

A nighttime photograph of the Garoña nuclear power plant. A tall, cylindrical cooling tower stands on the right, illuminated from below and topped with red lights. In the foreground on the left, a large sign is lit up with the text "PELIGRO NUCLEAR GREENPEACE". The background shows a dark landscape with hills and a body of water under a deep blue night sky.

Garoña. **The Price We Must Not Pay**

GREENPEACE

Catalaysing an Energy [R]evolution



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Introduction

One year after the Fukushima Daiichi nuclear plant accident, Greenpeace believes it is time to put into practice some of the lessons learned from the nuclear catastrophe. Here lies an opportunity to not repeat the same mistakes.

Fukushima Daiichi (Japan) No.1 power plant is identical to Santa M^a de Garoña (Burgos, Spain) power plant, closely located to densely populated cities like Vitoria or Bilbao, therefore we have not only the possibility but the obligation to avert a new nuclear disaster.

In this document Greenpeace outlines several of the technical problems facing Garoña power plant right now, which are just some of the reasons to justify its immediate closing.

The nuclear industry makes huge profits from nuclear energy but it is society at large who pays the consequences of an accident.

In addition, in Spain, the electrical system's tariff deficit contracted with electrical companies must not be "paid", by permitting Garoña to continue operating at the expense of putting society at risk.

Garoña demands a price society should not pay.

2

Similarities between Garoña and Fukushima

The commercial operation of Santa María de Garoña (Burgos, Spain) nuclear power plant begun 40 years ago, is the only of the so called First Generation Spanish plants to be operative. The other two, Vandellós-1 and Zorita, have been closed. The first one following an accident in 1989 and the second one for safety reasons in 2006.

Garoña was designed in the 60's. Its BWR/3 reactor with Mark I containment was designed and manufactured by General Electric. It is the same reactor found at Fukushima Daiichi No.1 power plant.

The vulnerability of the containment design for the boiling water reactor Mark I had been long known at international level. Nonetheless, in Fukushima, the company that owned the nuclear plant and the regulators continuously ignored all recommendations¹.

SPECIFICATIONS OF BOTH NUCLEAR POWER PLANTS

SANTA M^a DE GAROÑA

LOCATION

Santa M^a de Garoña (Burgos).

OWNED BY

Nuclenor (Endesa 50%, Iberdrola 50%).

MODEL

BWR (boiling water reactor), design by General Electric (USA) BWR-3 Mark-1.

ELECTRICAL POWER (MWe)

466 (generates 3,830 GWh, which represents 1.38% of the electrical output for mainland Spain²).

HIGH-LEVEL RADIOACTIVE WASTE (SPENT FUEL)

In pool.

RELEASE OF LIQUID RADIOACTIVE EFFLUENTS

Into River Ebro.

CONSTRUCTION AUTHORIZATION

05/02/1966.

START UP AUTHORIZATION

10/30/1970.

DEFINITIVE PLANT SHUTDOWN PERMIT

07/05/2013.

SATURATION LEVEL OF SPENT FUEL POOL

84.20%.

SATURATION OF SPENT FUEL POOL EXPECTED TO OCCUR

2015.

FUKUSHIMA DAIICHI

LOCATION

Fukushima Prefecture (Japan).

OWNED BY

TEPCO, Tokyo Electric Power Co.

MODEL

BWR (boiling water reactor), design by General Electric (USA) BWR-3 Mark-1.

ELECTRICAL POWER (MWe)

439³.

START UP AUTHORIZATION

Was connected to the grid in 1971.

HIGH-LEVEL RADIOACTIVE WASTE (SPENT FUEL)

In pool.

Reactor and Security Problems at Garoña Nuclear Plant

In the last 33 years the world has witness five major accidents where a substantial fuel melt down has occurred. In four of these cases boiling water reactors, like the one at Garoña nuclear plant, were involved. It is the same reactor operating at Chernobyl in 1986 (a boiling water reactor soviet design, named RBMK) and the model the three Fukushima Daiichi units had in 2011 (Mark I Boiling Water Reactor).

Based upon these five meltdowns, the probability of significant accidents is one core-melt for every 2,900 years of reactor operation⁴. In other words, based upon observed experience with more than 400 reactors operating worldwide, a significant nuclear accident has occurred approximately every seven years⁵.

Bearing in mind the true situation, known both to industry and governments, it is necessary to have a clear understanding of the state every and each nuclear power plant is in. Following is a description of some of the problems Garoña power plant faces today.

State of the Reactor

Garoña is an old power plant, it was design to have a 25 year life expectancy and so far has been operating 41 years. In the past four years there have been clear signs that it has outrun its service life. One of the many problems it faces is an **stress corrosion cracking** which primarily affects two components of the reactor vessel (the heart of the nuclear power plant where uranium fuel is kept): the barrel and the control rod penetrations.

The barrel is a big metal cylinder located inside the vessel which surrounds the fuel elements (the core). Its integrity is vital to the power plant's safety since it provides structural support to the core, which is key for the nuclear reaction to stay under control. Corrosion has generated millimetric but very long cracks (over 10 meters in total length). The main ones cross the thickness of the metal and take approximately half of the barrel's circumference. In 2000 it was decided to weld a metal structure to the lower part of the barrel instead of substituting it, a measure technically insufficient⁶.

The control rods keep in check the nuclear reactions that take place in the reactor vessel. These rods access the inside of the vessel through **tubes called penetrations** which are fit in the vessel. **More than 70%** of Garoña's penetration tubes **suffer corrosion problems** which in turn have caused cracks. Some of these are through cracks (they go through the entire thickness of the tube). That is why radioactive water has leaked from the inside to the outside of the vessel (that is how the problem was discovered in 1981). And they can cause structural malformations in the penetration tubes which in case of emergency may prevent the proper insertion of the control rods.

The Nuclear Safety Council (CSN abbreviation in Spanish) allowed, provisionally, to have it repair by installing metallic parts over the cracks of the penetration tubes. These parts have had to be substituted on several occasions⁷. The problem has not been solved and "inevitably" keeps getting worse. For economic reasons Nuclenor, owner of the power plant, refuses to change the penetration tubes for ones which are more resistant to corrosion.

In addition, the manufacturer, General Electric, recently discovered a **failure in the insertion of the control rods in the fuel channels for design basis earthquake circumstances** (that is, for earthquakes of an intensity foreseen in the design of the reactor), specially under certain pressure situations inside the vessel.

The failure was notified to the companies operating this type of reactor, Nuclenor included, and to the regulatory bodies. The Unites States prestigious Union of Concerned Scientists (UCS) analyzed the situation and stated that "if a failure occurs in the insertion of the control rods" it could lead to "a situation were shutting down this type of nuclear plant becomes impossible in case of emergency."

Clearly this could lead to an accident were a core meltdown occurs. Nuclenor is aware of the problem but states there is no reason for concern⁸.

3

The Spent Fuel Pool

The spent fuel pool is located in the reactor site but at a higher level, over the containment vessel, and with a protection level substantially lower than the reactor.

In Garoña the spent fuel storing capacity of the pool is at 84,20% and it is estimated that by 2015 it will reach maximum capacity.

Based on the Fukushima accident, the Petition Review Board of the Nuclear Regulatory Commission (NRC) will study if modifications are necessary to increase safety in spent fuel pools of reactors with Mark I [NF 2011]⁹ type of containment.

According to the French IRSN, large quantities of radioactive pollution were leaked from the spent fuel pool in Fukushima Unit 4¹⁰. According to a report¹¹ by the Japan Atomic Energy Commission, a scenario based on the meltdown of the irradiated fuel stored in the pool in Reactor No. 4 could have led to a forced evacuation of up to 170 km to 250 km, including a large section of the Tokyo megapolis. The Japanese authorities admitted the magnitude of the evacuation would have made it impractical.

The Electricity Supply

Regarding the vulnerability of nuclear power plants with a reactor like Garoña's, in 1971 the United States Government warned that if the emergency cooling system of the reactor failed, light water reactors risked suffering an "lethal nuclear explosion and spreading radioactive fallout"¹².

If all energy sources were taken out of service, including external and emergency electric generators, the cooling function would be lost and the damage to the core of the reactor would be total; that is, it would meltdown¹³.

Garoña's electricity system is in bad conditions, as evidence by the fact that on a report published the 5th of June 2009 the CSN conditioned the renewal of the operating permit to the substitution of the electricity system.

Cooling System

Garoña also has cooling problems in its day-to-day operation. Studies carried out by an independent institution, approved by the Ministry of Environment, in regards to the water temperature of the River Ebro when passing through the site of the nuclear power plant, confirm the thermal pollution the waters of the Ebro suffer at the Sobrón reservoir, a problem that can also be observed several kilometres upstream from the power plant, towards the town of Frías.

The overheating not only alters the physiochemical conditions and dynamics of the mass of water and creates environmental problems for the flora and fauna, it also proves the lack of capacity of Garoña nuclear power plant to properly cool the core of the reactor in its day-to-day operation, forcing it to spill cooling water into the Ebro at an excessively high temperature, way above the level allowed by the existing authorisation.

The water temperature can vary up to 14.5 degrees between the water located before and at the nuclear power plant cooling water abstraction point. Regulation allows a maximum increase of three degrees for this type of spill.

Official measurements are not performed by the Confederación Hidrográfica del Ebro (CHE), the institution responsible for controlling the bodies of water in that basin and guaranteeing its quality, it adopts those carried out by the company that owns the nuclear power plant¹⁴.

It must be noted that Fukushima nuclear power plant also experienced similar incidents. In 2002, the cover ups perpetrated by TEPCO, owner of the power plant, were uncovered. In 2006, TEPCO admitted having falsified cooling water reports between 1985 and 1988¹⁵. Despite the wrong doing no regulatory measurements were set in place to improve the situation¹⁶. Just before the nuclear accident, Japan's Nuclear Safety Commission granted TEPCO the mandatory authorisation to extend the life of the reactors another ten years¹⁷.

As a forewarning, two weeks prior the start of the disaster, Japan's Nuclear Safety Commission accused TEPCO of not inspecting their equipment properly, including the cooling system and the spent fuel pools¹⁸.

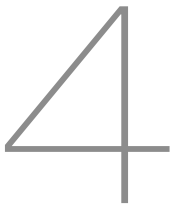
Evacuation Plans

Garofña is 23 km away from Miranda de Ebro (Burgos, Spain) with 30,000 residents and 40 km away from Vitoria/Gasteiz with 240,000 residents.

In case of a nuclear accident the population can avoid exposure to radioactive fallout in only two ways: confinement and/or evacuation. Confinement is only possible during a limited period and evacuation relies on complex logistics to inform, displace and shelter the population.

The only provision contemplated on the chapter, Plans for Managing an Accident, of the CSN report on stress tests for Garofña nuclear power plant was to improve communications by implementing a new Alternative Center for Emergencies. In regards to escape routes, it notes that there is at least one possible escape route in case of an earthquake and were the Arroyo Dam to break the time available before all roads are affected¹⁹ is 14 hours. That is all. The present emergency plan has not taken into consideration aspects which turn out to be unpredictable in Japan, such as:

- Evacuation of people based on concentric circles ranging from 5.20 or up to 30 km is inadequate and too rigid.
- Confinement of people is insufficient if radioactive discharges last over 10 days.
- Highly contaminated areas have to be evacuated up to 50km from the nuclear plant, and this is still not enough.
- Authorities are not able to adequately control and regulate the radioactivity of the various goods sold on the market, in particular food, which can lead to serious consequences.
- Authorities don't know how to cope with contaminated territories and the huge quantity of radioactive waste.



What Could Go Wrong at Garoña? Stress Tests Reveal Five Main Deficiencies

On the 25th of March 2011, the European Council decided that “the safety of all the nuclear power plants in the European Union should be reviewed using an integral and transparent risk assessment (“stress tests”)”.²⁰

According to the information provided by the CSN, the stress tests performed on Garoña, which are still to be finished, reveal that the nuclear plant is:

- **Incapable of resisting an earthquake** with a horizontal acceleration of 0,30 g (g, gravity acceleration) as specified by the regulator after the Fukushima disaster. The earthquake that hit Lorca (Murcia, Spain) last year had a horizontal acceleration of 0,36 g.
- **Very high risk of a flood** if one of the dams upstream breaks.
- **The spent nuclear fuel is not properly protected** in case of loss of the cooling system in the power plant.
- **The lack of measures to lower hydrogen concentrations** risks an explosion in the reactor’s containment.
- **The CSN has not assessed external risks** such as plane crashes or terrorist attacks. A collision against the reactor site will cause the core to meltdown, event that could happen even if the airplane was a relatively small one (Airbus A320). The protection of the spent fuel pool inside the reactor’s site is considerably lower than the reactor’s, its damage could lead to additional radioactivity release.²¹

The nuclear power plant operator has fail to provide a realistic analysis of the risks pose by natural disasters (electric storm, external fires, extreme weather temperatures, sharp increase of underground water levels,...), internal flooding or fires after an earthquake.

Any accident that involves the loss of electricity supply would mean we could be facing an accident similar to the one at Fukushima Daiichi.

Who, How and Why Wants to Keep Garoña Operative

The Spanish Government wants to expand the service life of Garoña under the false pretense of reducing the deficit of electricity charges and thus revoking a ministerial decree of July 2009 which demanded its closing on July 2013.

On July 14th 2011, the Spanish Supreme Court upheld the 2009 Government's decision to end operations definitively at this atomic power plant on July 2013. The Spanish Supreme Court also ratified the decision to rule out any compensation²².

Although the Spanish conservative political party, Partido Popular, put safety over productivity during the first months of 2011, after the Fukushima accident, their election manifesto included the expansion of the service life of nuclear power plants. One of the first measures proposed by the Government of Mariano Rajoy was to reopen Garoña on the ground that it is impossible to reduce the deficit of electricity charges without amortized power plants. Since the liberalization of the electric industry the Government has incurred in a 24 billion Euro debt with the big electric companies. Why? Because prices do not reflect accurately the real cost of electricity, specially since the actual system is distorted by the patches and subsidies granted to dirty energies.

However, nuclear energy will not help reduce the deficit because nuclear and other types of electricity producers are paid the same in the actual pricing policy system of the electricity wholesale market. It is a marginal system, it is the last power plant to become operational which sets the price.

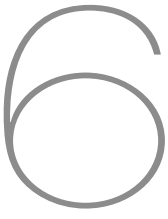
Therefore, the opposite can be **concluded**, unnecessary costs and compensations must be avoided. One of the reasons the pricing policy should be urgently reviewed is to avoid unreasonably compensations to facilities which have already been recouped (windfall profits of nuclear and hydraulic facilities)²³.

The closing of Garoña nuclear power plant would save unnecessary costs and compensations. The companies that own Garoña profit from its operation but for society there are no benefits, only risks and costs.

Garoña closing would not only help protect people and the environment, it would also create more jobs for during the years that can take to dismantle a nuclear power plant more employment is generated than while operating.

In addition, state grants could be allocated to promote the type of development which created more job positions and revitalized the economy. The resolution of the General Secretariat of Industry of November 16th 2010 calls for the granting of subventions to promote the reindustrialization of the areas affected by Santa María de Garoña nuclear power plant in 2011²⁴. The maximum total amount granted in 2011 was 20,740,480 Euros.

The Government now has to explain what happens to these grants and to the ministerial decree which if revoked might prove detrimental to those for whom the subventions were intended.



Greenpeace Demands

- 1. The immediate closing of Garoña nuclear power plant** and the development of an intelligent, efficient and 100% renewable energy model.
- 2. A timetable for a progressive but urgent phase-out of all dirty energies** and its substitution for renewable energies, and energy saving and energy efficient measures. Law must limit the life service of existing nuclear power plants to 30 years and prohibit special renewals of operating permits once the time limit has been reached, and establish a timeline for a progressive closing of coal-fired power stations.
- 3. The elimination of all subsidies, whether direct or indirect, to fossil fuels and nuclear energy**, as well as to all equipment and inefficient energy uses.
- 4. Energy generation must internalize external costs** (social and environmental) so the price of each energy unit supplied reflects the real cost, including the cost of CO₂ emissions, waste (for the period they are hazardous), risks of nuclear power (including full coverage for damage in case of a nuclear accident), and apply the principle “polluter pays”. Polluting must be an expensive activity.
- 5. On the other hand, it is necessary to clarify and decide what model to follow and what the goal is. It's necessary to have a long-term perspective. Therefore, Greenpeace recommends a long-term energy plan that leads us as quickly as possible to an intelligent, efficient and 100% renewable energy system.**²⁵

Endnotes

- 1 *Las lecciones de Fukushima*. Greenpeace Spain. March 2012. Available at www.greenpeace.es
- 2 Informe del Sistema Eléctrico Español 2010 (REE). http://www.ree.es/sistema_electrico/pdf/infosis/Inf_Sis_Elec_REE_2010.pdf
- 3 http://elpais.com/diario/2011/03/13/internacional/1299970807_850215.html
- 4 14,500 reactor years divided by 5 core-melt = one core-melt in 2,900 reactor years. Dr. Gordon Thompson, *New and Significant Information from the Fukushima Daiichi Accident in the Context of Future Operation of the Pilgrim Nuclear Power Plant*, Institute for Resource and Security Studies, 1 June 2011. Commissioned by the Office of the Attorney General, Commonwealth of Massachusetts.
- 5 $2.900/400 = 7,25$
- 6 *Energía nuclear. La central de Garoña*. Publication – 12 August 2008. <http://www.greenpeace.org/espana/Global/espana/report/nuclear/energ-a-nuclear-la-central-de.pdf>
- 7 *Energía nuclear. La central de Garoña*. Publication – 12 August 2008. <http://www.greenpeace.org/espana/Global/espana/report/nuclear/energ-a-nuclear-la-central-de.pdf>
- 8 GE Hitachi informed the Nuclear Regulatory Commission (NRC) about a safety problem related to the reactor shut down system at its boiling water reactors (BWRs) via a September 27, 2011 update to NRC Event Report No. 46230 dated September 3, 2010:
- 9 *Consecuencias en las centrales nucleares españolas tras la colisión de un avión de pasajeros*. Greenpeace Spain (in collaboration with Oda Becker). December 2011. Available at www.greenpeace.es.
- 10 "Our results indicate that ¹³⁷Cs emissions peaked on 14–15 March but were generally high from 12 until 19 March, when they suddenly dropped by orders of magnitude exactly when spraying of water on the spent-fuel pool of unit 4 started" (in A. Stohl et al, *Atmos. Chem. Phys. Discuss.*, 11, 28319-28394, 2011, doi:10.5194/acpd-11-28319-2011). The French IRSN explains that most of the source term was released between the 12th and the 22nd of March (in *Synthèse des informations disponibles sur la contamination radioactive de l'environnement terrestre japonais provoquée par l'accident de Fukushima Daiichi*).
- 11 Tokyo exodus nuke report's worst scenario, 'Migration' plan mullied at height of atomic crisis, *The Japan Times*, 6 January 2012
- 12 The English-language journal *Ampo*, published more than 35 year ago, in 1975. In its article "Nuclear Reactors: Risking the Ultimate Pollution".
- 13 *Las lecciones de Fukushima*. Greenpeace Spain. March 2012.
- 14 Seguimiento de las temperaturas de la descarga térmica de la CN de Santa María de Garoña. Medidas de Nucleonor (Endesa Iberdrola). <http://www.greenpeace.org/espana/es/reports/Seguimiento-de-la-temperatura-de-la-descarga-termica/>
- 15 Japan's nuclear power operator has checked past, Reuters, 12 March 2011. <http://www.reuters.com/article/2011/03/12/usjapan-nuclear-operator-idUSTRE72B1B420110312>
- 16 Special Report: Fukushima long ranked most hazardous plant, Reuters, 26 July 2011.
- 17 Ministry of Economy, Trade and Industry press release in Japanese: <http://www.meti.go.jp/press/20110207001/20110207001.pdf>
- 18 Tabuchi, H. et al. 2011. Japan Extended Reactor's Life, Despite Warning, *The New York Times*, 21 July 2011.
- 19 http://www.csn.es/images/stories/actualidad_datos/pruebas_de_resistencia_informe_final.pdf
- 20 25/3/2011 Nr: EUCO 10/11 <http://www.european-council.europa.eu/council-meetings/conclusions.aspx?lang=es>
- 21 According to project flexRISK, the source term for a serious accident due to technical failures is, 342,000 TBq for Iodine 131 and 78,790 TBq for cesium-137 (radioactivity released in Chernobyl => cesium-137: around 100,000 TBq; Iodine 131: around 2,000,000 TBq [FAIRLIE 2006]). In case of a plane crash, the source term would be considerably higher due to the thermal effect of the flaming fuel. The extent of the radioactive fallout due to a serious accident in Santa María de Garoña nuclear power plant under different weather conditions can be found at flexRISK web [FLEXRISK 2011]. *Consecuencias en las centrales nucleares españolas tras la colisión de un avión de pasajeros*. Greenpeace Spain (in collaboration with Oda Becker). December 2011.
- 22 Under Spanish legislation, reactor operators must apply for a license renewal every 10 years. Santa María de Garoña nuclear power plant was the first atomic energy plant in Spain to be granted a license to operate over 40 years (in particular, 42 years, till July 2013).
- 23 Propuestas de Greenpeace a la Comisión Nacional de Energía para acabar con el déficit de tarifa y alcanzar un modelo energético sostenible. Sistema eléctrico. February 2012. http://www.greenpeace.org/espana/Global/espana/report/cambio_climatico/Feb2012_RespuestadeGP_cuestionarioCNE_electricidad.pdf
- 24 http://boe.es/boe/consultas/bases_datos/doc.php?id=BOEA-2010-18054.
- 25 <http://www.revolucionenergetica.es/>

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