AUTORITÉ DE SÛRETÉ NUCLÉAIRE

RÉPUBLIQUE FRANÇAISE

NUCLEAR PRESSURE EQUIPMENT
DEPARTMENT

Dijon, 31st January 2017

The Chairman of AREVA NP

Subject: Inspection of nuclear pressure equipment (ESPN) manufacturing
Multinational inspection – Creusot Forge plant
INSSN-DEP-2016-0759 and INSSN-DEP-2016-0760, 28th November to 2nd December 2016

Dear Sir,

Within the framework of ASN's duties concerning inspection of ESPN manufacturing as stipulated by Article L. 592-22 of the Environment Code, a multinational inspection of AREVA NP took place from 28th November to 2nd December 2016 in its Creusot Forge plant in Le Creusot (71).

With respect to ASN's areas of competence, kindly find herewith a summary of the inspection, along with the main requests and observations arising from the findings made by the inspectors on this occasion.

INSPECTION SUMMARY

With regard to the irregularities detected at Creusot Forge in early 2016, which affect forgings installed in the nuclear reactors of various countries, a multinational inspection of AREVA NP took place from 28th November to 2nd December 2016, in its Creusot Forge plant in Le Creusot (71), in accordance with the inspection protocol of the *Multinational Design Evaluation Program* (MDEP). This inspection, led by ASN, involved inspectors from the American, British, Canadian, Chinese and Finnish safety regulators, who used the *Quality Assurance / Quality Management Criteria for Multinational Vendor Inspection* baseline requirements detailed in MDEP technical report TR-VICWG-03 of 30th January 2014.

The aim of this inspection was to examine the review method for the component files already assessed and those currently undergoing assessment and to examine the organisational and technical changes, as well as the changes in terms of quality and nuclear safety culture implemented within the Creusot Forge plant.

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The inspectors examined the technical documentation concerning the organisation and quality system implemented at Creusot Forge, the AREVA NP review of the Creusot Forge manufacturing files and manufacturing processes control.

In the light of this examination, the inspectors noted that the NQ-ACF-16009 action plan for the Creusot Forge site transmitted to ASN on 1st August 2016 in letter reference ARV-DEP-00544 is in the process of being implemented. The inspectors consider that a certain number of subjects need to be adapted and supplemented, such as management of change, human resources, exhaustiveness of root cause analyses, detection of irregular practices, reviews of manufactured component files, management of current manufacturing processes, internal monitoring by Creusot Forge and the quality and nuclear safety culture.

This inspection was the subject of 18 corrective actions requests and 14 additional information requests.

A. CORRECTIVE ACTION REQUESTS

You sent me and presented action plan reference NQ-ACF-16009 for the Creusot Forge site, which is currently being deployed (hereinafter referred to as the "Creusot Forge quality plan"). This can be broken down into seven points for dealing with the findings and the irregularities already detected at Creusot Forge, identifying and processing any irregularities not yet detected, analysing and reinforcing the efficiency of the production processes in the plant, deploying standard quality and monitoring tools, reinforcing organisation and skills, reinforcing culture and leadership and implementing independent internal monitoring lines. The findings described below were made with respect to the objectives of our action plan.

Definition, monitoring and impacts of the action plan

Analysis of causes of failure to detect irregularities

The inspectors noted that AREVA NP has produced a root cause analysis which led to the irregularities detected at Creusot Forge since 2015. In your letter reference ARV-DEP-00578 of 4th October 2016, you state that some of the actions in your Creusot Forge quality plan come from assessment of the probable causes of the irregularities and that they aim to prevent such practices from happening again in the future.

The inspectors however noted that the causes of the failure to detect these irregularities by the quality system and internal inspection bodies have not yet been analysed. This analysis is essential in order to guarantee the exhaustiveness and pertinence of the improvements that need to be made to prevent this type of irregularity from happening again.

Request A1: I ask that you send me an analysis of the causes of the failure to detect the irregularities identified to date by the quality system and by the internal inspection bodies at AREVA NP.

Analysis of the causes of irregularities and LRA review

Within the framework of your Creusot Forge quality plan, you had a review of the Creusot Forge quality system and manufacturing conformity since 2004 carried out by Lloyd's Register Apave (LRA). This review, combined with your causes analysis, contributes to the definition of the improvement process initiated at Creusot Forge.

I consider however that they are unable to guarantee that all the causes, as well as the corresponding corrective and preventive measures necessary, have been identified. The inspectors noted that there were a number of limitations to the analysis of causes (in particular concerning the methodology applied, the number of participants and the period evaluated), that the LRA review is not at present conclusive with regard to the conformity of the quality system and that the review report was not available as at the date of the inspection.

The inspectors also noted that AREVA NP had carried out these analyses or defined the scope and provided the input data, a process which fails to offer maximum guarantees of independence.

I consider that the identification of corrective measures must be consolidated through an iterative approach, in particular when the LRA review has returned its conclusions and further to the review of the files and analysis of the quality and safety culture at Creusot Forge.

Request A2: I ask that you inform me of the steps you intend to take to consolidate the identification of the necessary corrective and preventive measures.

Monitoring of the action plan

The management of the progress of your Creusot Forge quality plan was presented to the inspectors. They found that not all the actions identified in this plan were adequately traceable, that their link with the results of the analysis of causes or the review carried out by LRA are not systematically traced and that there is no indicator for measuring the effectiveness of each one. The inspectors found that the management of implementation of the action plan is unable to demonstrate that the steps taken are appropriate and long-term.

Request A3: I ask that you document the implementation in your quality system of all the measures identified in your Creusot Forge quality plan. This practice shall enable you to demonstrate the effectiveness and sustainability of these measures.

Change control

The inspectors noted that the Creusot Forge quality plan led to an in-depth change in the organisation and quality system of the plant, which comes on top of the numerous steps taken concerning the manufacturing processes.

The inspectors also found that other organisational changes concerning monitoring had been decided on by AREVA NP.

These changes are numerous and entail risks which could affect the quality of the parts produced. The inspectors found that there are no arrangements for management of change for assessing the impact: identification of changes, evaluation of their progress, effectiveness and sustainability.

<u>Request A4</u>: I ask that you conduct a risk assessment concerning the quality of the parts produced, linked to all organisational changes, the quality system and the monitoring procedures you have implemented or that you will be implementing, and to identify and as applicable implement the necessary preventive measures

<u>Human resources requirements</u>

You presented the Creusot Forge quality plan, as well as the ongoing developments within the AREVA NP group. The inspectors noted that the actions to be performed by the teams in charge of quality and safety represent a significant additional workload, to be carried out at the same time as routine activities.

For example, the personnel questioned stated that the team in charge of quality at Creusot Forge is under-staffed and the inspectors noted that a part of this team was assigned to inputting data into the deviations management system and to corrective measures.

The inspectors also noted the delay in this data input and the fact that the deviations processing monitoring tool was incomplete: no analysis of the causes and impact of the deviations, or identification of corrective measures and deadlines, or assessment of their effectiveness.

Furthermore, the inspectors noted that the existing human resources will need to deal with an increase in workload once manufacturing resumes.

I would recall that the provision of the human resources necessary for the implementation and upkeep of the quality management system and for permanent improvement of its effectiveness is required by section 6.1 of standard NF EN ISO 9001:2008 invoked by the RCC-M construction code that you adopted for the manufacture of level N1 nuclear pressure equipment.

<u>Request A5</u>: In the light of the changes you envisage and the steps necessary for detecting and processing deviations, I ask that you define and make available the human resources necessary for management of routine activities and implementation of the changes.

<u>Review of past and present manufacturing</u>

<u>Organisation and methodology of review of the manufacturing files</u>

In letter reference ARV-DEP-00578 of 4th October 2016 you informed me of your decision to initiate an exhaustive review of the manufacturing files for the parts manufactured in your Creusot Forge plant. During the inspection you stated that this review was being entrusted to your EIRA inspection structure and involved personnel from three geographical sites. You presented the inspector training procedures for this review and their supervision by more experienced inspectors, for whom the qualification criteria were not clearly defined. Finally, you stated that the review by a technical committee of the findings of your inspectors would be subject to certain criteria. These various points are not defined in the notes which were presented to the ASN inspectors (notes reference CM-2016-0023 rev. 0 concerning the organisation of this review, D02-ARV-01-096-931 rev. A concerning examination of the files and the processing of the findings and IN-EIRA-16-0014 rev. 2 concerning EIRA activities within the framework of this mission).

Request A6: I ask that you update and send me the whole documentation setting out the procedures with regard to the organisation, inspector supervision and processing of findings, so that they define all the steps taken to carry out your exhaustive review of the files for the parts manufactured in your Creusot Forge plant.

Scope of checks during the manufacturing files review

The inspectors observed that the purpose of your review of the files, for the parts already delivered to the end customer, was to demonstrate that there was no technical risk liable to compromise the integrity of the equipment and, for the parts currently undergoing assessment, to demonstrate conformity with the applicable requirements. They examined the inspection guides for verification of files associated to forgings, reference 5.31 for the parts already delivered to the end customer and 5.30 for the parts currently undergoing assessment.

They noted that these guides do not ask the EIRA inspectors to stipulate the specifications, codes and standards applicable to the manufacture of each of the parts examined, on the basis of which your inspectors carried out their examination. This information is however essential for interpreting the conclusions of their inspections.

Request A7: I ask that, in your inspection reports, you specify the detailed applicable baseline requirements (specifications, codes, standards) on the basis of which your inspectors performed their examination.

The inspectors noted that guide 5.31 does not require your inspectors to verify that the dimensional inspections, visual examinations and non-destructive tests were carried out in accordance with the applicable baseline requirements. The absence of such checks during your review cannot guarantee the absence of technical elements liable to compromise the integrity of the manufactured parts.

Request A8: I ask that you modify and send me your guide 5.31 to integrate the verification of compliance with the applicable baseline requirements for dimensional inspections, visual examinations and non-destructive tests, in particular their stage of performance, the scope and mode of examination, the acceptance criteria applied and the conformity of the results. Generally speaking, for each verification point in your guides, any information required by the applicable baseline requirements and not appearing in the archived documents shall be identified.

The inspectors examined the inspection report concerning the review of the file for RPV core shell C2 of Bugey NPP reactor n° 5, signed on 4th October 2016. It states that this examination was performed in accordance with revision B of guide 5.31, whereas this guide has been revised since then to include additional verification points.

Request A9 : I ask that you carry out and send me an analysis of the impact of the updating of your inspection guides on the reports already produced in the light of previous revisions of these guides. For the review of the file for the RPV core shell C2 of Bugey NPP reactor n° 5, you will specify the steps you are taking to take account of the additional verification points which are included in the revised guide 5.31.

Production process control

Increasing the technical skills of operators and coordinators

Your Creusot Forge quality plan is structured according to a number of points, one of which aims to reinforce the organisation and skills within your plant. The inspectors noted that a campaign to raise awareness of technical issues relating to certain manufacturing operations had been carried out with the operators and technical coordinators. The inspectors questioned some of those present in the workshop concerned by these issues and noted that the level of awareness of the issues linked to forging of stainless steel parts could be improved.

Request A10: I ask that you adapt your awareness-raising campaign accordingly. You will send me documents identifying the Creusot Forge personnel being made aware of technical issues and presenting the methods for reinforcing and maintaining these skills over the long-term for each identified manufacturing process.

Internal monitoring of Creusot Forge activities

Monitoring by EIRA

The inspectors noted that you asked your EIRA inspection structure to conduct an internal inspection of the Creusot Forge activities, until such time as the internal monitoring put into place by this plant's quality department was considered to be operational and robust. This mission is described in a document presented to the inspectors and entitled "monitoring of manufacturing activities at Le Creusot". This document carries no reference and is not registered in your quality system, which is in deviation of section 4.2.1 of standard NF EN ISO 9001:2008 referenced by the RCC-M construction code that you selected for the manufacture of level N1 nuclear pressure equipment.

Request A11: In your quality system, I ask that you formally identify the procedures for internal monitoring of activities at Creusot Forge by EIRA and send me the corresponding documents.

The inspectors examined the EIRA inspection guide concerning monitoring of heat treatment activities and noted that this guide specifies no particular verification point for the various parameters identified by Creusot Forge as critical during quenching operations. More generally, they noted that the monitoring guides used by EIRA are those implemented generically during AREVA NP monitoring of its suppliers. EIRA also intends to increase the frequency of implementation of these guides within the Creusot Forge plant. These procedures cannot guarantee the robustness of internal monitoring in your Creusot Forge plant if the inspection guides used are not appropriate for the specific nature of its manufacturing processes.

Request A12: I ask that you implement internal monitoring appropriate to the specific nature of the manufacturing processes at Creusot Forge and inform me of these procedures.

Supervision of Creusot Forge inspectors

The inspectors noted that the Creusot Forge quality manager supervises the plant's internal inspectors but that no qualification for this supervision function is defined.

Request A13: I ask that you define and send me the qualification corresponding to the function of supervisor of the Creusot Forge internal inspectors.

Detection of irregular practices

The inspectors noted that a programme dedicated to fraud detection was in the process of being drawn up at AREVA NP.

The inspectors also noted that the scope of provisional monitoring performed by AREVA NP's EIRA internal inspection structure, pending qualification of the Creusot Forge plant's internal inspectors, does not deal with fraud detection. Changes to the scope of monitoring were in progress as at the date of the inspection.

The inspectors noted that identification of the first irregularities dates from February 2016 and that at that date, no specific checks were run by AREVA NP to detect this type of practice.

Request A14: I ask that you rapidly take steps to detect frauds. You will send me details of these measures and the corresponding calendar.

Quality and nuclear safety culture

Assessment of the nuclear safety culture

The irregularities you detected in the files for the parts manufactured in your Creusot Forge plant reveal unacceptable practices. The inspectors found that the level of the current nuclear safety culture within Creusot Forge has not been assessed and that no assessment criteria have been defined.

The inspectors investigated the effectiveness of the steps taken at Creusot Forge to reinforce the quality and safety culture. Two examples in particular draw their attention:

- the inspectors found that a Creusot Forge internal inspector had on two occasions found a deviation concerning the dimensional verification of Charpy test specimens, but did not open a quality incident sheet, given that the deviation had already been identified elsewhere and that corrective measures were in progress;
- on a workshop document, dated September 2016, the inspectors observed recorded manufacturing data that had been changed by hand with no explanation, date, nor identity of the person involved. This document was the subject of several inspections (Creusot Forge internal inspection, EDF monitoring, approved third-party and inspection by the AREVA NP group) before the deviation was recorded by the Creusot Forge quality department.

In this context, you provide no justification of the fact that the present level of quality and nuclear safety culture at Creusot Forge is acceptable. Nor do you demonstrate that the nuclear safety culture in your plant is being constantly improved, as required by IAEA Requirements 12 and 13 defined in the *General Safety Requirements Part II, Leadership and Management for Safety*.

<u>Request A15</u>: I ask that you carry out an assessment of the level of the quality and nuclear safety culture in your Creusot Forge plant and take measures to guarantee continuous improvement of the nuclear safety culture above the level you have defined as acceptable.

<u>Safety culture at all management levels</u>

The inspectors found cases demonstrating that the principles of nuclear safety culture were not adequately fostered at all management levels within Creusot Forge, contrary to the stipulations of IAEA Requirement 12 defined in the *General Safety Requirements Part II, Leadership and Management for Safety*.

<u>Request A16</u>: I ask that you take steps to guarantee that the principles of nuclear safety culture are applied and fostered at all management levels within your Creusot Forge plant.

<u>Other points</u>

<u>Signatories of quality assurance documents</u>

The inspectors noted that Creusot Forge had recently set up a system of double checks on numerous manufacturing and testing documents. The categories of persons involved in writing, checking and approval are defined, but there are no requirements for these persons to have sufficient quality assurance skills.

<u>Request A17:</u> I ask that you define the role and the skills required for the signatories responsible for writing, checking or approving these documents. You will send me these requirements.

<u>Non-conformity on dimensional verification of Charpy test specimens</u>

A deviation was detected regarding non-verification of a dimension on the Charpy test specimens, required by standard NF EN ISO 148-1. This deviation was attributed to the dimensional verification machine in your plant, which was to be replaced in January 2017.

I consider that an impact assessment must be produced for the tests performed on the test specimens inspected by the machine, which was unable to verify all the dimensions required by the standard.

<u>Request A18</u>: I ask that you produce this impact assessment.

B. ADDITIONAL INFORMATION REQUESTS

Scope of checks during the manufacturing files review

The inspectors noted that guide 5.31 did not ask your inspectors to check the location and the direction of sampling of test coupons and test pieces intended for mechanical tests, even though this verification point is stipulated in guide 5.30.

Request B1: I ask that you inform me of the reasons guide 5.31 does not include checks on the location and sampling direction of the mechanical test coupons and test specimens.

You presented the inspectors with the review process for the manufacturing files for forged components intended for civil nuclear power reactor pressure equipment, specifying that this took account of all the experience feedback from the other actions already initiated, in particular the LRA review which concerned a sample of the manufacturing files. At the end of this review, LRA made specific comments for each file examined. Guides 5.30 and 5.31 that you use require that your inspectors take account of these comments. LRA representatives presented technical recommendations, which were transmitted to you following the second phase of their review, some of which are generic in nature. The inspectors noted that no document formally incorporates these recommendations into the verification guides used for the purposes of your review. For example, the LRA auditors identified deviations concerning the dimensions of mechanical test specimens, while no verification on this subject appears in your guides.

Request B2: I ask that you inform me which LRA technical recommendations are not subject to verification in your guides 5.30 and 5.31, tell me the reasons and present how these recommendations will be taken into account in your review.

You also informed the inspectors that the review process for the manufacturing files for forged components intended for civil nuclear power reactor pressure equipment took account of all the generic irregularities detected by AREVA NP during the so called "marked files" review and the GV/RP2 and GV/RQ1 project (replacement steam generators) files. These irregularities are presented in a memo which more specifically mentions certain verifications to be carried out to assess the extent to which the chemical analysis reports produced by an outside laboratory are credible. This memo more specifically asks that particular attention be given to the format of the reports which, in certain cases, were improperly modified. It also states that when it is impossible to find the records archived directly by the outside laboratory, this should be mentioned on the technical processing sheet. The inspectors noted that these two verification points do not appear in guides 5.30 and 5.31 even though they appear in the memo on the basis of which these guides were produced.

Request B3: I ask that you inform me how your inspection guides take account of all the recommendations in your memo identifying the generic irregularities you have detected, in particular those concerning the examination of the chemical analysis reports. If any points in this memo are not incorporated into your guides, you will explain why.

Specific investigations conducted outside the individual files review

Several elements detected during the review of the so called "marked files" evoke doubts concerning the drop-weight test records. Consequently, the conformity of the drop-weight tests cannot be guaranteed solely by a documentary review of the individual files and, if there is no guarantee of the RT_{NDT} values contained in the files, the consequences for the integrity of the parts must be analysed.

Request B4: I ask that you assess and inform me of the level of confidence that can be placed in the RT_{NDT} values contained in the manufacturing files and, as necessary, analyse the consequences for the integrity of the parts.

Review of casted components files archived by Creusot Forge

The information you presented for the inspection concerns the review files for the nuclear pressure equipment forgings installed or intended for installation in civil nuclear power reactors. Certain generic recommendations presented by the representatives of the LRA review concern files for casted components and relate to weld repairs and radiographic inspection of these castings. During your examination of the so called "marked files", you also made observations concerning casted components. As yet, you have not sent ASN the verification procedures for the files concerning manufacture of casted components.

Request B5: I ask that you inform me of the steps you are taking for examination of the casted components manufacturing files, regardless of their archival location. You will specify how experience feedback from both your review of so called "marked files" and the LRA recommendations are taken into account.

Exhaustiveness of production process control analyses

The inspectors examined your Creusot Forge quality plan, which more specifically contains a series of measures for analysing and reinforcing the effectiveness of the plant's production processes, along with the deployment of standard quality and monitoring tools. In this context, you carried out failure modes, effects and criticality analyses (FMECA) on certain processes linked to the manufacture of parts for the ongoing contracts (action n° 15 in your Creusot Forge quality plan). The inspectors examined the FMECA concerning the manufacture of nozzle support shells and upper shells from ferritic steel for the SG/ND replacement steam generators intended for the 1300 MWe reactors. They noted that this FMECA had been carried out only for the forging and heat treatment operations. This analysis does not for example take account of proven failures in the past linked to the processes for analysing the hydrogen content during forging, machining of test rings and peelable coating. No document substantiating the choice of this scope of analysis and its objective was presented to them.

Request B6: I ask that you explain the reasons for which not all the processes linked to nozzle support shell and upper shell manufacturing were the subject of a FMECA.

The inspectors found that the FMECA of the forging and heat treatment processes for the nozzle support rings and upper shells for the GV/ND steam generators took no account of the failures caused by the lack of homogeneity throughout the useful volume of the furnaces, even though this type of deviation was detected during the course of previous manufacturing operations in your plant.

<u>Request B7</u>: I ask that you substantiate the failure to take account of the flaws caused by the lack of homogeneity throughout the useful volume of the furnaces in your FMECA of the forging and heat treatment processes for the nozzle support rings and upper shells for the GV/ND steam generators.

The inspectors examined the FMECAs used for the manufacture of the GV/ND steam generators' nozzle support shells and upper shells made of ferritic steel as well as the austenitic-ferritic stainless steel main coolant lines. They found that with respect to certain failures considered to be the most critical, for example those linked to the quenching operations, the action taken to prevent them happening is not specified, more particularly if this action is already put in place in the plant. There is thus a risk that all the countermeasures needed to prevent the failures identified in your FMECAs are not permanently implemented within the Creusot Forge plant.

<u>Request B8</u>: I ask that you send me the documents demonstrating the implementation at Creusot Forge of all the countermeasures needed to prevent the failures identified in your FMECA concerning the manufacture of the nozzle support shells and upper shells for the GV/ND steam generators, including if these countermeasures have already been implemented within your organisation.

The inspectors examined how the failures linked to the quenching operations were taken into account in your FMECA concerning the steam generator nozzle support shells and upper shells. They noted that the failure of the agitators had been assessed with a lower criticality level than the other failures considered.

<u>Request B9</u>: I ask that you substantiate the criticality level assigned to the failure of the quenching tank agitators, in particular in the event of failure of all the agitators.

The inspectors noted that your personnel in charge of heat treatment operations used a list of check-points ahead of quenching, in order to ensure that the operation could take place in good conditions. They noted that this document was an informal one and was not recorded in your quality system.

<u>Request B10</u>: I ask that you inform me of the reasons for which the document containing the check-points ahead of the quenching operation is not recorded in your quality system and demonstrate how this practice is compatible with the long-term manufacturing process control objective.

The inspectors examined your review of the capability of the non-destructive testing techniques utilised at Creusot Forge (action n° 11 of the Creusot Forge quality plan). They noted that the conclusions of this review and the resulting actions were not formally documented. I consider that in the absence of any formal documentation of the conclusions of your analysis, the capability of your inspection techniques is not proven.

<u>Request B11</u>: I ask that you inform me of the actions taken at Creusot Forge following your capability analysis of your non-destructive inspection techniques.

The inspectors noted that an action was in progress to improve Creusot Forge's monitoring of the quality of the ingots ordered from the steel mill (action n° 17 of the Creusot Forge quality plan).

<u>Request B12</u>: I ask that you send me the conclusions of action n° 17 of your Creusot Forge quality plan.

The inspectors noted that the Ishikawa analysis of your forging process for the steam generators' nozzle support shells and upper shells and the analysis of the capability of your non-destructive inspections techniques were performed exclusively by persons directly involved in carrying out these activities. They in particular noted that the impacts on the performance of the other activities carried out during manufacturing, and organisational and human factors in general, were not exhaustively taken into account.

<u>Request B13</u>: I ask that you inform me how your production processes efficiency analysis takes account of the impacts of a process on the interacting processes and of organisational and human factors.

<u>Monitoring by EIRA</u>

During the inspection, it was impossible to ascertain whether the internal monitoring performed by EIRA in your Creusot Forge plant only concerned the manufacture of components intended for equipment manufactured by AREVA NP.

<u>Request B14</u>: I ask that you inform me of the scope of the activities for which internal monitoring of the Creusot Forge activities will be carried out by the EIRA inspection structure.

C. OBSERVATIONS

Not applicable.

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Kindly send me your comments and answers concerning these points within a maximum of two months. As regards the commitments you will be required to make, I ask that you identify them clearly and indicate a completion date for each one.

Finally, in accordance with the transparency and public information approach set out in the provisions of Article L. 125-13 of the Environment Code, I inform you that this letter will also be placed on-line on the ASN website (<u>www.asn.fr</u>).

Yours sincerely,

The Deputy Director General

Julien COLLET

External copies:

- foreign safety regulators who took part in the inspection