Irregularities and falsifications

Background and suggested improvements

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OUTLINE

1. Background: Technical EPR vessel head anomaly

2. Irregularities and falsifications

3. What kind of improvements with regard to CSFI?
Flamanville 3 RPV anomalies

- Compliance with minimal mechanical properties required in acceptance tests zone (surface to be welded)

  ▪ Sample test zone

  ▪ Acceptance tests zone

- Chemical and mechanical tests on a sample of the EPR reactor vessel head and bottom (late 2014, performed to address the risk of heterogeneity at ASN request)

  ➢ Results of Charpy test (impact energy) lower than codes and regulation values

  ➢ Attributed to the high carbon concentration in the sample resulting from the manufacturing process (large ingot)
Flamanville 3 RPV anomalies

New French regulation highlighted the risk of heterogeneities in the vessel heads

Technological anomaly
Identification of a zone with higher carbon content and lower mechanical properties than expected

Risk of brittle fracture

AREVA has to demonstrate the behavior of the vessel heads

- Demonstration that the thermal-mechanical loads can’t initiate the propagation of the biggest potential defect, not detected by NDT

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Flamanville 3 RPV anomalies

Same anomaly in other components?

Background: Technical EPR vessel head anomaly

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Flamanville 3 RPV anomalies

Review identified several SG bottom channel heads (2015)

- Manufactured by Creusot Forge and Japan Casting & Forging Corp. (18 PWR units in France)
- Charpy V-notch tests results (approximately 30J at 0°C): no compliance with French regulation on a qualification component

Same anomaly in other components?

Generic anomaly in the composition of the steel of heavy components: a technical anomaly despite compliance with industrial codes and standards, highlighted by the French regulation

Potentially international issue

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WENRA works on this issue (carbon heterogeneity) in order to consider a potential recommendation.

1. On related safety risks,
   - Licensees should be encouraged to identify the components concerned by carbon positive macro-segregation issue, among those equipping operating reactors.
   - Licensees should launch Investigations and corrective actions to demonstrate that components affected by carbon segregation are safe in operation.

2. On manufacturing processes, licensees have to monitor the manufacturing processes that may cause a carbon segregation concern and therefore affect the mechanical properties of the products, especially the weight and type of ingots, the pouring process, the discard rate, the machining rate and the forging stages.

3. On the codes and regulation, action should be taken on current manufacturing codes or regulation so that they prevent the risks due to residual carbon positive macro-segregation.

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Audit of manufacturing quality in Areva Creusot Forge plant (2015)

First audit limited in terms of period (between 2010-2014); out of the manufacturing period of FA3 vessel

At end of 2015, ASN requested to extend the period of the audit

Flamanville 3 RPV anomalies

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- Areva Creusot Forge (France) – 2016
  - Irregularities detected concerning manufacturing parameters or test results
    - 87 marked files
      - inconsistencies
      - modifications
      - omissions in the production files

File archived by Le Creusot ≠ File transmitted to manufacturer, licensee, ASN

Irregularities of about 400 pieces among 10,000, since 1965
(around 100 for French nuclear industry: SG, primary branch, transport packages)

Main safety case for the lower shell of an SG in F

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Irregularities and falsifications

New SG in Gravelines – ASN request to check files

- Irregularity discovered in a unmarked file
- Changes made to the results of mechanical tests on the upper shell

File archived by Le Creusot ≠ File transmitted to manufacturer, licensee, ASN

File archived by Le Creusot

File transmitted

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Irregularities and falsifications

2015:
- Several cases of nonconformance in the products manufactured at Le Creusot
- ASN requests inspections of past manufacturing products, which exhibit noncompliant results

2016: New inspections launched by AREVA

2017: Full examination decided: 10000 files, 6000 of them in the nuclear field, 150 people dedicated to examinations

From September 2016
Full examination process

July 2016
Discovery of irregularities in « unmarked files »

April 2016
Discovery of « marked files »

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Irregularities and falsifications

Meanwhile, other CSFI cases

- **Westinghouse - Mangiarotti (Italy) – November 2015**
  - Manufacture of heavy components (steam generators for EDF, AP1000…):
    - Concealment of the absence of the heat treatment on a gage block and attempt to transmit a falsified certificate on this block

- **SBS Forge (France) – November 2015**
  - Forge specialized in ring rolling products: Metallurgical reports had been falsified
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Findings

- CSFI as well observed abroad
- Controls based on trust and openness put into question
- In 2015 and 2016, falsifications especially in pressure equipments

Need to adapt the **oversight processes** (internal and external)

Need for an analysis of the **reasons for irregularities** in order to adapt the monitoring system
What kind of improvements with regard to CSFI?

Analysis of the reasons for irregularities system

- Economic pressure
- Technical difficulties
- Gain in time
- Poor appraisal of safety issues and requirements
- Culture of deviation justifications

Motivation

Opportunity

Justification

Fraud risk

Ineffective controls
Inappropriate organization
Handwriting documents

Dr Donald R. Cressey – Triangle fraud (1950)

Actions to adapt the monitoring system

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What kind of improvements with regard to CSFI?

Information and notification
- Protection of whistle-blowers
- Encouraging the information to Regulatory bodies when knowing case of falsification
- Systematic analysis of alerts

Controls and tests
- Promoting automatic data transmission to foster integrity
- Increasing the controls and tests monitoring by agreed third party
- Requiring independent tests on samples coming from the manufacturer

Oversight and Inspections
- Suppliers inspections (whatever the level, abroad)
- Methodology to identify sensitive suppliers
- Making inspectors aware of the risk of fraud

Applicable to all actors (suppliers, customers, licensees, safety authorities)
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