.14 μ Sv, that is, very good results in this regard.

In parallel with these processes, another example of respect for the Environment created by Cofrentes is that we have had no environmental incidents, an aspect that we have framed in our Environmental Management Program certified with the EMAS III regulations.

ELECTRICITY GENERATION 2021 - RELIABILITY

Our mission is to generate electricity, which also allows us to provide reliability to the National Electric System.

In 2021, we generated 8,069 GWh with a Capacity Factor of 89.01%, that is, almost 90% of the total energy that we could deliver, even



Spent fuel loading equipment next to the first five loaded casks.

though it was a year with a scheduled Refueling stop.

Our Unscheduled Unavailability was 1,046 (very low) and our **Operating Factor**, that is, the time we were connected to the network, **was 90%** of what is possible.

This data is remarkably good for a year with Refueling and demonstrates the sustained reliability of our plant since it is the best data since 2004 in a Refueling year.

OPERATING LICENSE RENEWAL - 2030

There are two other very relevant milestones in 2021 for Cofrentes. One of them is that on March 17 we received the Operating License from the Ministry of Ecological Transition and the Demographic Challenge, previously favorably assessed by the Nuclear Safety Council,

which granted us an operating permit until November 2030.

This renewal was linked to the action plans associated with the Periodic Safety Review (PSR) and the Integrated Aging Management Plan (PIEGE).

SPENT FUEL MANAGEMENT

Another of the relevant milestones of the period has been the management of spent fuel. In 2021 we obtained the authorization for the commissioning of the Individualized Temporary Storage (ITS), and we completed the loading of five containers with a great job by the entire team which in the end allowed us to start refueling without space limitations in our pools.

As an equally important milestone, it should be noted that as of 2026 we will have to adapt to the homogeneous container currently being tendered by Enresa.

23rd REFUELING

At Cofrentes, we carried out the Refueling in the final stretch of 2021.

As relevant aspects to highlight: the temporary hiring of 1,200 external people from more than 100 companies with whom we carried out 25 design modifications and more than 10,000 tasks.

The most relevant activities were vessel unclogging, vessel internals inspections, dry pipe replacement, checking the SRV and MSIV valves, the replacement of the Low Pressure Turbine Rotor "B," the modernization of the Fire Protection System, refurbishment of the Generation Switch, etc.

All these activities require great coordination, training, preparatory meetings, supervision, and conveying of expectations for their proper execution.

SAFETY AND QUALITY: 23rd REFUELING OBJECTIVES

It is very gratifying when a refueling is finished, to feel proud of the results obtained. We have satisfactorily covered the eight objectives for Safety and Quality established for the refueling. We have complied with occupational accidents with sick leave, the nuclear safety objectives, and the collective dose objectives. There were no significant incidents. We stuck to the program. The energy losses due to the probable association with the Refueling were lower than those foreseen as a target, and we have complied with the scope of work and design modifications that we had planned.

RELIABILITY: WANO 3Q 2021 PERFORMANCE INDEX INDICATORS

Finally, there is a piece of information that summarizes the good performance of Cofrentes, and it is the combined indicator that WANO uses with all the plants worldwide. This incorporates aspects of Occupational Risk Prevention, Reliability, Radiological Protection, and Fuel Reliability, among others, and Cofrentes, for several years now, has been at 100% thanks to the efforts of the entire team.

These results have been obtained thanks to the FANTASTIC HUMAN TEAM that we have at the Cofrentes Nuclear Power Plant.

Nada de lo que hagas hoy en esta Central será tan importante como volver a casa con tu familia.

Nothing you do on this Station today will be as important as going home to your family.

Safety first!

¡La seguridad es lo primero!

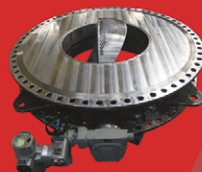
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DOEL, Thiange, **Bélgica**
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Krsko, **Eslovenia**
Trillo, **España**
Almaraz I & II, **España**
Vandellós II, Asco I & II, **España**
Zorita, Garoña, Cofrentes, **España**



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Third session



**ANTONIO
MARTINAVARRO**

DIRECTOR OF THE VANDELLÓS II
NUCLEAR POWER PLANT

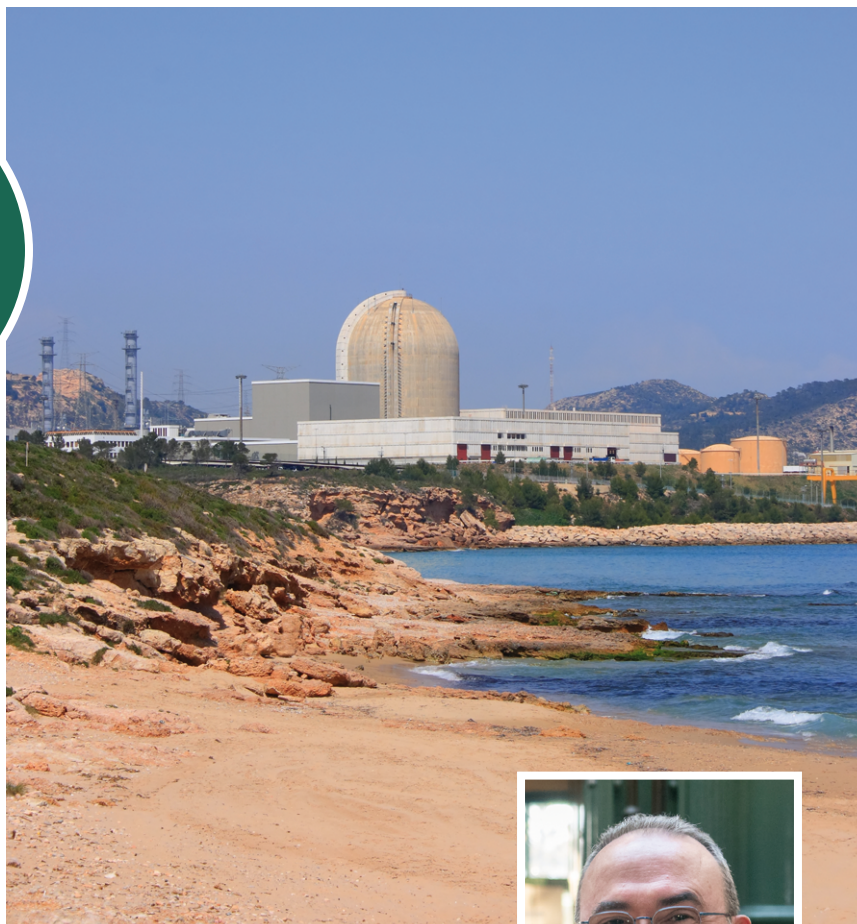
SAFETY

In 2021, following the protocols established in Safety Instruction IS-10, the Vandellós II nuclear power plant notified the Nuclear Safety Council (CSN) of a total of 6 notifiable events, all of them classified at level 0 of the INES scale except for 1 INES 1 event.

On the other hand, as far as occupational accidents with sick leave are concerned, the **general frequency rate stands at 0.97%** compared to 1.79% in 2021.

PRODUCTION

In 2021, the Vandellós II nuclear power plant recorded **a load factor of 85.85%**. The plant had an automatic shutdown on April 28 due to a malfunction in the voltage regulator as a result of an electrical transient originating outside the facility, and between May 15 and June 23 it had a scheduled shutdown to perform its 24th Refueling.



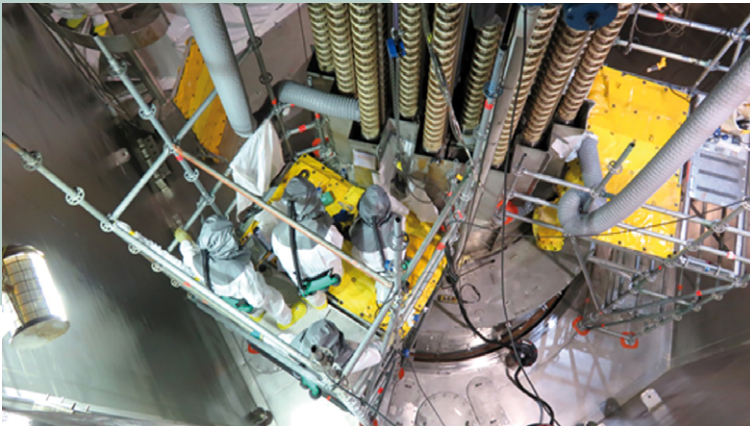
OPERATIONAL EXPERIENCE

In 2021, Vandellós II NPP replaced the wiring and connectors for the intranuclear thermocouples that monitor the temperature inside the core in order to improve the reliability of the ICCMS (Inadequate Core Cooling Monitor System) by eliminating defects in the connectors. With this work, by recovering non-sectioned thermocouples, a greater margin was gained for compliance with the technical operating specifications, while the connections and wiring have been simplified and the plant has increased its robustness and operational safety since the new arrangement allows for fewer actions, shorter handling times, and lower doses to personnel.



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**EDUARDO
GALLEGO**
VOCAL of the SNE

Another important experience in 2021 was related to the effects of the November maritime storm on the facility, especially in the part most connected to the Mediterranean Sea, with special attention to the effects on the pump house, the damage to grids, and the accumulation of algae in the condenser water boxes.

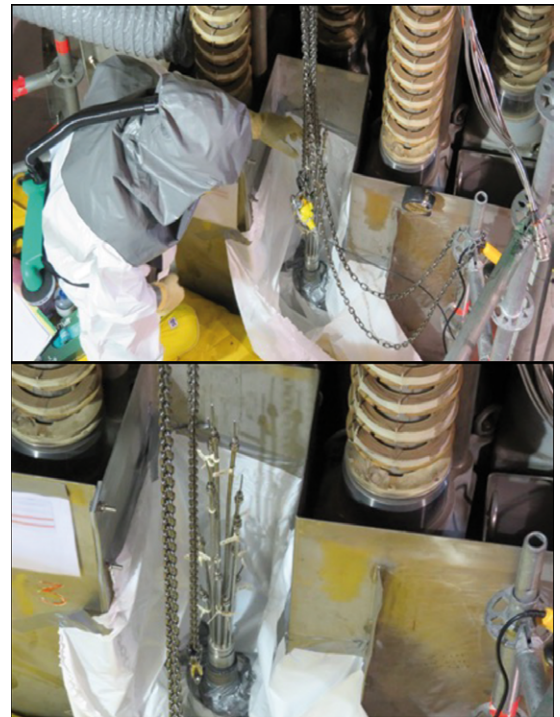


OUTLOOK 2022

The main challenges for the year 2022 at the Vandellós II nuclear power plant are specified in the preparation of a new WANO Peer Review mission and the preparation for the 25th Refueling, which will take place in the fall. The plant continues to work hard to improve its operational reliability with specific plans aimed at detecting and resolving equipment obsolescence problems and strict compliance

with the facility maintenance plan.

Vandellós II continues to prepare for the future entry into so-called long-term operation, and for this purpose, it is working on the upcoming incorporation of improved technical operating specifications and life management programs for its structures, systems, and components in accordance with the



provisions of the recent periodic safety review which extended its operating license until the year 2030.

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NUCLEAR ENERGY**

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**JORDI
SABARTÉS**

DIRECTOR OF THE ASCÓ
NUCLEAR POWER PLANT



SAFETY

In 2021, following the protocols established in Safety Instruction IS-10, the Ascó nuclear power plant notified the Nuclear Safety Council (CSN) of a total of 9 notifiable events, 5 corresponding to Unit I and 4 to Unit II. All of these were classified at level 0 on the INES Scale, with the exception of an incident corresponding to an automatic shutdown of the turbine caused by the shutdown of the two main feedwater turbopumps that took place in April in unit I and that was classified at level 1 on the INES Scale.

In terms of occupational safety, the overall frequency rate with sick leave stands at 3.31 in 2021.

PRODUCTION

With regard to production during the year, the Ascó I NPP reached a load factor of 81.25%, registering four brief unscheduled stops and two scheduled stops, one of which corresponded to the 28th refueling (October 16 to December 5). Among the relevant projects that were carried out, in addition to the refurbishment of 64 of the 157 elements that make up the reactor core, various activities carried out in the primary circuit stand out, such as the remote visual inspection of the outside of the vessel and the lid as well as the external inspec-

tion of the penetrations of the bottom of the vessel. The inspection of pipes by induced currents in the three steam generators and the replacement of the motor of one of the reactor coolant pumps were also carried out. Other outstanding works were the replacement of the insulation heat exchangers for the safeguard trains and the replacement of the engine of one of the emergency diesel generators for the facility.

With regard to Ascó II, the plant reached an annual load factor of 98.73%, registering an unscheduled shutdown due to a malfunction of the alternator voltage measurement loop.

OTHER SIGNIFICANT MILESTONES

On October 1, the Ascó NPP obtained the renewal of the Operating License for its two units until the year 2030 for Unit I and until 2031 for Unit II. This new license is undoubtedly a recognition of the road traveled and our daily effort, and it also represents a future expectation for the new generations that have been joining our organization as staff and as collaborators.

Likewise, the plant hosted an IAEA SALTO Mission in July in which 11 experts from 8 countries partic-

ipated and evaluated the status of the actions undertaken by ANAV to operate the Ascó NPP beyond the life established in its initial design. This mission, requested by ANAV, has had at the Ascó NPP the first Spanish nuclear power plant to be presented for an international evaluation of these characteristics. Among the main results and recommendations, it should be noted that the IAEA team confirmed that ANAV has a good basis to complete the activities related to LTO and is suitably prepared for safe long-term operation.

OUTLOOK 2022

The Ascó NPP will face significant challenges during 2022 led by the 27th Refueling of Unit II. The plant will continue with the spent fuel loading plan for the Individualized Temporary Storage (ITS) and will begin to apply the commitments assumed in the framework for the periodic safety review that has served as the basis for the renewal of the operating license and that includes about 500 actions. In the field of preparation for long-term operation, the Ascó NPP will begin the implementation of the Action Plan derived from the SALTO Mission and will continue working on its management plans for the obsolescence of equipment and the aging of structures, systems, and components.

MAINTENANCE AND SUPPORT SERVICES FOR OPERATION OF THERMAL, HYDRAULIC AND NUCLEAR POWER PLANTS

SERVICES

- Component maintenance
- Operational support services
- Support services for stops and refueling
- Plant decommissioning

ACTIONS

- Preventive, predictive and corrective maintenance
- Design modifications
- Auxiliary activities in the NSSS
- Boiler and turbine adjustments

REFERENCES

- Almaraz 1 & 2 NPP
- Cofrentes NPP
- Trillo NPP
- Vandellós 1 & 2 NPP
- Ascó 1 & 2 NPP
- Sta. M^a de Garoña NPP
- José Cabrera NPP
- Valdecaballeros NPP
- Andújar Uranium Plant
- Escombreras TPP
- Castellón TPP
- Aceca TPP
- Escatrón TPP
- Escucha TPP
- Alcodia TPP
- Velilla TPP
- Narcea TPP
- Elcogas TPP
- Los Barrios TPP



Closing Session



EMILIO MÍNGUEZ
VICE-PRESIDENT OF THE SNE

By way of summary, obviously, I cannot synthesize the entire amount of information that the plant directors have given us. First of all, we would like to apologize for any difficulties we have had with the connection. Secondly, of course, I would like to join the support of our colleagues from the Ukrainian Nuclear Society, the Ukrainian nuclear sector, and especially the Ukrainian power plants and, in general, also the population of Ukraine. Wish-

ing that this situation, which was unimaginable in this century a few months ago or even a few days ago will soon come to an end. I would also like to remind you that this annual Session on Operational Experiences will have a second part which we would like to have in-person and that will be announced shortly.

As I said, without going into detail, the length and intensity of the directors' messages have been very clear and very comprehensive. In the first place, despite working in a COVID environment, they have managed to achieve 20.8% nuclear generation with an installed power of only 6.5% and with an operation factor that has practically reached 90% (up to 87%), taking into account, in addition, that refuelings were carried out at three plants in 2021 (Almaraz I, Ascó I and Cofrentes), and that in addition, given the timing of the refuelings, there was excellent communication between the different participants, both from the plants themselves and external participants, and excellent

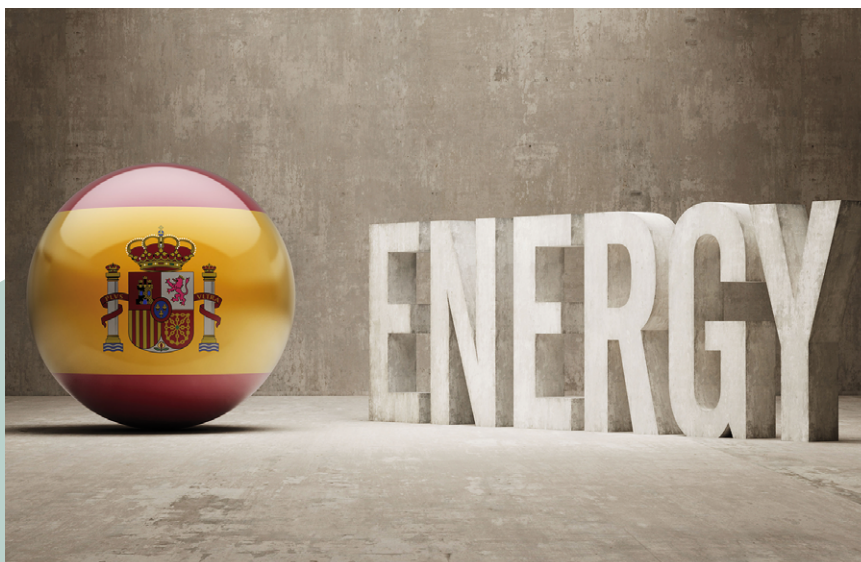
planning was achieved trying to avoid not having 3000 megawatts connected to the network and, furthermore, without emitting CO₂.

We have had, as I have said, very clear and comprehensive information on the various activities carried out at each plant, for the refuelings that have been carried out, those that are in preparation for refueling in 2022, inspections, reportable events, action plans to increase reliability and reduce or eliminate unscheduled shutdowns and, in some cases, emergency exercises carried out jointly with the Military Emergency Unit (UME), as has been the case at Almaraz.

After the explanations given, the nuclear safety and radiological protection for both the plant personnel and the external personnel and the environment have been excellent and are unquestionable. And, in addition, we have to highlight occupational safety in general in all plants, and the fact that there was only one minor occupational accident is a reason to take action to reach the objective of zero accidents.

We cannot forget to make a special mention of Francesc and to give Jordi a lot of encouragement, and to pass it on to all his colleagues for that accident that occurred at the Ascó plant.

This shows us the excellent quality and commitment of the professionals in the nuclear sector and also of the companies related to plant operations and maintenance. The human team at our plants is excellent, and from the Spanish Nuclear Society, we would like to thank them for their dedication, professionalism, and commitment, especially in the conditions we have had to experience in the year 2021 and that, with their work, plant operation has been maintained uninterrupted.





In spite of working in a COVID environment, nuclear generation has reached 20.8%, with an installed power of only 6.5% and an operating factor that has practically reached 90%

With this review of the status of our plants in 2021, we can say that their health and commitment are excellent, so not only has CO₂ emission been avoided, there has been a high number of hours of operation, and we can say that, in line with the excellent news of including nuclear energy in the taxonomy, it shows that this is imperative and essential to reach zero carbon emission levels and face the challenges of climate change.

With regard to the energy transition, given the current energy crisis, we believe that it is necessary to review and extend the deadline for the closure and activity periods of the plants, as well as other fiscal aspects in order to achieve decarbonization levels.

And, finally, I would like to thank, of course, the Deputy Director of Nuclear Energy, José Manuel Redondo, for offering his time for this important day; to the directors of the plants, Rafael, Francisco Javier, Antonio, Javier, and Jordi for

your excellent presentations and for your dedication yet another year to update us on the status of the Spanish nuclear power plants; to the moderators Enrique, Lauren, and Eduardo, and above all, of course, to the entire Programs Commission, especially Amparo and Eva, for preparing this conference, and I am sure that they are preparing its second part, which will surely be before the summer.

And that's all. I would just like to thank all of you who have connected and have followed this session. And I'll give the floor to Professor Javier Díez, Commissioner of the Nuclear Safety Council, whom I would like to thank on behalf of the Nuclear Society for his presence once again at this session to proceed with the closing.



JAVIER DÍEZ

JAVIER DÍEZ NUCLEAR SAFETY COUNCIL BOARD MEMBER

Distinguished authorities, distinguished friends,

Thank you for inviting the Nuclear Safety Council (CSN) to this Session on operational experiences in which I am going to present three points:

TRANSITION AT THE CSN

As you know, recently we have been in a transition period at the CSN, the President, Jose Maria Serena, is leaving us for personal and family reasons. From here I wish to express my gratitude to you for

the multitude of hours you have dedicated to the Council during these three years.

He chaired the Plenary during a time when it was possible to carry out 6 PSRs – and 6 RAEX, and also on time, and in the midst of two years of confinement. A task that did not seem easy.

I also would like to thank him for his important impulse to improve efficiency and effectiveness at the CSN. Yesterday we were in a meeting with several of you, where Council technicians presented us with a Pert diagram made with Microsoft Project, and it was indicated that the critical path for that project had to be calculated. These topics are new to the Council.

Looking ahead, the CSN statute establishes that the longest-serving director automatically assumes the acting presidency. And that is me. This will be formalized at an upcoming Council of Ministers.

These transitional periods can last one or two months, until the new President is appointed, according to the process established in the Council statute which requires an

appearance in the Congress of Deputies.

From the plenary session of the Council, the 4 board members are going to try to ensure that the machinery does not stop and that we continue to function.

PROJECTS IN THE LICENSING PROCESS

- Decommissioning of the Garoña nuclear power plant. We are going to see if now that we don't have any PSRs coming up if we can speed up this issue.
- The High Technology Investment Plan (INVEAT) represents "an unprecedented renovation in the National Health System (SNS)." "795 million euros will be distributed among the autonomous communities to acquire 850 high-tech radiotherapy units which will allow health centers to update their technological equipment, improving the diagnostic and therapeutic capacity for patients with different types of cancer, including childhood cancer." This requires a major effort to license this equipment on time.
- On the other hand, the Amancio Ortega Foundation has made



a donation that will allow the SNS to have 10 proton therapy devices. With this, Spain will be an international benchmark for this type of therapy. The most important aspect of this initiative is the realization of less invasive treatments. Until a couple of years ago, there was no proton therapy facility in Spain and now there are two in operation that, with this donation from the Amancio Ortega Foundation, will become 12.

All this equipment must be licensed by the Nuclear Safety Council, and once it starts into operation, a continuous inspection and control process will be carried out.

In order to carry out these licenses on time, we are going to hire a support team of about 18 people for a fixed period of time to perform this workload.

– We have the licensing of the Fertiliberia Project in Huelva and the Hondón project in Cartagena, Murcia.

– On the other hand, it will soon be necessary to start evaluating the Trillo nuclear power plant. Starting with the base document.

– We will see how the 7th General Radioactive Waste Management Plan progresses and what dedication is required on the part of the Council to license the different facilities required there.

ONGOING INTERNAL CSN PROJECTS

Another project that we have carried out in the Council has been the SAT project: Systematic Approach to Training, which has been implemented in your plants for years. We have carried out this project with collaboration from Tecnatom and now the next deadline is to apply it. I would like to highlight one of the activities derived from this project.

With the intention of streamlining licensing processes, we want to promote the use of quantitative management techniques. To this

end, those positions that require knowledge of these techniques have been identified (project managers, area managers, deputy directors, directors, general secretary, legal counsel, administration, etc.). As a result, there are about 80 people who should have these skills, and we have launched a Microsoft Project course for those 80 people, as well as being open to some more.

About four editions of these courses will be developed, in which we hope around 100 people will enroll, and we will buy the Microsoft Project license for each of them. We want to have these activities completed in this year 2022. So, within the SAT project, we will apply operational research techniques at the CSN.

As there are usually master's degree students here, I have to say that we have approved the 2022 public employment offer in plenary, and we want to make a call for 5 positions.

I declare this session as closed.

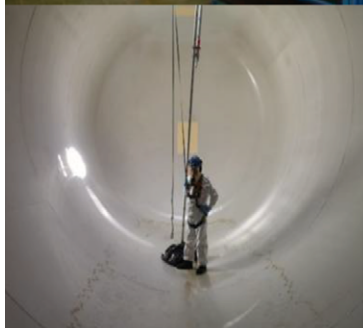
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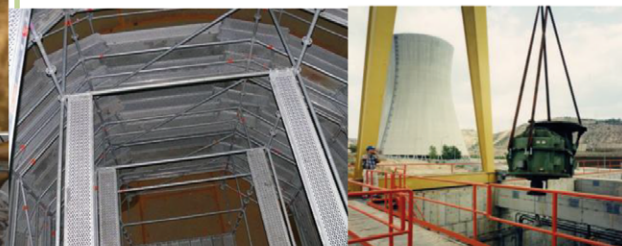
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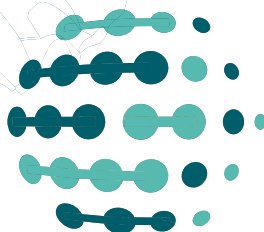
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SPECIAL Session



ENERGY: THE ENGINE OF GROWTH AND SUSTAINABILITY

Javier Targhetta

CEO of Atlantic Copper and President of Primigea

The second part of the annual SNE Conference on the experiences and perspectives of Spanish nuclear power plants in 2021 was held in person at the Higher Technical School of Industrial Engineers (ETSII) at the Polytechnic University of Madrid on September 6, 2020.

The SNE prepared a special session on "Energy: The Engine of Growth and Sustainability" given by Javier Targhetta, CEO of Atlantic Copper.

In addition, the opening session was attended by Ignacio Araluce, President of Foro Nuclear, and Héctor Dominguis, current President of the SNE, who moderated the session.

HÉCTOR DOMINGUIS

PRESIDENT OF THE SNE

Héctor Dominguis opened the Special Session with the following words: Welcome to the second part of the **33rd Operational Experiences Session**. At last, we can meet again in person, face to face, to share experiences and recover the human character of this great **session for all**

professionals in the nuclear sector in our country.

On behalf of the Board of Directors of the SNE, I would like to thank all the people whose work has allowed us to be here today, and especially the members of the Programs Commission, all those who attended, the Higher Technical School of Engineers Industrial for hosting us (as they do every year).

And of course, I would also like to **thank** our guests **Ignacio Araluce** and **Javier Targhetta**, CEO of Atlantic Copper, who wanted to join us during this session.

But, before giving the floor to our guests, I would like to spend a few minutes **reviewing the situation for nuclear energy in the current economic and geopolitical framework:**



Spain cannot afford to do away with nuclear power, so it is necessary to review the energy strategy and create a regulatory framework that allows for the continuity of the plants

As you well know, the SNE represents all the professionals in the sector and, as such, we have come to this event. But we cannot forget that most of the people who are part of the SNE **also work in companies that carry out their activities in other industries** beyond the nuclear sector. In fact, **many of the companies we represent** work in wind, solar, gas, hydro-electric... and, in addition, they have **research projects** related to energy storage, carbon capture, hydrogen, fusion... among many others.

Therefore, when we say that **nuclear energy** is a **sustainable and essential** source of energy to combat **global warming**, we say it with **professional conviction**, with **knowledge of the facts**, and above all, **without ideologies**.

Because in this sector we always defend that **energy has no political**

side, although unfortunately in recent years a **confrontation** has been created between energy sources, which are used as **arguments** to defend political ideologies.

And this is a serious mistake that will lead us to have an **inadequate and inefficient** energy system.

Decisions on energy strategy must be made based on **scientific and technical reasoning**, with the aim of creating a **solid and resilient electrical system** that must meet **3 fundamental requirements**:

1. **Security of supply**; closely linked to the degree of energy independence.
2. **Environmental sustainability**; equivalent to **decarbonization**.
3. **Industrial Competitiveness**, as a reflection of the **efficiency** of the system, **regulation**, and **energy prices**.

If we analyze the **Spanish electricity system** in view of the events experienced during this last year, **we do not comply** with energy **independence, environmental sustainability, or industrial competitiveness**... And therefore, it is clear that a **thorough review** of the energy strategy is necessary for Spain.

And given this **necessary review**, it is undeniable that nuclear energy must play a **leading role** because:

- It **operates 24 hours a day, 7 days a week** without interruption. This allows 6% of the installed power in the country to generate 21% of the electricity we get. Therefore, it provides guarantee of supply.
- Along with wind power, it is the source **that emits the least CO₂** throughout its life cycle, and in fact, it generates 30% of the **emission-free** electricity in Spain. Therefore, it provides **environmental sustainability**.
- It has a **stable generation cost** that is not significantly affected by external **geopolitical** factors. Therefore, it provides **industrial competitiveness**.

And despite this data, nuclear energy is sometimes **still described as the industry of the last century, inefficient, unprofitable**, and even a "**populist hoax**." And one cannot help but wonder if what is **really populist** is not **ignoring** the proven technical and scientific criteria to defend an **impossible ideology** that distances us from the electrical system that the country needs and from **common sense**.

Because despite any political ideology, there is a clear world **scientific consensus** regarding **global warming** and the need to reduce CO₂ emissions, **promoting** the use of **ALL** low-carbon energies.

It is already accepted by all that **global warming** is a reality and one of the greatest challenges facing humanity.

And faced with this challenge, studies led by the EU **scientific body** and the UN Group of experts on **climate change** have **shown** that the **impact** of nuclear power on the **en-**



vironment is equivalent to that of renewable energies.

And as a result of these **conclusions**, the **European Parliament ratified** the inclusion of nuclear energy in the **green taxonomy**, whose main purpose is to **promote economic activities** that contribute to the fulfillment of **climate objectives**, based mainly on **environmental impact and decarbonization** criteria.

Criteria that nuclear energy amply meets. That is why the European Commission has gone a step further, **recommending** that all **Member States postpone** the closure of nuclear power plants that are still in operation.

And these recommendations are **backed up** by the excellent management of nuclear power plants in general and of the Spanish plants in particular, which are **internationally recognized** and operate in compli-

ance with the highest **quality and safety standards** in the world.

We have **up-to-date** facilities that are impeccably **managed** by **internationally renowned professionals**. Who **demonstrate** their management year after year in this session on **operational experiences**.

We have a public company responsible for waste management (**ENRESA**) which is an **international benchmark**.

There is an independent regulatory body (**CSN**), which ensures the safe operation of nuclear facilities.

There are **international organizations** that promote **cooperation** and **excellence** in the management of the industry.

In fact, **there is no** industry that collaborates so **efficiently** and so **openly** on a **global** level for the **continuous improvement** of its sector.

With all this, fortunately, **certain myths have been overcome**, such as the **40-year limit**, demonstrating that the **design life** has nothing to do with the **useful life** of a facility.

In fact, the Spanish nuclear power plants **today are more efficient and safer** than when they began their operation thanks to maintenance plans, design modifications, and improvements which involve **investments** of around **30 million euros per year per reactor**, so there is no doubt that they are up to date and capable of **continuing to operate** until they are 60 or even 80 years old, as is already happening in countries such as France or the United States.

It has also been amply demonstrated that **nuclear waste management** is a matter that has been **technically resolved**.

All **human activity** generates waste... the important thing is how

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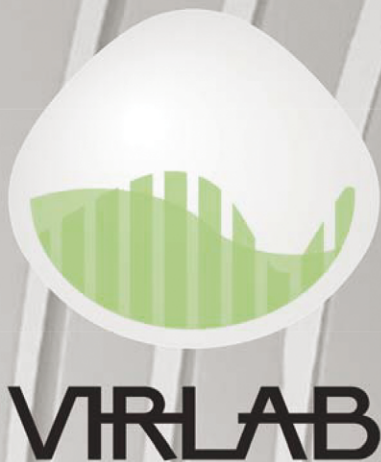
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that waste is managed. Because **well-managed waste does not pollute**. And in Spain, **radioactive waste** is managed in such a way that it does not create any impact on the **environment or on people's health**.

We have been managing waste and used fuel from nuclear power plants for **60 years**, without any incidents during all these years. And this is because it is managed impeccably:

- With **environmental monitoring** plans at all nuclear power plants to ensure that it has no impact on the environment.
- And with technical solutions for **waste management**, both in the **medium term** (with temporary storage) and in the **long term**, with deep geopolitical storage.

Therefore, the solutions exist, the only thing missing is the will and political consensus to implement them.

But beyond their **minimal environmental impact**, nuclear power plants have a **great social impact** on their surroundings.

- They are facilities that operate in the **very long term**. Therefore, they generate **job stability**.
- They demand and provide high levels of **training**. Therefore, they provide qualified and quality employment.
- And they are far from **big cities**. Therefore, they provide a better **distribution** for the population and employment in the country.

In total, our industry generates more than **20,000 stable, direct and indirect jobs** in Spain, and has an **auxiliary engineering**, component manufacturing, and support services industry with international recognition, present in more than 40 countries.

Beyond direct and indirect employment, nuclear energy generates a **large amount of incidental employment** in nearby towns. **Restaurants, shops, lodging**; that promotes the creation of other industries. Without these plants, the **industries created in their surroundings** would be seriously affected.



Proof of this is that after the closure and decommissioning of the **José Cabrera plant**, where before there was **industry, tourism, and prosperity**, now there is **depopulation, economic recession, and decline**.

Fortunately, the situation in **Spain is not a reflection** of what is happening in the world.

In fact, Spain is **left alone** in its commitment to **closing nuclear power plants** at a time when the **trend is to lengthen the life** of the plants in operation and the announcement of new reactors.

In **2021**, the **UN** warned that the **global goals** to stop **global warming** could NOT be achieved if **nuclear power is excluded**.

And the **IAEA** predicts a **scenario** in which **nuclear power production doubles** to 792 gigawatts of electricity in **2050**, 10% more than it predicted for that year in its last calculation.

In fact, **2021** was the year with the **highest number** of nuclear power plants **under construction since 1986 with 56 reactors** under construction, **95 planned**, and **355 proposed**.

In addition, the data that we are seeing from 2022 shows that the trend is continuing.

Therefore, this means that there are many **governments and investors** who are convinced that nuclear energy is a **viable and necessary investment**.

We all are well aware of energy strategies for European countries:

- **France, Belgium, the United Kingdom, Poland, Hungary, and the Netherlands** who are extending the life of their reactors and building new reactors (whether they are generation IV, generation III, or SMR reactors).
 - **And on the other hand, we have countries like Finland** that revised its energy policy to include nuclear energy as a sustainable energy source (led by the green party, until recently anti-nuclear).
 - Or **Sweden** that eliminated the ban on the construction of nuclear power plants in 2020. And with a mix of 30% nuclear and 60% renewable energies, it is the country in Europe that emits the least CO₂ per kW.
- And if we go beyond Europe,
- **The US** announced its intention to build 300 new reactors, including SMRs.
 - **China** intends to build **150 reactors** in the next **fifteen years**.



- **Korea** has made a **180°** turn in its energy policy to promote nuclear power.
- And **Japan**, 11 years after the Fukushima accident, is **promoting nuclear energy again** with the **reactivation of 10 reactors** and announcing the construction of at least **7 new generation reactors**.

If we also add all the **initiatives under development**, which will determine the **future** of the nuclear industry: **SMRs, fusion, 4th Generation, thorium...**

I think it is clear that the **nuclear future** in Europe and in the **world is prosperous**.

But... what about **Spain**? What **energy strategy** does Spain have?

As we all know, in 2019 the Integrated National Energy and Climate Plan (**INECP**) was presented. A Plan that includes:

- **Almost doubling** renewable power. Increasing from 58 GW in 2020 to 111 GW in 2030.
- The closure of **4 of the 7** operating **nuclear reactors** in Spain. Which represents 17% of CO₂-free electricity, with the closure of the **other 3** reactors expected between **2030 and 2035**.
- At the same time maintaining **all the installed gas power**, with **future use predictably greater** than current use.
- All of this, in a scenario in which **electricity consumption in Europe is expected to double** between 2020 and 2050, will cause fossil fuels to play an even **greater role** in our electricity system as **manageable fixed energy**. Creating:
 - **Even more dependency** on third parties.
 - **Even more price uncertainty**.
 - **And less capacity to meet** decarbonization targets.

In other words, we will **continue to fail to comply** with the **basic pillars** for a **solid and reliable** electrical system.

Therefore, in this **scenario**:

From the **Spanish Nuclear Society**, we demand that nuclear energy be considered **an essential source of energy for the present and the future**.

If we want to have a **safe, competitive, and sustainable** energy system and face the expected increases in electricity **demand**:

We must have all low-carbon energy sources. And, therefore, put an end to the **false dichotomy** of nuclear or renewable energies since both are **necessary and essential** for achieving a **more sustainable economy**.

Spain cannot afford to do away with nuclear power, so it is necessary to **review the energy strategy** and create a **regulatory framework** that allows for the **continuity** of Spanish nuclear power plants for at least **20 more years**.

IGNACIO ARALUCE

PRESIDENT OF THE SPANISH NUCLEAR INDUSTRY FORUM

I would like to start my speech by thanking the Spanish Nuclear Society for inviting me to participate again in this session for "Nuclear Power Plants in 2021. Experiences and Perspectives."

After the COVID-19 pandemic and more since the end of February of this year 2022, the energy situation in Europe, and in the world globally, is one of great uncertainty, not only because of the increase in the prices of raw materials in international markets, which has also meant an exponential increase in electricity prices, but especially with regard to the guarantee of supply in the coming months and years. Spain is no stranger to this situation.



The excellent conditions of our plants are achieved thanks to the capacity and experience of the companies that make up the Spanish nuclear industry, as well as the professionalism and high qualifications of the 30,000 people who work in them



Despite this, and although it may seem paradoxical, the position of published opinion and public opinion in our country regarding nuclear power generation has changed substantially in the last year. Where before only negative issues were pointed out, especially safety and the lack of a strategy for radioactive waste management, these issues are now said to be under control. On the other hand, its positive characteristics stand out: **nuclear is a technology that fights against climate change, helps to maintain energy supply, and is competitive.**

In fact, in Spain, the seven units that make up the Spanish nuclear park contribute to the stability, regulation, and balance of the national electricity system since they produce electricity at full power for nearly 90% of the equivalent hours of the year. **In the last decade, the Spanish nuclear park has been the only technology that has produced more than 20% of the electrical**

energy consumed year after year, continuously 24 hours a day, 365 days a year.

Along with this, it is a technology that does not emit greenhouse gases, preventing the emission of more than 20 million tons of CO₂ into the atmosphere each year and producing more than 30% of emissions-free electricity.

On the other hand, **nuclear energy does not put pressure on prices in the wholesale electricity market** as its production is offered at a zero price. This means that, without nuclear power, wholesale market prices would be even higher. In fact, under no circumstance does nuclear energy benefit from the high prices matched in the wholesale market since its electricity production is committed to bilateral term contracts at prices below €67/MWh for the next few years.

It must be taken into account that nuclear power plants are economically competitive if their intrinsic

costs are taken into account. However, **they have been subjected to excessive, discriminatory, and confiscatory taxation since 2013.**

For all these reasons, from numerous instances, it has been claimed that, as several countries near us have already decided, the operation of the nuclear park can continue for a longer time than is currently agreed, and this will lead to the cessation of the operation of the last plant in the year 2035.

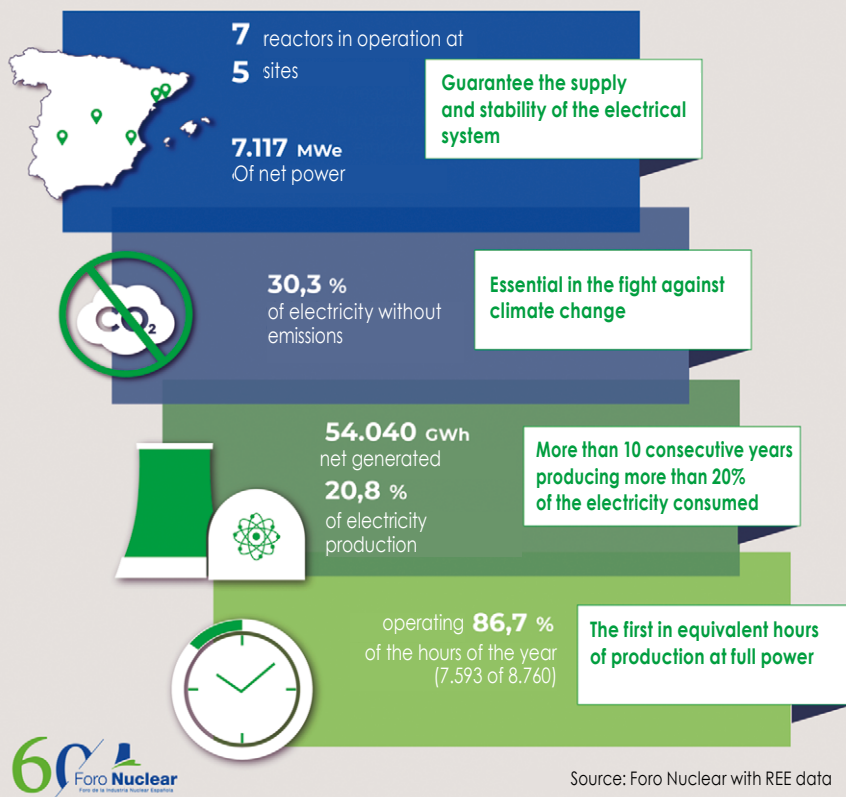
In this context, it is essential for nuclear power plants to continue to seek excellence in their operation in accordance with all established regulations, both nationally and internationally, demonstrating day by day that the **contribution of nuclear energy, as I have indicated before, is essential for our electricity system and for achieving the objectives of the energy transition in the coming years.**

The current framework, the Integrated National Energy and Climate Plan 2021-2030 and the Protocol of Intentions agreed upon in March 2019 between Enresa and the companies that own the nuclear power plants with the support of the Ministry for Ecological Transition establishes an operating calendar for the seven power plants within certain deadlines, within the climate and energy policy planned, as it could not be otherwise, by the Government of Spain.

Thus, **the owner companies will comply with said agreement, but it should be noted that both they and the facilities themselves are prepared from a technical and organizational point of view to be able to operate for at least 60 years.**

The excellent conditions in which the Spanish nuclear power plants are currently found, such as the ability to maintain and improve them in the event that their operating periods are extended, are also achieved thanks to the capacity and experience of all the companies that make up the Spanish nuclear industry, as well as the professionalism and high qualifications of the almost 30,000 people who work there.

Data on nuclear energy in Spain in 2021





Given the circumstances of the energy sector that I mentioned at the beginning of my presentation, **in the event that the Government of Spain were to propose a review of the Protocol of Intentions and an extension of the operating authorizations to the companies owning the Spanish nuclear power plants, we would be at their disposal, in addition to the fact that it would be absolutely necessary for the appropriate mechanisms to be established to guarantee the viability (economic and regulatory) of the continuity of the nuclear park during the entire period of its operation.**

JAVIER TARGHETTA

CEO OF ATLANTIC COPPER AND
PRESIDENT OF PRIMIGEA

The history of humanity is, to a large extent, the story of the struggle to build a better world, a challenge that, since the abolition of slavery in the 19th century, has placed people and their environment at the center of all the great private initiatives and public policies. The conquest of new rights and social progress have been reflected in the great macroeconomic figures of recent decades.

Since the 1970s, energy consumption has doubled in line with population growth, the global mobile fleet has gone from 250 million vehicles to 1.4 billion, and maritime trade that mobilized 100 million tons now moves more than 1.8 billion. In the last 20 years, GDP per capita has increased tenfold (from \$1,200 to \$10,900).

The advances have been significant and, at present, 90% of the world's population has access to electricity. However, all the advances in innovation and efficiency have inevitably gone hand in hand with greater use of so-called fossil fuels, thereby causing serious concern about the increase in greenhouse gas emissions, which, in turn, may be putting the future of the planet at risk. A planet, by the way, for which we do not have a plan B. It seems evident, then, that in this



The commitment to reduce emissions by 2050 requires promoting new initiatives that, at the same time, meet the energy consumption needs of our society

context, global consensus has been reached on the need to decarbonize the economy and promote sustainable growth to curb climate change.

The commitment to reduce emissions by 2050 requires promoting new initiatives that, at the same

time, meet the energy consumption needs of our society. Generation from clean energy sources such as renewable and nuclear energies and massive electrical energy storage technologies, the electrification of vehicles and homes, the commitment to efficiency through the





reduction of consumption, self-generation or circularity, and the development of new technologies such as green hydrogen, as well as the capture and storage or use of CO₂ are some examples of how we have to advance in this transformation towards a more sustainable economy and production system.

Sustainable development is already a necessity in the present that poses another extraordinary challenge at the same time: the availability of absolutely essential raw

materials for achieving the objectives of the Green Deal. For example, in the case of sustainable mobility, the battery for an electric vehicle needs 52 kg of graphite, 35 kg of aluminum, 29 kg of nickel, 20 kg of steel, 10 kg of manganese, 8 kg of copper, 6 kg of lithium, and 5 kg of iron, many metals which of which the European Union is deficient in. The development of renewable energies already multiplies copper needs, fourfold in the case of wind power and twofold for solar panels. The demand for

copper associated with the energy transition will mean an additional accumulated consumption of 120 million tons in the next two decades throughout the world. It is an example of what happens with a long list of other metals and materials, such as nickel, molybdenum, cobalt, lithium, aluminum, etc.

However, as I have already mentioned, Europe is deficient in metallic minerals, many of which the EU itself has classified as critical materials due to internal scarcity and external dependence on other areas of the world. Europe will have to compete with other large economies, such as the US and China, which are much better positioned to supply their industry and energy needs. This dependence, in the undesirable case of continuing with it, would weigh down the industrial and social development of Europe and would put the great achievement of the welfare state that the EU has achieved in recent decades at risk. Hence the need to highlight the importance of the non-energy raw materials industry, a sector that in our country brings together 3,755 companies, 2,711 farms, and 1,925 factories that generate more than 300,000 jobs (direct, indirect, and incidental).

In this context of external dependence, *Primigear* emerged in 2019, whose main objective is to face these challenges and promote responsible access to mineral raw materials, as well as to promote the development of an essential and strategic industry that contributes 256 billion euros of added value to the national economy and on which 4 million jobs and 181,000 companies depend throughout Spain. The recent approval by the Council of Ministers of the Roadmap for the Sustainable Management of Mineral Raw Materials, in whose preparation *Primigear* has had active participation, gives us great hope because only with the joint commitment of civil society and public administrations will be able to continue growing as a country. Spain has important deposits and mineral reserves that can be exploited and that require





large investments for the exploration and exploitation of their deposits, as well as the promotion of the circular economy. All of this can only be undertaken with investment-friendly environments and a determined willingness to support central, regional, and local administrations, in line with the EU's "Raw Material Initiative."

GEOPOLITICS AND RESOURCES

In recent months, an unexpected factor has been added to these great challenges posed by the energy transition and digitization that can hinder our growth as well as our sustainability objectives. A convulsive geopolitical context and an energy crisis due to the exorbitant costs of electricity and gas. This situation forces the EU and the governments of the member states to immediately develop a much more realistic energy policy in terms of the supply of energy raw materi-

Sustainable development is already a necessity in the present that poses another extraordinary challenge at the same time: the availability of absolutely essential raw materials to achieve the objectives of the Green Deal

als, a substantial modification of the price-fixing system of the European electricity markets, an active reconsideration of nuclear energy as one of the fundamental sources of the generation mix and, without a doubt, to accelerate the transition to generating electricity from renewable sources, specifically, wind and photovoltaic. In addition, the coordinated progress towards the production of competitive green H_2 and the development of massive electricity storage batteries should complete the energy policy of the EU and its countries without delay and over the next few years

until European independence in the energy sector is achieved. To achieve the difficult goal of energy independence in the EU, it must have the technologies and reliable supply of materials necessary for the development of the different projects that will enable us to achieve this goal, and this also requires awareness of our great limitations and a commitment, also immediate, for the exploration, exploitation, and transformation of the necessary raw materials, both through the primary route and the secondary route, that is, the circular economy.

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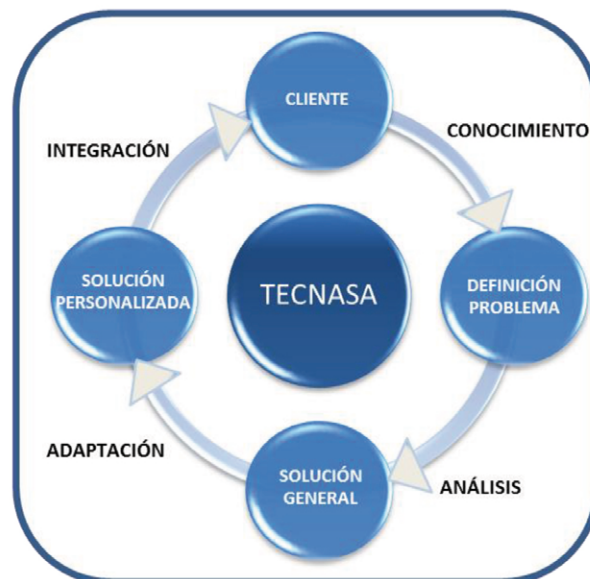
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"First Container Loading at the ITS for the Cofrentes NPP"
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• NUCLEAR ESPAÑA AWARD FOR THE BEST INFORMATIVE ARTICLE

"A Hero in Chernobyl – Valery Legasov"
to **Nuclear Young People**

• BEST DOCTORAL THESIS ON NUCLEAR SCIENCE AND TECHNOLOGY 2021

"E-life Neutronics Model of the ITER Tokamak"
by **Gabriel Pedroche Sánchez**

• BEST PRESENTATIONS FROM THE 46TH ANNUAL MEETING 2021

– QUALITY, REGULATION, ORGANIZATION, AND HUMAN FACTORS

"Software for Quality Management Systems and Organization of Radioactive Facilities (SIGOR)"
Miguel Embid Segura

– FUEL

"European Project for the Isotopic Characterization of Irradiated BWR Fuel (EURAD)"
Marta Berrios Torres, Miriam Vázquez Antolín, and Ana Muñoz Sicilia

– COMMUNICATION

"Internal Cultural Change. Key for Digital Marketing"
Ana Izquierdo Garijo and Manuel Fernández Ordóñez

– DECOMMISSIONING

"Inno4Graph: Development of Tools for Graphite Reactor Decommissioning. Gathering of Data from European Graphite Reactors"
Gonzalo Medinilla Téllez, Nieves Martín Palomo, and José Luis Leganés

– SSC DESIGN AND BEHAVIOR

"Use of Rivet Nuts in Civil Structures in the Nuclear Field as an Alternative to Conventional Bolted Joints"
Ángel de Blas Gordo

– TRAINING

"Evolution of 3D Simulators. An ENUSA-ENSA AIE Proposal for Virtual Training with an OJT Approach"
Vanessa Barambones and Esther Sánchez Benavente

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"Characterization of Hydrogen and Deuterium Transport Parameters in EUROFER Low Neutron Activation Ferritic-Martensitic Steel"
Igor Peñalva Bengoa, Jon Azkurreta Fuentes, and Mainer Pérez Gúezo

– WASTE MANAGEMENT

"Technical Feasibility Study on the Use of Laser Systems for Radioactive Waste Decontamination"
Karen Arlet Guzmán García, Daniel Solís Tovar, and Alfonso Córdoba González

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"Technological Solutions Applied by ENSA in the Welding of Sectors PS1 and PS4 for ITER"

Domingo Lima, Fernando Sánchez, and Javier Múgica

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"Nuclear Fuel Cycle Optimization Under Uncertainty"
Aris Villacorta Skarbeli, Francisco Álvarez Velarde, and Vicente Bécares Palacios

– THERMOHYDRAULICS AND NEUTRONICS

"Mean Thickness of Liquid Film in Annular Air-Water Flow in Vertical Free Fall Analyzed Experimentally and Using CFD Code"
Yago Rivera Durán, Yaisel Cordova Chávez, and José Luis Muñoz-Cobo

– POSTER

"Spanish Contribution to the IFMIF-DONES Accelerator"
Iván Podadera Aliseda

• NUCLEAR MASTERS 2021

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"Characterization of Toroidal Alfvénic Modes in Fusion Plasmas in Tokamaks"

Finalists: **Bárbara Navarro Mas**

"Analysis and Verification of the Evolution of the Concentration of Neutron Poison Xe-135 in a PWR-KWU Type Nuclear Reactor During an Operational Transient"

Manuela María Alberola Herrero

"Analysis of Alternatives for the Decommissioning of a Graphite Nuclear Reactor"

– BEST RECORDS

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Al Awad Abdulrahman

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informative
article



Best
technical
article



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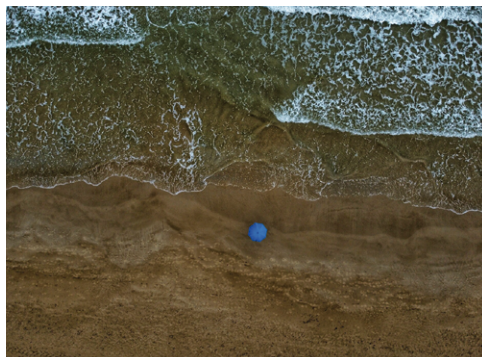


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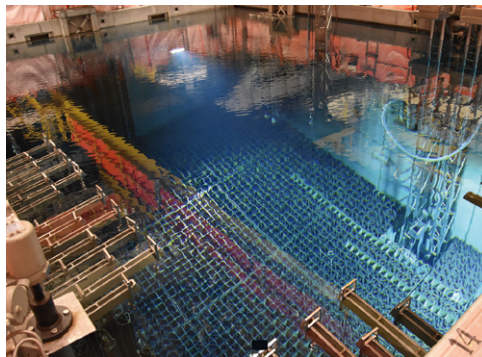


Third Prize:
THE VORTICES MADE THE ARCOS OF ALCONETAR
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María del Prado Ordiales Rey

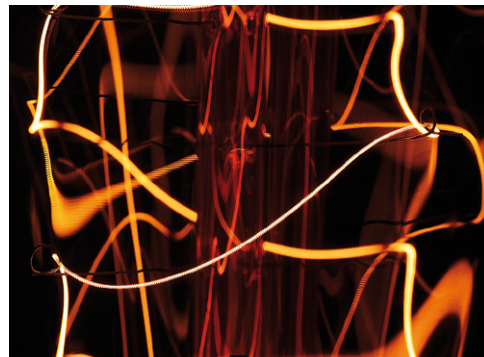
EXPERT JURY AWARDS ENERGY CATEGORY



First Prize:
ANOTHER DAY
Maita Morales

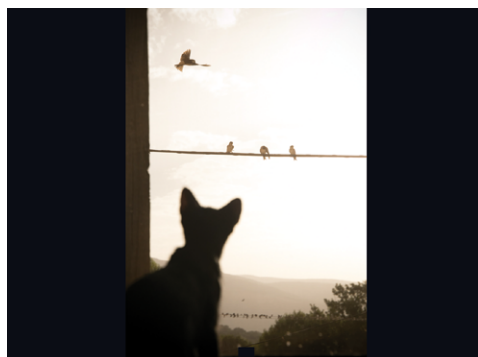


Second Prize:
NUCLEAR POLICROMY
Carlos Gómez



Third Prize:
INCANDESCENCE
Marc Altés Soler

POPULAR JURY AWARDS



First Prize:
FLY WITH ME
Francisco Javier Hernández Delgado



Second Prize:
ATOMIC ERA
Marc Altés Soler



Third Prize:
SEA OF WOOD
Marc Altés Soler



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- ▶ Probabilistic Safety Analysis (PSA)
- ▶ Design Modifications
- ▶ Software Development and Simulation
- ▶ Low-Level Radwaste Management
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- ▶ Cybersecurity



■ Almaraz Nuclear Power Plant (Spain).



■ Angra Nuclear Power Plant (Brazil).



■ Cofrentes Nuclear Power Plant (Spain).



■ ITER (France).



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