

# Anomalies and suspected falsifications at Areva's Creusot Forge site: Overview

Briefing– Greenpeace France, June 2016

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Is the Areva suspected falsifications controversy simply a matter of documents? In this briefing, Greenpeace reviews the importance of quality control measures and safety requirements for all of the potentially defective parts. The report presents a non-exhaustive list of countries in which these parts are used at nuclear facilities.

## Background

On 3 May, the Nuclear Safety Authority (ASN) announced that Areva had informed it of “irregularities concerning components manufactured in its Creusot Forge plant.”<sup>1</sup> Problems concern documents attesting to the quality of several parts manufactured at the site. The ASN specifies “inconsistencies”, pointing to shortcomings in quality control (as a best-case scenario) but also mentions “omissions or modifications”, implying the potential falsifications of manufacturing reports. The identified parts are large components for nuclear reactors operated by EDF in France and by other firms in several countries.

Questions over quality control were first raised after irregularities were found in late 2014 in the EPR vessel in Flamanville following an ASN request. Finding Areva's audit of parts manufactured since 2010 too limited and superficial, the ASN requested a more detailed assessment going back to 2004, when the first EPR parts were made. Areva, which has owned the Creusot site since 2006, decided to review reports on all parts made since the plant began operating in 1965.

## Initial observations

At least 400 of the 10,000 quality documents (technical compliance slips) reviewed by Areva – concerning around 4% of all manufactured parts – contained defects. Problems concern the concentration levels of carbon and other elements contained in metallic parts, which determine the mechanical strength of machined components. These levels were incorrectly reported or not reported at all. Figures which did not comply with regulatory safety requirements may have been masked using this process.

If non-nuclear equipment such as turbine rotors are affected, over half of the 400 identified components are parts used in heavy equipment that is essential to operating reactors: components in vessels, which contain nuclear fuel, in lids, in pressurisers, which maintain pressure in the primary system, and in shells and heads in steam generators, which evacuate heat to a secondary circuit, among others.

This equipment must be extremely robust and operate to the highest mechanical standard to ensure total safety. Most of it is designed according to the ‘break preclusion’ principle: because the consequences of a sudden breakdown would be too serious to manage, safety inspections must completely guarantee that the irreproachable quality of the design and manufacture of the parts excludes any possibility of breakage during use. For this reason, potential irregularities in parts and, to an even greater degree, possible falsifications in the reports which call into question manufacturing quality, represent a serious safety threat.

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<sup>1</sup> ASN, Information Note, 3 May 2016, <http://bit.ly/1tnQCcl>

## Unacceptable minimisation

On 3 May, the ASN asked Areva “to send it the list of parts concerned as rapidly as possible, along with its assessment of the consequences for the safety of the facilities.”<sup>2</sup> Instead, Areva and its main client EDF have tried to downplay the impact of these revelations by quickly confirming that, without any proof, “*there are no mechanical problems with the parts*”, based on current information.

On 12 May, EDF’s Senior Executive Vice President of Nuclear and Thermal operations Dominique Minière announced to the general assembly of EDF shareholders that:

*“...to date, our assessments have led us to take no action at currently operating power stations.”*

This does not mean that nothing serious has been identified. Following the discovery of irregularities, tests which would specifically look into and determine the extent of their severity have simply not yet been carried out. As the ASN said on 3 May, “the review process will need to be seen through to completion in order to assess all the anomalies which may have affected past manufacturing operations and draw any relevant conclusions regarding the safety of the facilities.” Until then, any conclusions are premature.

But on 31 May, instead of meeting its commitment to deliver the list of parts, Areva announced in a statement that a first internal analysis of two-thirds of the findings of anomalies had been completed, and said again that it “*does not affect the mechanical integrity of the manufactured parts.*” The chief of the antenna ASN based in Caen, Guillaume Bouyt immediately reacted “*ASN considers that the justifications provided to date is insufficient to reach that conclusion*”.

EDF, in turn, stated that “safety was not compromised”<sup>3</sup>, but did not produce any new evidence. Its analysis seems to be based on additional data provided by Areva. In view of the concerns regarding the technical quality and the sincerity of Areva’s documents, this move can by no means be regarded as sufficient.

It is impossible to guarantee the quality the parts when the content of the documents cannot be trusted. Despite this fact, on 4 May, France’s environment minister Ségolène Royal affirmed on RTL radio:

*“I reviewed the matter this morning before coming here and can safely say that initial results are good: the parts are compatible – it is the documents which are defective”.*

These declarations seem premature, to say the least. When errors are mistakenly or intentionally included in manufacturing documents, the true quality of the components cannot be known with certainty without verification or new tests. Like those under way for the upper and lower heads of the EPR vessel, these tests will be long and complex. It is currently impossible to predict acceptable results, especially given that initial indications are, to the contrary, worrying.

## Trust in quality control: irreversible damage

Furthermore, the existence of falsifications, even if re-assessments show they do not jeopardise the safety of parts, is an extremely worrisome hypothesis. It is a sign made all the more alarming by the recent revelation of fraud involving forged certificates<sup>4</sup> for non-compliant mechanical parts made by a machinery company in the Loire region (Boën’s SBS forge, according to the press<sup>5</sup>) and used in several nuclear stations.

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<sup>2</sup> ASN, Information Note, 3 May 2016, <http://bit.ly/1tnQCcl>

<sup>3</sup> EDF, Information Note, 13 June 2016, [bit.ly/1ZNhgG8](http://bit.ly/1ZNhgG8)

<sup>4</sup> “Falsification of materials analysis reports: ASN is collaborating with the ongoing judicial inquiry” - 20 April 2016, <http://bit.ly/1U6vAWv>

<sup>5</sup> The ASN news release indicates that “at the request of the judicial authorities, the names of the companies concerned have been withheld.” SBS is mentioned here: <http://bit.ly/1sleSoZ>

France's entire system of safety assessment and supervision is fundamentally based on the quality and accuracy of information provided by manufacturers and operators. This principle dates to the period when the State was the industrial operator, inspector and authority – the possibility of fraud was excluded. Adequate measures to detect and eliminate fraud are not included. Fraud at this level, if it is proven, deeply challenges this entire system and our trust in how safe it is. It is therefore all the more shocking to hear the minister in charge of nuclear safety downplay initial findings.

### **Complete transparency must be ensured quickly**

The little information available is not enough to measure the extent and gravity of the matter, though some does exist on the number of problematic reports and the nature of some of them. The ASN has asked Areva to provide it with a list of the parts concerned, but Areva as well as EDF refuse to take this necessary, albeit not sufficient, step.

To ensure complete transparency, **Greenpeace asks that this list of parts, along with detailed information about incriminated documents and the nature of the irregularities, omissions or modifications noted for each part, be made public.**

This detailed list must be released to the French authorities and public AND to the authorities and the public in each country concerned. Each country's safety authorities and regulators must be able to decide how to assess stations using parts that were machined at the Creusot site and on any action to be taken, if necessary.

Ségolène Royal's reaction contrasts with her response to the initial discovery of a problem with the EPR vessel in April 2015<sup>6</sup>, when she ensured "*the utmost transparency on the subject*" and, above all, appealed to the High Committee for Transparency and Information on Nuclear Safety (HCTISN)<sup>7</sup>. She asked that: "*no doubt be allowed to subsist after the testing and analysis process as to how these tests are conducted and the content of their results.*" The same requirement must apply to the assessment of all of the problems identified since at the Creusot site.

Asking Areva to handle the detailed analysis – with assistance from EDF – of all of the site's manufacturing reports since it opened is symptomatic of the current system of governance, in which industry is responsible for ensuring safety. This approach is consistent with the 'trust in the honesty of industry' principle – a principle which suspicions of falsifications are calling into question. Trust has been irreversibly damaged. It is essential that an independent and transparent assessment be carried out of the method and soundness of Areva's audit. This must be done to guarantee the absence of similar problems which may be undetected or even concealed in the approximately 9,600 reports which Areva has deemed free from defects.

### **In addition to the audit, systematic re-assessments of parts are needed**

Technical documents must provide irrefutable proof that parts comply with quality requirements – in particular parts subject to the "break preclusion" principle, for which quality is essential to safety. When an error or forgery in a document renders compliance uncertain, only a technical review of the concerned parts can clear up any doubt. In certain cases, a non-destructive inspection of the parts is necessary, involving the surface inspection of chemical composition. When a problem is identified, a destructive inspection of a sacrificed similar part is required to take samples for more detailed chemical or mechanical tests.

In this case, initial assessments confirm the need for such tests. In the case of the EPR vessel, initial destructive inspections carried out on a head similar to those in place revealed excessive carbon levels which Areva considered it had under control thanks to its

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<sup>6</sup> Announcement by the minister, Ségolène Royal on 7 April 2015: <http://bit.ly/24hxhoE>

<sup>7</sup> Letter sent to the HCTISN by the minister, Ségolène Royal on 5 October 2015: <http://bit.ly/1XaFz3h>

manufacturing and quality control system. Similarly, an ASN letter dated 09 May 2016<sup>8</sup> reveals that a similar carbon segregation problem had been identified in several head domes for steam generators, the destination of which the ASN does not specify. Although Areva approved the manufactured parts, a review of the tests carried out on a sacrificed part (an identical part destroyed for the purpose of the tests) and the subsequent inspections which followed led Areva to make these parts again.

**Greenpeace asks that once the list of concerned facilities is published, their operations be halted immediately so that an initial inspection can identify necessary tests** and additional proof to be provided in order to clear up any doubt regarding the quality of all incriminated parts.

### **Parts in service: at least a dozen countries potentially affected**

In over 200 reports on the most safety-sensitive equipment in nuclear reactors, around 60 parts are thought to be currently in service in operating reactors at nuclear plants across France. All of EDF's reactors, as well as other large components in other nuclear stations, may be affected by parts produced at Creusot Forge. Despite the existence of this specific figure, no official information on the reactors or affected parts has been provided so far. Increasingly precise indications are available day after day, although they do not appear to be always fully consistent:

- shortly after “anomalies” were detected in the EPR vessel, the ASN voiced concern over several vessel heads (manufactured in previous years to replace the original heads), and specifically mentioned the Chinon B3 and Cruas 3 reactors;
- in a 25 May article, satirical weekly *Canard Enchaîné*, referring to an internal report from Areva, reported at least two facilities with defects “which could affect safety”: a primary head in a steam generator at the Gravelines 2 plant and an intermediate shell in a steam generator in Bugey 2.
- On the 31 May, Areva specified that two thirds of the reports had been analyzed, and that the last third was still being examined. EDF said on 13 June that Areva provided it with 80 reports, concerning approximately one third of the nuclear fleet, i.e. 19 reactors on 12 stations: Blayais 3, Bugey 2, 3 and 4, Cattenom 1, Chinon 1 and 3, Civaux 2, Dampierre 1, 3 and 4, Fessenheim 1, Golfech 2, Gravelines 3, Paluel 1, Saint-Laurent 1 and 2, and Tricastin 2 and 3. According to EDF, only 12 reports on 9 parts used at Blayais 1 and Fessenheim 2 would still be under analysis.

At the same time, even if some of the 140 or more erroneous reports may concern parts which are no longer in use, many of them are likely to concern equipment which is currently used in reactors operated abroad. Based on information published in recent years by Areva regarding the clients of its heavy equipment manufacturing activity, Greenpeace established a list of at least a dozen countries in Europe and around the world operating reactors fitted with parts made at Creusot Forge and which could be potentially affected by errors or falsifications.

In Europe, potential problems were confirmed in at least three countries:

- **United Kingdom:** ONR, Britain's regulator confirmed in a communiqué dated 13 May<sup>9</sup> that the Sizewell B reactor is equipped with potentially affected parts from the Creusot site and stated it was waiting until 31 May for detailed information from Areva confirming whether the parts were in fact affected. The reactor vessel, and the replacement vessel closure head may be affected.

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<sup>8</sup> ASN letter to the General Director of Areva NP dated 9 May 2016: <http://bit.ly/1Wurr4f>

<sup>9</sup> ONR communiqué, 13 May 2016: <http://bit.ly/1OZYI4S>

- **Sweden:** Similarly, Vattenfal, which operates the country's Ringhals station, said on 18 May<sup>10</sup> that two components used in the Ringhals 4 reactor may be affected. Steam generators in reactors 3 and 4 have been replaced with Creusot-made parts.
- **Switzerland:** vessels in the Beznau 1 and 2 reactors as well as replacement steam generators were supplied by Creusot. While there has been no official confirmation, Swiss media<sup>11</sup> has reported on an ASN report suggesting that parts from Creusot may need more extensive testing.

Stations operating in other European countries, including the following, may also be affected:

- **Belgium:** Tihange and Doel use replacement steam generators, vessel closure heads and pressurisers supplied by Creusot.
- **Spain:** Asco and Almaraz use replacement steam generators from the site.
- **Slovenia:** Krsko uses replacement steam generators from the site.

Elsewhere, potentially affected parts are used in operational reactors on three continents:

- **United States:** various reactors use potentially affected parts: vessel components (at Prairie Island 1 and 2), replacement lids (North Anna, Surry, Three Mile Island, Crystal River 3, Arkansas, Turkey Point, Salem, Saint Lucie, D.C. Cook), steam generators (Prairie Island 1, Callaway, Arkansas, Salem, Saint Lucie, Three Mile Island) and pressurisers (Saint Lucie and Milestone).
- **Brazil:** Angra II uses replacement steam generators.
- **China:** equipment in the Guangdong 1 and 2 reactors, Ling Ao 1 and 2 reactors and Ling Ao 3 and 4 reactors, as well as replacement reactor vessel heads at the Qinshan station.
- **South Korea:** parts in the Ulchin 1 and 2 reactors.
- **South Africa:** parts in the Koeberg 1 and 2 reactors.

## International precedents

To date, the safety assessment system, traditionally based on cooperation between firms which were entirely owned and operated by the State, has not identified problems or concerns regarding falsification on this scale. However, cases of massive fraud have been revealed in other countries.

In 2002 in Japan, where nuclear operators are private, falsifications were discovered which went back to the 1980s and became systematic in the 1990s. The fraud involved the concealment of defects such as cracks and their severity, and tampering with safety tests during inspections, in connection with several primary circuit components in boiling water reactors, including those at Fukushima Daiichi, as well as other safety-sensitive parts such as recirculation pumps.

Authorities focused on the worst 29 cases involving TEPCO, but the fraud was far more vast and implicated other operators as well. At least two thirds of the country's boiling water reactors (BWR) were affected, and five out of eleven of Japan's nuclear operators and the three companies which provided heavy equipment for these reactors were implicated. Given the severity of the breaches, the threat posed to safety and the inspections which were required, TEPCO's 17 reactors were taken off line temporarily. They were put back into operation only after various inspections and repairs were carried out.

On 11 October 2002, five out of Japan's eleven nuclear operators admitted to having falsified safety reports for two-thirds (18) of the 28 boiling water reactors in the country. All three of

<sup>10</sup> Vattenfal communiqué, 18 May 2016: <http://bit.ly/2800g54>

<sup>11</sup> "Le scandale en France remet en question la sécurité de Beznau I", [www.24heures.ch](http://www.24heures.ch), 27 May 2016 (in French)

the firms which equipped Japanese BWRs were implicated in concealing safety-related problems.

Between 2012-2014, in Korea, where the safety assessment system is similar to the one in France, and the nuclear operator is a subsidiary of the Korean Electric Power Corporation (KEPCO) (which is 51% State owned), various cases of fraud were uncovered. Falsified certificates for cable systems led to the closure of two reactors in 2013, the extended closure of one reactor, and delays in the start-up of a newly constructed one. In October 2012 the government indicated that 277 out of the 22,000 component inspection documents studied, involving 20 reactors, had been falsified, and that 2,010 out of 218,000 documents studied, involving an additional eight units – five of which were under construction at the time – had also been forged.

If the falsifications implicating the Creusot site are confirmed, they should result in the precautionary closure of the reactors and necessary inspections, as Greenpeace requests. Furthermore, this is the first time such a problem has occurred at the international level, between operators and one supplier located in different countries. Even if it is premature to address this aspect now, legal issues regarding damage liability may arise.

### **Reactors under construction: the uncertainty of EPR**

While it is too early to say if these possible falsifications directly implicate parts made for EPR reactors currently under construction, the irregularities observed in these parts and a lack of transparency means that the utmost caution is needed regarding the quality – and therefore safety – of manufactured components for EPR reactors.

The **Flamanville EPR** is the first among those affected by these problems. The first “serious anomalies” identified by the ASN in spring 2015 were found on the upper and lower heads of the vessel. Excess carbon in the central portion raises questions about their mechanical ability to withstand a sudden breakdown in certain conditions (notably, the need, in certain cases, to inject large amounts of cold water into the vessel, which can create a risk of thermal shock).

A technical assessment of these issues is under way. Contrary to the comforting statements made in recent months, tests have proven to be more complex than expected, particularly because the extent of carbon segregation is in fact greater than what Areva estimated. The ASN approved a program involving two sacrificial parts in December 2015. Areva and EDF, however, announced in April 2016 that the program will include a third part (the inclusion of this part, contrary to their communiqué, is still under review by the ASN and awaits approval). The technical findings of the assessments and studies carried out by Areva, which remain quite uncertain, will not be submitted to the ASN before late 2016 or even early 2017. Subsequent analysis of the results by the Institute for Radiation Protection and Nuclear Safety (IRSN) and the Advisory Committee of ASN means that the ASN will only be able to issue recommendations four or five months later.

Parallel to the technical assessment process, examination is needed of how such a breakdown in the quality of essential parts could happen. To this end, the Ministry of the Environment, Energy and Marine Affairs has asked the HCTISN to clarify how such an irregularity occurred and why it was only revealed nine years after the incriminated parts were manufactured. A specific working group within the HCTISN relies on elements submitted to it in a fully transparent manner by the ASN; this despite Areva, to the contrary, not facilitating access to the information.

These exchanges highlight that as early as **August 2006**, the ASN, pointing out the risk of carbon segregation, asked Areva to provide evidence of the quality and consistency of the central portion of the heads (where excess carbon is found). Overall, the process reveals the lengths to which Areva went to delay providing evidence of quality in order to ship and install

the defective vessel before its faults were identified, giving the ASN and public authorities no choice in the matter.

In the letter dated 9 May 2016<sup>12</sup> to Areva, the ASN raises another question. Since the beginning, Areva has justified its manufacturing process by saying that the heads were similar in size to parts used in 1,300 MWe reactors (made using the same process), but “these justifications have not been supported by documentary evidence.” In 2015, Areva stated that the technical manufacturing process for the upper head was very similar to that of the one-piece replacement lid for 900 MWe reactors, but the ASN has pointed out that teams at Creusot Forge “have been unable to provide documentary proof during inspection.” In other words, no technical document exists to support Areva’s suggestion that the risk of segregation was fully considered.

The same letter also reveals both a new technical problem, and a confirmed case of concealment involving heads in the Flamanville 3 pressuriser. Although not initially planned, additional tests performed in December 2008 showed significant variations from expected results, which Areva attributed to the presence of major carbon segregation in the upper head of the pressuriser. However neither these tests nor their results were shared with the ASN, which discovered them during the April 2016 inspection.

All of these elements, which have caused additional delays to construction at the Flamanville site, reinforce the possibility that the ASN will not grant the approval Areva needs to prove the safety and quality of the vessel, which could definitively jeopardise the launch of the EPR reactor.

These developments have obvious implications for other EPR reactors under construction or planned worldwide. The **Taishan EPR** is the most directly affected: at least two, and possibly all four vessel heads in the two EPR reactors under construction in China (in Guangdong province) were manufactured at the Creusot Forge site using the exact same process as the one used for parts at Flamanville. The Taishan construction site is therefore exposed to the same risks as Flamanville, and, furthermore, the current audit of everything manufactured at Creusot may find other parts are affected. Vessel heads for the **Olkiluoto 3 EPR in Finland** were forged and processed in Japan and are therefore not concerned, but verification is needed to ensure that other parts in this reactor are not subject to the problems at Creusot (in terms of steam generators and pressurisers, for example).

Lastly, concerning the already highly controversial **Hinkley Point C** project in the UK, clarifications are needed as to which equipment was made in advance: the upper and lower heads of the vessel, which were already forged for this project at the Creusot site using the same techniques that were used to make the Flamanville parts, are now earmarked for destruction to provide samples for the tests currently under way to demonstrate the safety of the Flamanville reactor. This is further evidence that the project is unviable.

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<sup>12</sup> ASN letter to the General Director of Areva NP dated 9 May 2016: <http://bit.ly/1Wurr4f>