

Investigation on the carbon segregation issue in Japan

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Introduction

News Releases from ASN

Certain EDF reactor steam generators in service could contain an anomaly similar to that affecting the Flamanville EPR vessel

ASN asked EDF to demonstrate the mechanical strength these channel head which were manufactured by Creusot Forge (CF) and Japan Casting and Forging Corporation (JCFC)

(28/6/2016)



The NRA took action
in conjunction with ASN and NRC



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NRA's Investigation

- NRA requested JP Licensees in August 2016

✓ If the vessel component is made by forging, to evaluate and report the risk that the forged component may have the zones with excessive carbon concentration



Related (only Japanese)
<http://www.nsr.go.jp/data/000161517.pdf>

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Result from JP Licensees

- Need to confirm whether or not having high carbon concentration zone of forged components
- No forged components of PWR vessel bottom head, steam generator CH and pressurizer bottom head in Japan

| Equipment | Component | JCFC ^{*1} | JSW ^{*2} | KSC ^{*3} | Non-forged |
|-----------------|--------------|--------------------|-------------------|-------------------|------------|
| BWR Pressure | Top head | 0 (3) | 0 (19) | 0 (3) | 0 |
| | Ring | 0 | 4 (9) | 0 (2) | 10 |
| | Bottom head | 3 | 16 | 3 | 3 |
| PWR Vessel | Top head | 6 (2) | 10 (3) | 0 | 0 |
| | Ring | 2 (2) | 7 (10) | 0 | 0 |
| | Bottom head | 0 | 0 | 0 | 21 |
| Steam Generator | Channel head | 0 | 0 | 0 | 21 |
| Pressurizer | Bottom head | 0 | 0 | 0 | 21 |

*1 JCFC: Japan Casting & Forging Corporation

*2 JSW: The Japan Steel Works, Ltd.

*3 KSC: Kawasaki Steel Corporation, which is currently JFE Steel Corporation



- Number of Forged Components Used in Japan
(): Some parts were made with steel plates

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Point of NRA's consideration to confirm "sufficient discard"

- The standards: Sufficient discard shall be made from each ingot to secure freedom from excessive segregation.

Three ways of confirmation of "sufficient discard".

<No.1>

Discarded the central zone of the ingot in addition to the top and bottom.



<No.2>

Confirmed the highest carbon concentration low enough by product analysis.



<No.3>

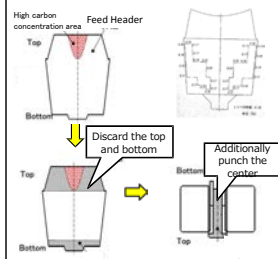
Manufactured in full compliance with the qualified processes, which assure sufficient discard.



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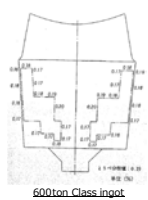
No.1: Discarded the central zone of the ingot in addition to the top and bottom.

Manufacturing Process



Ingot analysis

- There were many points of data for testing shaped components.



<http://www.nsr.go.jp/data/000171243.pdf>

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NRA's conclusion



<Conclusion on November 22th, 2016>

No carbon segregation issue identified on the forged components used at all Japanese Nuclear Power Plants.

- Confirmed the "Sufficient discard" in the result of NRA's investigation.
 - ✓ Discarded the central zone of the ingot (Ring shaped components)
 - ✓ Confirmed the highest carbon concentration low enough by product analysis
 - ✓ Manufactured in full compliance with the qualified processes, which assure sufficient discard



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Summary



- NRA has completed this investigation last November to lead the conclusion since direct communication with ASN last June.
- We consider discussing with international community how to assure material homogeneity of large forged components.



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Thank you for your attention.



<http://www.nra.go.jp/english/>



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