

NUCLEAR POWER IN FRANCE

Setting the record straight



The not so rosé truth about the French nuclear program



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Nuclear Power and France: Setting the Record Straight

INTRODUCTION

France gets nearly 80% of its electricity from its 58 nuclear reactors. However, such a heavy reliance on nuclear power brings with it many major, unresolved problems most especially that of radioactive waste. As a result, France has a hugely complex and unsolved radioactive waste problem.

1. France, like the U.S., has not solved its nuclear waste problem

A. The dirty and polluting process called reprocessing

- France reprocesses irradiated reactor fuel by soaking it in acid to extract plutonium and slightly enriched uranium. This results in massive releases of radioactive gases and liquids and the creation of solid wastes that place people and the environment at great risk. Reprocessing operations release larger volumes of radioactivity – typically by factors of several thousand – compared to radioactive releases from nuclear reactors.¹
- France reprocesses reactor fuel at the vast La Hague facility on the Normandy coast. The so-called low-level liquid wastes from reprocessing are discharged into the English Channel and into the air. However, these “low-level” wastes still contain highly radioactive and often long-lived isotopes. Dumping these same wastes into the sea in containers would violate the 1970 London Dumping Convention.²
- The liquid discharges from La Hague (and the UK reprocessing plant at Sellafield) have resulted in contamination of area beaches and of seas as far as away as the Arctic Circle and are considered among the ten main anthropogenic sources of radioactive pollution of the world’s oceans.³
- Two independent medical studies found elevated rates of leukemia in young people living around La Hague. (Similar leukemia clusters have also been recorded around the British reprocessing site at Sellafield which has turned the Irish Sea into one of the most radioactively contaminated bodies of water in the world).⁴
- The nuclear waste pumped into the sea from La Hague has been measured as 17 million times more radioactive than normal sea water according to an analysis by an independent French radiological laboratory.⁵
- La Hague routinely releases a radioactive cloud that is highly toxic. Concentrations of krypton-85 above the plant were found to register 90,000 times higher than natural

radiation levels according to research by a Belgian laboratory. La Hague also releases all of its carbon-14 emissions into the air, identified by the French Nuclear Safety Center as the isotope in reprocessing discharges that is most damaging to human health.⁶

- A plane crashing on one of La Hague's irradiated fuel storage ponds could result in radioactive releases more than six times the equivalent released from the Chernobyl reactor explosion.⁷
- France extracts plutonium through reprocessing to use as mixed-oxide (MOX) reactor fuel.
- For safety reasons, only 30% of a reactor core that can use MOX fuel is loaded with MOX. MOX reactors consume the plutonium fuel but the uranium-238 component of the fuel produces plutonium. Consequently, there is no net reduction of plutonium using MOX reactors. Waste fuel from MOX reactors is not reprocessed.⁸
- Less than 10 percent of France's nuclear electricity is produced by MOX reactors.⁹
- Ninety-five percent of the mass of spent reactor fuel is uranium, contaminated with traces of fission products, plutonium and other radioactive materials. This contamination makes re-enrichment complex and costly. Therefore it is not re-used as fuel. Instead, France sends this contaminated uranium to Russia.¹⁰

B. No nuclear waste repository

- Reprocessing has created large quantities of solid waste contaminated with plutonium. This, along with highly radioactive vitrified waste, will need to be "stored" in a repository. The volume of these wastes is estimated to be at least 10 times greater than the volume of high-level waste.¹¹
- France has faced public opposition to repositories and is characterizing only one – at Bure in northern France – that continues to face technical and political challenges and strong public opposition.¹²
- The vast majority of the uranium from reprocessing – non-fissile uranium-238 – will need to be disposed of as waste.
- The low- and intermediate-level waste dump sites that do exist – including in the important Champagne region – are leaking radioactivity into the ground water.¹³
- Much of the foreign waste resulting from reprocessing in France was never sent back to the country of origin despite a mandate to do so under French law. This has rendered the country a de facto dump site for its own and for foreign radioactive waste.
- Absent suitable disposal sites, the French nuclear reprocessing company, formerly COGEMA, discarded more than 100,000 casks of "low-level" radioactive waste from its uranium conversion plant into a nearby domestic waste dump.¹⁴

2. Reactors to bombs and the threat to security

- France has exported civilian nuclear technology and training to, or has engaged in nuclear cooperation with Pakistan, Israel, India and South Africa, all of which developed nuclear weapons.¹⁵
- France also exported nuclear technology to Iran, which had an active nuclear weapons program at least until 2003 according to U.S. intelligence reports.¹⁶
- France delivered and built Saddam Hussein's Osirak reactor in Iraq that was subsequently bombed by Israel in 1981.¹⁷
- France has actively exported reprocessing technologies to nations regardless of the proliferation impact (including to Israel and Iraq).¹⁸

- France manufactures MOX fuel at facilities in Belgium and southern France. This results in more than 10 tons of plutonium oxide powder – its most dangerous form – being transported from la Hague annually to these facilities.¹⁹
- A stockpile of more than 80 metric tons of plutonium has accumulated at La Hague. About 30 of these metric tons are of foreign origin. (The British Sellafield plutonium stockpile is even larger at 107 metric tons). The plutonium is stored in tens of thousands of containers representing a high security risk.²⁰
- France has supported Japanese nuclear programs, especially reprocessing, and has, along with Great Britain, shipped MOX fuel elements to Japan. A French shipment made in 1999 contained 221 kilograms of plutonium in the MOX fuel.²¹
- French support of Japan's nuclear program has helped invite the temptation as well as the capability for Japan to make nuclear weapons. In 2002, the leader of the Japanese Liberal Party, Ichiro Ozawa, declared it would be easy for Japan to produce nuclear warheads from its plutonium supplies at civilian nuclear plants.²²
- In early 2008, French president, Nicolas Sarkozy, peddled nuclear power in the Middle East, Asia and elsewhere. The profits would go to French nuclear giant Areva which is more than 90% government-owned. The *Washington Post* described Sarkozy as “the world's most aggressive salesman for nuclear power.”²³
- Enriching uranium for reactor fuel has produced depleted uranium (U-238 or DU) that remains hazardous for billions of years (DU half-life is 4.46 billion years). France, like all other countries, has no disposal solution for DU waste.
- Despite angry rhetoric directed toward Iran about its nuclear program, the French Eurodif uranium enrichment plant at Tricastin has been 10% owned by Iran since 1974.²⁴

3. French nuclear power has been costly to taxpayers

- The economic penalty of reprocessing had been kept secret until a government-commissioned study in 2000. It concluded that reprocessing and the use of MOX fuel in France had raised the kilowatt-hour cost of nuclear-generated electricity and cost the country tens of billions of francs.²⁵
- When evaluating the true costs of nuclear power in France, the entire nuclear complex must be considered. This includes: waste disposal, reactor decommissioning and dismantlement, uranium extraction and processing, reprocessing, MOX fuel production, accident and security risks, and significant health and genetic damage. Taken together, the costs of nuclear energy are enormous.²⁶
- When evaluating the true costs of nuclear power in France, the fact that the industry is almost entirely state-owned must be taken into account. This means that the true, but largely hidden costs, that include losses from exports of surplus electricity, construction delays and decommissioning over-runs, have been shouldered by French taxpayers.²⁷
- France banked on the plutonium “breeding” program as the basis for its massive nuclear power program. But uranium proved plentiful, plutonium uneconomic as a fuel and the country's flagship breeder reactor – the Superphenix – was a costly disaster. Over its 12 years of production, Superphenix produced just 8.2 TWh of electricity – a lifetime capacity of about six percent. (The U.S. breeder reactor – Fermi I – suffered a meltdown in 1966 and closed for good in 1972).²⁸
- Decommissioning costs are proving to be dramatically higher than predicted. The assessed cost of decommissioning the Brennilis reactor in Brittany currently stands at €482 million (\$677 million), 20 times the sum originally envisaged.²⁹

4. French reactor technology is aging and unsafe

- If the 58 French reactors currently operating in France were constructed today, they would not meet evolving safety standards, according to French nuclear safety authorities.³⁰
- A cascade of accidents in the summer of 2008 included leaks and spills from several nuclear facilities, particularly those at Tricastin, where radioactive contamination of two rivers resulted in a ban on drinking and bathing in the water. Tricastin area wine growers saw their businesses suffer while homeowners saw their property values plummet.³¹
- France, like all countries with nuclear reactors, has experienced a long list of near-misses. Some of these are listed in the Global Chance November 2008 report, *France's Nuclear Failures*.³²

5. French reactors, and reactor construction projects, are unreliable

- The European Pressurized Reactor or EPR (known in the U.S. as the Evolutionary Power Reactor) currently under construction in Finland (Olkiluoto-3) is already at least 60% over its projected \$4 billion budget and three years behind schedule.³³
- Progress on the EPR has been slowed by construction errors and technical failures including in key areas such as concrete pours and the stainless steel pipes that make up the main water coolant line.³⁴
- An Areva official blamed delays and technical flaws on inexperienced contractors working for an industry that has been dormant in Europe for 20 years.³⁵
- The EPR under construction in France, at Flamanville on the Normandy coast, has also experienced technical errors and safety flaws. Construction was halted at the site after the French Security Agency (ASN) issued an order concerning the pouring of concrete at the building site and criticized the operator – Électricité de France (EDF) – for a lack of rigorous oversight.³⁶
- At least seven EPR reactors are planned for six U.S. sites. Areva, and EDF stand to reap huge U.S. taxpayer funds if these projects – and an Areva-owned uranium enrichment plant planned for Idaho – go forward.³⁷
- A confidential report by EDF, withheld from the public but containing vital safety information, was leaked by a French activist in May 2006.³⁸ An analysis of the report showed that the EPR would not withstand the impact from a commercial jet airliner.³⁹
- Predicted construction times are overly optimistic. The last four reactors that were built in France – two units each at Choos and Civaux – became operational 15.5 and 12.5 years respectively after construction started.⁴⁰

6. Nuclear power is an unreliable choice under climate change

- Reactors rely on huge volumes of water for cooling. During droughts, insufficient water supplies cause reactors to shut down.
- During the heat wave of 2003, 17 French reactors were forced to power down or shut down completely as river water temperatures rose. France had no option but to import costly electricity from abroad.⁴¹
- When temperatures are high, reactors may need to discharge hotter water. France allowed this during the 2006 heat wave, but thermal discharges damage the surrounding aquatic environment and harm or drive away the species that inhabit it.⁴²
- In May 2007, technical problems with steam generators at a number of French nuclear plants caused the country to import record levels of electricity, a problem exacerbated by sudden, unseasonable cold temperatures.⁴³

- As climate change worsens, water shortages and heat waves will be more common making nuclear power an impractical option, a problem for a country so heavily dependent on nuclear energy supply.
- Nuclear power has not reduced France's dependency on oil. More than 70% of France's final energy is provided by fossil fuels – oil, gas and coal – with oil accounting for 49% of the energy consumption in 2007.⁴⁴
- Nuclear energy has not given France energy independence. Far from a “renewable” energy source, nuclear reactors require uranium, a finite source and all of which is imported.

7. The French do *not* love their nuclear power

- More than 50,000 French citizens in just two districts in north-eastern France have signed a petition to request a referendum on whether a nuclear waste dump would be sited in their area. This request has been ignored by French politicians.⁴⁵
- More than 25,000 people demonstrated against new nuclear power in Cherbourg on the 20th anniversary of the Chernobyl accident. Another 60,000 rallied in five cities in March 2007 in opposition to nuclear power. Fewer people rallied in the U.S. on the same day against the Iraq war.⁴⁶
- Areva was voted one of the world's most irresponsible corporations at the 2008 Public Eye awards in Davos, Switzerland, largely due to its uranium mining record in the Niger. The company is held responsible for the failure to inform workers of the health risks, radioactive contamination of the air, water and soil, and “suspicious deaths among the workers, caused by radioactive dust and contaminated groundwater.”⁴⁷
- The highly active anti-nuclear network in France – Réseau Sortir du Nucléaire – includes 820 non-governmental organizations.⁴⁸
- In a 2006 European poll, only 8% of the French population thought nuclear power was a solution to climate change.⁴⁹
- An annual fall poll in France records as many as 61% of the population favoring a phase-out of nuclear energy despite France's reputation as a country that loves its nuclear power.⁵⁰

8. Uranium Mining

- There are 210 abandoned uranium mines in France. These sites were never adequately cleaned up and radioactive mine tailings have been found in children's playgrounds and public parking lots.⁵¹
- In Niger, the French nuclear company Areva, under subsidiaries (and its predecessor, Cogema) has mined uranium at two sites for 40 years. This has resulted in contaminated air, dust and water supplies well above World Health Organization standards. Discarded radioactive metals from the mining operations have been sold in public marketplaces and used in household goods.⁵²
- Doctors interviewed at the two Areva-owned hospitals in the Niger mining towns, have admitted they do not diagnose uranium mining-related illnesses as it would reflect badly on the mining company.⁵³
- Areva has signed a deal for a huge new uranium mine – Imouraren – in Niger, that, if opened, would be the second largest uranium mine in the world. Mineral extraction already threatens to deplete the Sahara water supply in the next several decades.
- The most negatively impacted by uranium mining in Niger have been the nomadic Touareg people who have suffered the health and environmental consequences and

seen none of the alleged economic benefits. Some of the Touareg – described by one Areva official as “an illusion,” are fighting back, resulting in a crackdown by Niger authorities including arbitrary arrests, imprisonments and executions.⁵⁴

Further Reading

France’s Nuclear Fix? By Arjun Makhijani, Ph.D. Science for Democratic Action, Vol. 15, No.2. January 2008, at: www.ieer.org/sdfiles/15-2.pdf

French Nuclear Reprocessing – Failure at Home, Coup d’Etat in the United States, by Shaun Burnie, at: www.citizen.org/documents/BurnieFrenchReprocessing.pdf

The Cogema File, Safe EnergyCommunication Council, October 1, 2002, at:

<http://www.beyondnuclear.org/FranceNuclearMyths.html>

Sortir du Nucléaire Web site at: www.sortirdunucléaire.org

Nuclear Power in France: Systemic Issues Influencing Costs. Mycle Schneider, March 17, 2008, at:

<http://www.npec-web.org/Frameset.asp?PageType=Single&PDFFile=20080317-Schneider-NuclearPowerInFrance&PDFFolder=Presentations>

¹ *Possible Toxic Effects from the Nuclear Reprocessing Plants at Sellafield (UK) and Cap de la Hague (France.)* Scientific and Technological Options Assessment (STOA). European Parliament. November 2001. And at: http://www.europarl.europa.eu/stoa/publications/studies/20001701_en.pdf

² *Save our Seas*. Greenpeace. And at: <http://archive.greenpeace.org/odumping/oceanmain.html>

³ *Arctic Adaptability*, SEPA View, magazine of the Scottish Environment Protection Agency, Autumn 1999, pps 18-19. And at: http://www.sepa.org.uk/pdf/publications/sepaview/sepa_view_1_autumn1999.pdf

⁴ Dominique Pobel, Jean-Francois Viel: “Case-control study of leukemia among young people near La Hague nuclear reprocessing plant: the environmental hypothesis revisited.” *British Medical Journal*, No. 7074 Vol. 314, January 11, 1997. And at: <http://www.bmj.com/archive/7074pr.htm>. And: A-V Guizard, O. Boutou, D. Pottier, X. Troussard, D. Pheby, G. Launoy, R. Slama, A. Spira and ARKM; “The incidence of childhood leukemia around the La Hague nuclear reprocessing plant (France): a survey for years 1978-1998, *Journal of Epidemiology and Community Health*, July 2001, Vol. 55, pp. 49-474. And at: <http://jech.bmjournals.com>

⁵ Greenpeace press releases June 20, 1997 and May 27, 1999. And at:

<http://archive.greenpeace.org/comms/97/nuclear/press/reprojune20.html>

⁶ *La Hague radioactive air 90,000 times higher than background*. Greenpeace, November 9, 1998 and at:

<http://archive.greenpeace.org/pressreleases/nucleprocess/1998nov9.html>. And *High levels of carbon contamination around La Hague* and at: <http://archive.greenpeace.org/majordomo/index-press-releases/1998/msg00321.html>

⁷ *France’s Nuclear Failures: The great illusion of nuclear energy*. Global Chance. Published by Greenpeace. November 2008. <http://www.global-chance.org/IMG/pdf/G25englishFinal.pdf>

⁸ *The Nuclear Alchemy Gamble: An Assessment of Transmutation as a Nuclear Waste Management Strategy*. Hisham Zerriffi and Annie Makhijani, IEER, August 25, 2000. And see:

<http://www.ieer.org/reports/transm/report.pdf> pages 55-56 (77-78 on PDF). And also, according to Dr. Arjun Makhijani, by email, president of Institute for Energy and Environmental Research at www.ieer.org

⁹ *France’s Nuclear Fix?* page 5. *Science for Democratic Action*, Vol. 15. No. 2., January 2008. And at: <http://www.ieer.org/sdfiles/15-2.pdf>

¹⁰ *Ibid. France’s Nuclear Fix?*

¹¹ *Ibid.*

¹² *Ibid.*

¹³ *French Nuclear Reprocessing – Failure at Home, Coup d’Etat in the United States*, page 5. Shaun Burnie. May 2007. And at: <http://www.citizen.org/documents/Burnie%20paper%20on%20French%20reprocessing.pdf>

¹⁴ *Ibid. The Cogema File*. And see *Plusieurs tonnes de déchets radioactifs dans une décharge de la Drome*, *Le Monde*, July 22, 1999.

¹⁵ *Israel’s Nuclear Weapons Program*, December 1997 at: <http://nuclearweaponarchive.org/Israel/Isrhist.html> and *Pakistan Nuclear Weapons* at: <http://www.fas.org/nuke/guide/pakistan/nuke/index.html> and *Nuclear Power*

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- in France, Australia Uranium Association, December 2007 and at: <http://www.fas.org/nuke/guide/pakistan/nuke/index.html> and *France bets on Indian non-alignment to sell arms and reactors*, Agence France Presse, January 27, 2008 and at: http://afp.google.com/article/ALeqM5g-E_B56S5xYfz3cCqIA4HLgy_9OA
- ¹⁶ *Iran: Nuclear Intentions and Capabilities*. National Intelligence Estimate. November 2007. And at: <http://i.a.cnn.net/cnn/2007/images/12/03/iran.nie.pdf>
- ¹⁷ *WMD Around the World: Osiraq/Tammuz I* at: <http://www.fas.org/nuke/guide/iraq/facility/osiraq.htm> And *On This Day: 1981: Israel bombs Baghdad nuclear reactor*. BBC News. And at: http://news.bbc.co.uk/onthisday/hi/dates/stories/june/7/newsid_3014000/3014623.stm
- ¹⁸ Ibid. Shaun Burnie.
- ¹⁹ *The Transports in the French Plutonium Industry: A High Risk Activity*. WISE Paris. Xavier Coeytaux, Yacine B. Faid, Julie Hazemann, Yves Marignac, Mycle Schneider. February 2003 for Greenpeace. And at: <http://www.wise-paris.org/english/reports/030219TransPuMAJ-Summary.pdf>
- ²⁰ Ibid. *France's Nuclear Fix?*
- ²¹ *Ban plutonium shipments, Greenpeace tells France, UK, Japan*. July 8, 1999. And at: <http://www.greenpeace.org.uk/media/press-releases/ban-plutonium-shipments-greenpeace-tells-france-UK-and-Japan>
- ²² *Japanese Nukes Could Counter China - Politician*. Reuters. April 6, 2002. And at: <http://nucnews.net/nucnews/2002nn/0204nn/020408nn.htm#022>
- ²³ *Sarkozy pushes nuclear energy in the Mideast*. Molly Moore. Washington Post. January 20, 2008, and at: <http://www.washingtonpost.com/wp-dyn/content/article/2008/01/19/AR2008011902416.html>
- ²⁴ Ibid. *France's Nuclear Failures*.
- ²⁵ *Economic Forecast Study of the Nuclear Power Option*. Jean-Michel Charpin et al. July 2000. And at: http://fire.pppl.gov/eu_fr_fission_plan.pdf
- ²⁶ *Nucléaire: Comment en Sortir?* Réseau Sortir du Nucléaire. And at: <http://www.sortirdunucléaire.org/index.php?menu=sinformer&sousmenu=brochures&sousmenu=sorties5ou10ans&page=index>
- ²⁷ Ibid. *France's Nuclear Failures*.
- ²⁸ *Low-Carbon Diet without Nukes in France*. Annie and Arjun Makhijani. IEER. May 4, 2006 and at: <http://www.ieer.org/reports/energy/france/lowcarbonreport.pdf>. And see also *Answers.Com* Wikipedia entry on Superphenix at: <http://www.answers.com/topic/superph-nix?cat=technology>. And for Fermi meltdown, see: *We Almost Lost Detroit*, John G. Fuller. Ballantine Books, September 12, 1976.
- ²⁹ Ibid. *France's Nuclear Failures*.
- ³⁰ Ibid.
- ³¹ *Accidents and uncertain rules harm nuclear power's image in Europe*. Patricia Brett. International Herald Tribune. October 29, 2008. And at: http://www.beyondnuclear.org/images/documents/iht_nuclear_10292008.pdf
- ³² Ibid.
- ³³ *Nuclear Bid to Rival Coal Chilled by Flaws, Delay in Finland*. Alan Katz. Bloomberg.com. September 5, 2007. And at: <http://www.bloomberg.com/apps/news?pid=20601109&sid=aFhlySJ.IYQc&refer=news> And see: *Olkiluoto – Scandal After Scandal* at: <http://www.olkiluoto.info/en/12/3/86/>
- ³⁴ Ibid.
- ³⁵ Ibid.
- ³⁶ Letter from French Nuclear Safety Authority to Flamanville site director regarding safety flaws at the site. <http://www.greenpeace.org/raw/content/international/press/reports/asn-nuclear-safety-authority-3.pdf>
- ³⁷ *Areva Plans to Build a \$2 Billion Uranium Plant in Idaho*. State of Idaho, Department of Commerce. May 6, 2008. And see: <http://commerce.idaho.gov/news/article.aspx?newsid=125>
- ³⁸ Letter and report to the Director General of “la Sûreté Nucléaire et de la Radioprotection”, from B. Lescoeur, EDF, February 22, 2003. And: *EPR: polémique sur un scénario terroriste*. Yves Miserey, Le Figaro, May 20, 2006 and at: http://www.lefigaro.fr/sciences/20060520.FIG000000647_epr_polemique_sur_un_scenario_terroriste.html
- ³⁹ *Assessment of the Operational Risks and Hazards of the EPR when Subject to Aircraft Crash*, by John Large and Associates, May 18, 2006. And at: <http://www.greenpeace.org.uk/files/pdfs/migrated/MultimediaFiles/Live/FullReport/7671.pdf>
- ⁴⁰ Ibid. *France's Nuclear Failures*.

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- ⁴¹ *Climate change puts nuclear energy into hot water*. James Canter. *International Herald Tribune*. May 20, 2007. And at: <http://www.iht.com/articles/2007/05/20/africa/nuke.php>
- ⁴² Ibid. And see: *Licensed to Kill: How the nuclear industry destroys endangered marine wildlife and ocean habitat to save money*. Linda Gunter and Paul Gunter. 2001. And at: <http://www.beyondnuclear.org/animals.html>
- ⁴³ Ibid. *International Herald Tribune*, May 20, 2007.
- ⁴⁴ Ibid: *France's Nuclear Failures*.
- ⁴⁵ *France the Happy Atom's Land*. Sortir du Nucléaire. And at: <http://www.sortirdunucleaire.org/english/downloads/happy-atomsland.pdf>
- ⁴⁶ Ibid.
- ⁴⁷ Public Eye People's Award and Global Award to Areva at: <http://www.publiceye.ch/>
- ⁴⁸ Ibid *France the Happy Atom's Land*.
- ⁴⁹ Ibid.
- ⁵⁰ Ibid.
- ⁵¹ Radiological Hazards from Uranium Mining. CRIIRAD report. Bruno Chareyron.
- ⁵² Impact de l'exploitation de l'uranium par les filiales de COGEMA-AREVA au NIGER. Commission de Recherche et d'information Indépendantes sur la Radioactivité. April 2005.
- ⁵³ La Cogema au Niger. 2.3. Sherpa. April 2005.
- ⁵⁴ NIGER-Uranium - blessing or curse? IRIN, humanitarian news and analysis, a project of the UN Office for the Coordination of Humanitarian Affairs. October 10, 2007. And see: <http://www.irinnews.org/Report.aspx?ReportId=74738>

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