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Presentation before the U.S. Nuclear Regulatory Commission
Petition Review Board
10 CFR 2.206 on the AREVA-Creusot Forge components in US Reactors

Thank you.

I would first like to express my appreciation to the staff of the U.S. Nuclear Regulatory Commission for its December 30, 2016 decision to deny AREVA's December 15, 2016 request to withhold from public disclosure the U.S. reactors and their at-risk safety-related components that make up the all-important pressure coolant boundary during operation. AREVA had sought the non-disclosure as a business secret.

Those 17 units are now publicly identified as; Arkansas Nuclear One Unit 1 (AR); Beaver Valley Unit 1 (PA); Comanche Peak Unit 1 (TX); Farley 1 & 2 (AL); Millstone Unit 2 (CT); North Anna Units 1 & 2 (VA); Prairie Island 1 & 2 (MN); Sequoyah Unit 1 (TN); South Texas 1 & 2 (TX); Surry Unit 1 (VA); St. Lucie Unit 1 (FL); VC Summer (SC) and; Watts Bar Unit 1 (TN).

The Petitioners have filed an emergency enforcement petition under Chapter 10 of the Code of Federal Regulation Part 2.206 in request that the

US nuclear safety agency engage the inspection and material testing of US reactors with at-risk components with the same urgency as France and other European regulators are approaching the crisis.

Until material testing is conducted here in the United States, the NRC and more importantly the communities living near these impacted nuclear reactors will not know what risks these nuclear power stations pose.

The Petitioners have requested the meeting today with the Petition Review Board to supplement their petition for the requested emergency enforcement action.

The Petitioners largely rely upon expert opinion and documentation provided by John Large with Large Associates in their report entitled “IRREGULARITIES AND ANOMALIES RELATING TO THE FORGED COMPONENTS OF LE CREUSOT FORGE,” dated September 26, 2016 and prepared for Greenpeace France.

As a brief recap, in late 2014, the French nuclear design and manufacturing company AREVA notified the French nuclear safety regulator, Autorité de Sûreté Nucléaire [OW-TOR-RITAY-DU-SURETAY-NUCLAY AIR] (ASN), of the results of material tests that had been carried out on a component manufactured at the Creusot Forge in France. These tests were

undertaken by AREVA as part of a Qualification Technique (QT) of components for the European Pressurized Reactor (EPR) under construction at the Flamanville 3 nuclear power plant.

The AREVA test results revealed that the material characteristics of Creusot forged components for the reactor pressure vessel did not conform for fracture toughness to the design-basis specification as a result of anomalies developed during the manufacturing process.

The Large Associates report describes the forging process as it pertains to these anomalies.

In brief, following the pouring of low carbon ferritic steel, the ingot is allowed to slowly cool from the melting temperature of about 1,540 degrees C thereby undergoing solidification of the carbon alloy.

During the solidification process the solute is partitioned between the solid and liquid (molten) phases to either deplete or enrich the interdendritic (a branching, tree-like crystal structure) regions.

The progress of the 'mushy' solid-liquid phase varies within the body of the ingot and, particularly, the localized rate of cooling, leading to macrosegregation variations in the composition of the alloy. Variations in the ingot cooling rate lead to diverse macrosegregation regimes being

generated in different parts of the body of the ingot. In a low carbon steel alloy, this macrosegregation results in enhanced and depleted zones of carbon (i.e. the segregates), that is a loss of homogeneity and, at the microscale, inconsistencies in the chemical and physical make-up of the alloy, all resulting in variation in the chemical and physical material properties of the final steel component. Where the segregates are enhanced over the intended level (i.e. the carbon content is richer) the macrosegregation is referred to as 'positive'.

Almost all macrosegregation is undesirable for the first stage ingot manufacturing in the overall forging route because, unless the affected zones are cropped and discarded from the ingot prior to the final forging-machining processes, the variations remain in the body of the finished component.

The chemical inconsistencies introduced by macrosegregation can deliver different microstructures, and hence inconsistent mechanical properties of the steel.

The inclusion of segregates in finished forged components, even in minute limited quantities, may also lead to the formation of crack-type defects in conjunction with the application of weld deposited cladding.

The early stage of the forging process at Creusot (like all other forges) includes cropping, blooming and discarding potential sections of the ingot to remove the top and bottom macrosegregation zones.

The opportunity to intervene in the forging process to control and limit macrosegregation is during the casting-cooling and, separately, the blooming and discard stages – once these process stages have passed any macrosegregation zone remains captured and is progressively worked into the developing forged component shape.

AREVA now admits that the Creusot manufacturing route was flawed.

Subsequent test findings showed an increased carbon content across a large zone area of the equivalent of each of the upper and lower head shells that were already incorporated into the Unit 3 reactor pressure vessel. The excessive carbon contamination was indicated as present throughout the much of the thickness of the equivalent vessel head shell.

This particular 'carbon anomaly', also known as 'carbon macrosegregation', is identified as an unacceptable weakness in the steel alloy potentially resulting in rapid tearing and catastrophic failure under operational and accident conditions.

“In the macrosegregation zones of excess carbon the toughness or resistance of the steel to tearing and cracking is lowered, rendering forged components vulnerable to abrupt and catastrophic failure via rapid crack propagation and fast fracture – the fracture toughness is a particularly important material characteristic of the through-life components of the nuclear primary pressure circuit for which ‘break preclusion’ (i.e. no opportunity for catastrophic failure) is an absolute prerequisite of the design-basis and nuclear safety case.”

The sourcing of these suspect at-risk components goes beyond the Creusot Forge to include steam generator components manufactured at the Japan Casting and Forging Company and possibly Japan Steel Works which widens the international dimension and crisis of confidence in the safety of nuclear power plant operations. Large Associates reports that following a number of in situ inspections of the JCFC sourced SG manifolds (bottom heads), ASN announced that “JCFC channel heads: first measurements tend to show higher C% than 0.30%”, thereby raising doubts about the toughness characteristic of JCFC sourced components in particular. The higher the concentration of the carbon impurity in steel, the weaker the component.

France's single nuclear power plant operator, Électricité de France SA (EdF), was required to evaluate the nuclear safety of its operational reactors on a case-by-case basis. It was further revealed that the quality assurance and component conformity was unsatisfactory not only for the manufacturing route for the components had never been subject to QT and thus had not obtained a Certificate of Conformity, but also that these uncertainties involved components that had been manufactured as far back as 1965. ASN has generally coined these uncertainties as 'irregularities'. ASN defines such 'irregularities' to "comprise inconsistencies, modifications or omissions in the production files, concerning manufacturing parameters and test results."

The Petitioners remain concerned that if US nuclear power plants continue to operate without thorough inspections and material testing of these at-risk components then the public is being exposed to an unidentified measure of increased and undue risk from a potential accident arising from the failure of the installed suspect and at-risk components. The Petitioners have requested that the NRC responsibly address this undue risk through the requested enhanced inspections and material testing of at-risk components at U.S. reactor sites.

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In response to the growing AREVA-Creusot controversy overseas, David McIntyre with the NRC Office of Public Affairs has stated, "A preliminary review by NRC inspectors indicated that Areva had made a reasonable assessment supporting no nuclear safety concerns." Mr. McIntyre in press accounts has stated that the NRC "confidence is based on the US material qualification process, preliminary structural evaluations of reactor components under scrutiny in France, US material aging-management programs, our participation in a multinational inspection of Creusot Forge, and information supplied by Areva about the documentation anomalies."

However, it is the petitioners' understanding, again according to Large Associates expert evaluation and investigation into the Creusot Forge technical issues in France, United Kingdom and other Europe countries that *"the presence and extent of a macrosegregation zone can only be fully detected, mapped and examined by destructive means, so any potential defects have to be deduced via inference testing of i) a test ring taken from the surplus edges of the component and/or by destructively examining ii) a supernumerary or equivalent, replica forging that has followed through the same manufacturing route as the FA3 component."*

The Petitioners assert that just as the European nuclear safety agencies have required inspections and testing on a case-by-case basis, the NRC

should similarly undertake an urgent examination and material testing of US units with affected components, if not now as the Board has decided, at the next scheduled reactor outage.

Beyond Nuclear and the co-petitioners further supplement their emergency enforcement petition by identifying an apparent irregularity in AREVA communications to the NRC specific to its record keeping of US reactors affected by at-risk Creusot Forge components.

ASN defines 'irregularities' to "comprise inconsistencies, modifications or omissions in the production files, concerning manufacturing parameters and test results". This broad range definition covers AREVA Creusot manufacturing route, material defects, dubious recordkeeping and mismanagement.

The US NRC sent a November 30, 2016 email to AREVA entitled "NRC request for documentation associated with US components manufactured at Creusot Forge." AREVA's initial response dated December 15, 2016, AREVA's Attachment A entitled "Creusot Forge Forgings in U.S. Components" identifies the aforementioned 17 reactor units in the United States including units with components awaiting installation.

AREVA identified in its December 15, 2016 response that these units have a total of 127 at-risk forgings comprising reactor pressure vessels, replacement vessel heads, steam generator components and pressurizers components as part of the Creusot Forge manufacturing chain for its US customers.

AREVA then provided a second response to the list of at-risk components was substantially revised upward in a February 3, 2017 to 164 components for the 17 units.

The Petitioners note that AREVA's February 3, 2017 response to the NRC request for documentation states, "*In Reference 1, AREVA Inc. (AREVA) provided an Attachment A which listed U.S. nuclear power plants that ordered components fabricated with forgings from Creusot Forge (CF). In Reference 2, AREVA noted that the Attachment A list outlined components that were ordered but the actual number of forgings used may need to be updated by the prime contractor. AREVA has recently received information (Attachment B) from the prime contractor and has incorporated it in revision 1 of Attachment A in this [February 3, 2017] letter. No other revisions to Attachment A are anticipated in the future." [Emphasis added]*

Subsequent to AREVA's February 2017 revised response to the NRC, the Petitioners read a news account published by the TimesOnline in Pennsylvania dated February 15, 2017 headlined, "Groups calling for shutdown of Beaver Valley nuclear plant." The Petitioners are providing a copy of the news article to the Board as a supplement to the petition.

The news story states, *"FirstEnergy spokeswoman Jennifer Young confirmed Wednesday that Beaver Valley Unit 1 does have parts that were manufactured at the Areva facility in France. Those parts are located in the replacement reactor head and steam generators at Beaver Valley. In addition, Nuclear Regulatory Commission spokesman Neil Sheehan confirmed that Unit 2 at Beaver Valley 'has components made at the forge, but (FirstEnergy) has decided to delay their installation for at least a few years.'"*

Contrary to AREVA assertions in its February 3, 2017 response to the NRC request for information, Beaver Valley Unit 2 is revealed to have Creusot Forge replacement components for the reactor pressure vessel head and steam generators as confirmed by the NRC Region 1 Office of Public Affairs. However, Beaver Valley Unit 2 and these components are not listed in either of AREVA responses to the NRC Request for Additional

Information. The inclusion of Beaver Valley Unit 2 brings the total of impacted US reactors to 18 units, not 17.

The Petitioners contend that AREVA's apparent failure to accurately capture the factual record of Creusot Forge-sourced replacement pressure vessel heads and steam generator components to FirstEnergy's Beaver Valley Unit 2 constitutes an egregious "irregularity." If this is correct, it is unacceptable in terms of both nuclear safety and public confidence.

The Petitioners additionally supplement the emergency enforcement action request with a copy of the February 21, 2017 email from Paul Gunter with Beyond Nuclear to Neil Sheehan, NRC Region 1 Office of Public Affairs, on how the NRC will disposition AREVA's incomplete record keeping for Creusot Forge components at US nuclear power stations.

Mr. Sheehan's response is provided in the email thread to read, "I will confer with the staff on these questions and get back to you." The Petitioners are still waiting for the NRC Region 1 response to that February 21 email.

Given an apparent "irregularity" by AREVA's omission in two responses to the NRC request for information on Creusot Forge components in US reactors, the Petitioners assert that their action request for the issuance of

confirmatory licensee responses under 10CFR 50.54(f) is justified to rule out or discover any additional “irregularities” of reporting Creusot Forge and Japan Casting and Forge Corporation at-risk components.

In closing, the Petitioners wish to point out the FOIA/PA 2017-00208 request. The Petitioners are providing the Board with the NRC’s acknowledgement letter for FOIA/PA-00208 in request of all relevant NRC communications and documentation that regards the tracking of AREVA-Creusot Forge components at US reactors. The Petitioners request that the Petition Review Board delay its draft decision until after the agency completes its release of documents requested by Beyond Nuclear and allow some reasonable time of review by the Petitioners.

The Petitioners take this opportunity to make a request that the Petition Review Board provide them with an additional public meeting as is provided under Management Directive 8.11 “Review Process for 10 CFR 2.206 Petitions” so that we may incorporate any additional findings provided by the FOIA and further developments and judgments from ongoing investigations from overseas that potentially impact US reactor operators.

The Petitioners further request that that PRB meeting be afforded the opportunity of transparency through a live stream and archived webcast as has been the custom of the agency in previous public meetings under 10 CFR 2.206. The Petitioners assert that this is particularly appropriate for reactor safety issues on an international scope.

Thank you again for this opportunity to address the Petition Review Board and build ta public record on this matter of public health and safety.