NEA Nuclear Supply Chain Management Workshop, November 5-6, 2018, Boulogne-Billancourt

## Manufacturing Monitoring & In shop Inspection Alternative Approach to the EDF Doctrine

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## 1. Context

2. Purpose

**3. EDF Manufacturing surveillance doctrine** 

4. Alternative approach based in work done by EPRI

**5. Potentials Components** 

6. Summary



EDF 2018

## 1. Context

Due to the evolution of component suppliers for nuclear power plant, EDF adapts his manufacturing monitoring to keep a high quality of his procurements

# Difficulty to perform in shop inspection

Some suppliers do not allow inspector to attend to specific manufacturing steps

#### **Documents Confidentiality** Documentation not available for EDF review

PARTS manufacture without EDF surveillance

Suppliers do not share manufacturing documentation

Solution is to find a alternative approach to EDF manufacturing surveillance



## 2. Purpose

Provide components with high quality level to avoid defect during operating phases

#### FRENCH LAW "Arrêté INB" 07/02/12

That requires the operator to exercise on its suppliers monitoring to ensure that the operations they perform meet the requirements defined

# QUALITY INSURANCE On parts ordered

Give to EDF an assurance of the conformity of the ordered product with the technical and quality requirements specified in the contract.

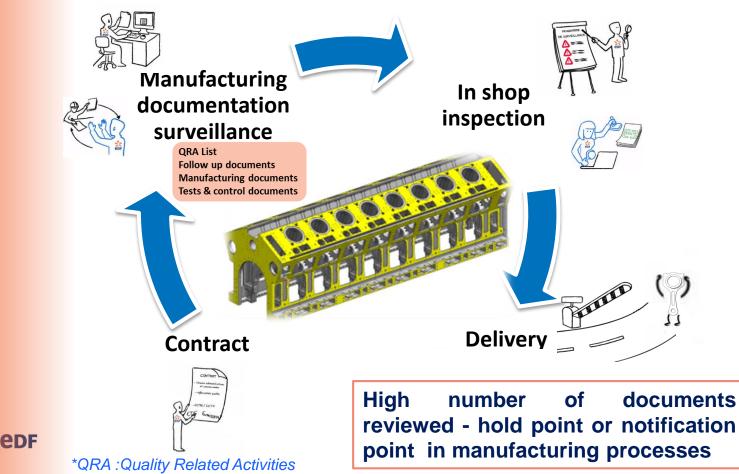
#### FEEDBACK For improvement

To provide the elements of feedback for improving the technical doctrine and / or the doctrine of supervision and inspection of achievements.

Those Elements allow to build EDF Manufacturing Monitoring Doctrine

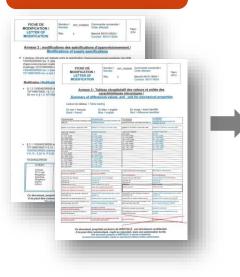


# 3. EDF Manufacturing surveillance doctrine



1<sup>st</sup> Step – Demonstration of the commercial grade

### EDF requirements



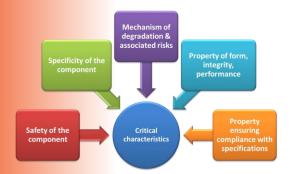
## Supplier requirements

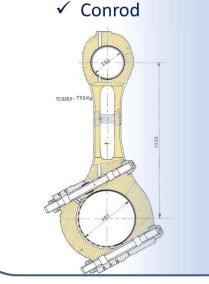


EDF requirements move to supplier requirements

edr

2<sup>nd</sup> Step – Identification of critical characteristics with acceptance criteria





1 – Part reference
2 – Chemical Composition
3 - Rm, Rp0,2, E, A% (Room temp & op. temp)
4 – impact strength (20°C)
5 - Hardness
6 - Surface defects
7 - Volumique defects
8 - Dimensional
9 - Roughness
10 - Mass
11 – Oil supply channels

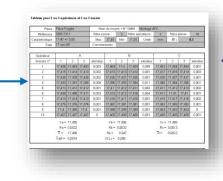


3<sup>rd</sup> Step – Choice of verification method for critical characteristics

2 - Chemical CompositionMéthode 1- Examination of preducts on delivery - Non destructive and destructive tests- Control referenced in the order- Control of the reference of parts3 - Rm, Rp0,2, E, A% (Room temp & op. temp)Méthode 1- Surveillance by the customer the control of critical charac Control referenced in the order- Control of the reference of parts4 - impact strength (20°C)Méthode 1- Surveillance by the customer the control of critical charac Surveillance by the customer the control of critical charac Item/supplier performance record7 - Volumique defectsMéthode 1- Method 3 - In shop inspection during manufacturing- Method 3 - In shop inspection during manufacturing- Method 4 - Item/supplier performance record		Verification Method	• Method 1 – Special Tests and inspections	Method 2- Commercial-grad survey
2 - Chemical Composition       Méthode 1         3 - Rm, Rp0,2, E, A% (Room temp & op. temp)       Méthode 1         4 - impact strength (20°C)       Méthode 1         5 - Hardness       Méthode 1         6 - Surface defects       Méthode 1         7 - Volumique defects       Méthode 1 ou 2         9 - Roughness       Méthode 1         10 - Mass       Méthode 1         11 - Oil supply channels       Méthode 1	1 – Part reference	Méthode 1		supplier on his
3 - Rm, Rp0,2, E, A% (Room temp & op. temp)       Méthode 1         4 - impact strength (20°C)       Méthode 1         5 - Hardness       Méthode 1         6 - Surface defects       Méthode 1         7 - Volumique defects       Méthode 1         8 - Dimensional       Méthode 1 ou 2         9 - Roughness       Méthode 1         10 - Mass       Méthode 1         11 - Oil supply channels       Méthode 1	2 – Chemical Composition	Méthode 1	delivery	critical charac.
5 - Hardness       Méthode 1         6 - Surface defects       Méthode 1         7 - Volumique defects       Méthode 1         8 - Dimensional       Méthode 1 ou 2         9 - Roughness       Méthode 1         10 - Mass       Méthode 1         11 - Oil supply channels       Méthode 1		Méthode 1	and destructive	Control of the
5 - Hardness       Méthode 1         6 - Surface defects       Méthode 1         7 - Volumique defects       Méthode 1         8 - Dimensional       Méthode 1 ou 2         9 - Roughness       Méthode 1         10 - Mass       Méthode 1         11 - Oil supply channels       Méthode 1	4 – impact strength (20°C)	Méthode 1		
6 - Surface defects       Méthode 1         7 - Volumique defects       Méthode 1         8 - Dimensional       Méthode 1 ou 2         9 - Roughness       Méthode 1         10 - Mass       Méthode 1         11 - Oil supply channels       Méthode 1	5 - Hardness	Méthode 1	customer the	he
7 - Volumique defects       Méthode 1         8 - Dimensional       Méthode 1 ou 2         9 - Roughness       Méthode 1         10 - Mass       Méthode 1         11 - Oil supply channels       Méthode 1	6 - Surface defects	Méthode 1		
8 - Dimensional       Méthode 1 ou 2         9 - Roughness       Méthode 1         10 - Mass       Méthode 1         11 - Oil supply channels       Méthode 1	7 - Volumique defects	Méthode 1		performance record
9 - Roughness     Méthode 1       10 - Mass     Méthode 1       11 - Oil supply channels     Méthode 1	8 - Dimensional	Méthode 1 ou 2	surveillance	Method 4 -
11 - Oil supply channels     Méthode 1	9 - Roughness	Méthode 1		
11 – Oil supply channels Méthode 1	10 - Mass	Méthode 1		
	11 – Oil supply channels	Méthode 1	manufacturing	



4<sup>th</sup> Step – Define type of tests and inspection



#### ✓ Method 2

- Audit of metrological function
- Inspection of dimensional control

### Dimensional case



#### ✓ Method 1

- Dimensional control perform by inspectors



Place:		Wartsila Italia	S.p.A., Tries	ste					
Inspection	s Date:	3/12/2016				I	Drawing Ref.: 10	07188547 rev 07188549 rev	
				INSPEC	TED PIECE	S			
Serial No.	C [%] 0,15 - 0,2	Si [%] 1 max. 0,40	Mn [%] 0,50 - 0,90	P [%] max. 0,025	S [%] max. 0,035	Cr [%]	Mo [%] 0 0,25 - 0,35	Ni [%]	Result
5057-1	0,20	0,28	0,71	0,009	0,002	1,64	0,28	1,68	Conform
5057-9	0,20	0,27	0,68	0,009	0,002	1,59	0,26	1,62	Conform
5057-15	0,20	0,27	0,70	0,009	0,002	1,63	0,28	1,67	Conform
5057-22	0,21	0,28	0,70	0,010	0,002	1,63	0,28	1,67	Conform
6057-30	0,21	0,28	0,71	0,009	0,002	1,65	0,28	1,70	Conform
5057-36	0,21	0,28	0,71	0,010	0,002	1,62	0,28	1,68	Conform
5057-39	0,21	0,27	0,70	0,010	0,002	1,62	0,28	1,67	Conform

#### **CONNECTING ROD SHAFT – TENSILE TEST**

Place:	Wartsila Italia S.p.A	., Trieste			
Inspections Date:	13/12/2016		Drawing Ref.: 107188547 rev. b 107188549 rev. b		
		INSF	ECTED PIECES		
Serial No.	Rm [MPa]	Re [MPa]	A [%]	Z [%]	D 1
Serial No.	min. 850	min. 600	min, 14	min. 45	Result
6057-1	1257	837	15	64	CONFORM
6057-9	1195	791	16	64	CONFORM
6057-15	1171	831	15	62	CONFORM
6057-22	1182	760	16	64	CONFORM
6057-30	1210	792	14	62	CONFORM
6057-36	1182	830	16	63	CONFORM
6057-39	1238	837	15	58	CONFORM
	ENSILE TEST MACHIN	E	SERIAL NO:		V913
MODEL: GALDABINI	QUASAR 250		EXPIRING DATE:		24/05/2017

#### CONNECTING ROD SHAFT DIMENSIONAL MEASUREMENT

Place:		Mantovani S.p.A.	, Gussago							
Inspections	Date:	20/10/2016				Drav	ving Ref	: 10718	88547 rev b	
	×			B	C	5		G1	G2	
	-	- ØF				-	- <sup>G</sup> //	G3		
Serial No.	Batch N		7	Dimensio	ons [mm]		-G_[//		G4	
Serial No.	Batch N		B	Dimensio F		G ((	G //	0.03	G4	
Serial No.	Batch N	0.	B 851±0,2	F 45 H7	G1	G (0 G2	G3	0.03 G4	G4	
Serial No.	Batch N	0A		F 45 H7 45,025	G1 0,008	G (0 G2 0,007	G3 0,020	G4 0,018	G4 Result Conform	
		io. A 275 g6	851±0,2	F 45 H7	G1	G (0 G2	G3	0.03	G4 Result Conform Conform	
6057-1	1÷6	io. A 275 g6 274,982	851±0,2 851,001	F 45 H7 45,025	G1 0,008	G (0 G2 0,007 0,012 0,006	G3 0,020 0,018 0,006	G4 0,018 0,002 0,011	G4 Result Conform Conform Conform	
6057-1 6057-9	1÷6 8÷11	io. <u>A</u> <u>275 g6</u> <u>274,982</u> <u>274,970</u>	851±0,2 851,001 851,084	F 45 H7 45,025 45,025	G1 0,008 0,006	G (0 G2 0,007 0,012	G3 0,020 0,018	G4 0,018 0,002	G4 Result Conform Conform Conform Conform	
6057-1 6057-9 6057-15	1÷6 8÷11 13÷18	io. A 275 g6 274,982 274,970 274,972	851±0,2 851,001 851,084 851,071	F 45 H7 45,025 45,025 45,021	G1 0,008 0,006 0,002	G (0 G2 0,007 0,012 0,006	G3 0,020 0,018 0,006	G4 0,018 0,002 0,011	G4 Result Conform Conform Conform	
6057-1 6057-9 6057-15 6057-22	1÷6 8÷11 13÷18 19÷24	io. A 275 g6 274,982 274,970 274,972 274,965	851±0,2 851,001 851,084 851,071 851,096	F 45 H7 45,025 45,025 45,021 45,022	G1 0,008 0,006 0,002 0,007	G (6 G2 0,007 0,012 0,006 0,009	G3 0,020 0,018 0,006 0,018	G4 0,018 0,002 0,011 0,008	G4 Result Conform Conform Conform Conform	

Place:	Wartsila Italia S.p./	A., Trieste			
Inspections Date:	13/12/2016			Drawin	g Ref.: 107188547 rev. h 107188549 rev. h
		INSP	ECTED PIECES		
			[J]		
Serial No.	Specimen 1 min. 40*0,7	Specimen 2 min. 40*0,7	Specimen 3 min. 40*0,7	AVERAGE min. 40	Result
6057-1	62	60	72	65	Conform
6057-9	88	64	70	74	Conform
6057-15	98	66	80	81	Conform
6057-22	56	68	66	63	Conform
6057-30	74	62	58	65	Conform
6057-36	84	70	76	77	Conform
6057-39	70	80	72	74	Conform
TEST EQUIPMENT: I	MPACT TESTER		SERIAL NO		7705 / RS-7705
MODEL: METROCON			EXPIRING DATE		24/05/2017



Place:	Wartsila Italia S.p.A., Trieste		
Inspections Date:	28/11/2016	Drawing Ref.: 107188547 rev. b 107188549 rev. b	
		INSPECTED PIECES	
Serial No.		Analysed Surface	Result
6057-1		100%	Conform
5057-9		100%	Conform
5057-15		100%	Conform
5057-22		100%	Conform
5057-30		100%	Conform
6057-36		100%	Conform
6057-39	100%		Conform
TEST EQUIPMENT: N	AGNETIC BENCH	SERIAL NO:	5777
MODEL: MAGISCOP	CEM 2600-1	EXPIRING DATE:	11/2017

Place:	Wartsila Italia S.p.A	A., Trieste					
Inspections Date:	25 - 28/12/2016			Drawing Ref.: 107188547 rev. 1 107188549 rev. 1 DBAE213529			
		n	NSPECTED PIECES				
Seri	al No.	Analysed Sur		Result			
5057-1		100%		Conform			
5057-9		100%		Conform			
057-15		100%		Conform			
6057-22		100%		Conform			
5057-30		100%		Conform			
6057-36		100%		Conform			
6057-39		100%		Conform			
TEST EQUIPMENT: C	LYMPUS OMNISCAN N	//X-2	SERIAL NO:	OMNI2-101098			
COUPLING MEDIUM:	VANGUARD SNW 220		STANDARD	EN 10228 - 3			

CONNECTING ROD	SHAFT – R	ROUGHNESS
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Place:	Wartsila Italia S.p.A.,	Trieste		D I D A JOSTODAJS 1	
Inspections Date:	14/12/2016	Drawing Ref.: 107188547 rev. b 107188549 rev. b			
		Ra [µm]		and and a	
Serial No.	Shaft	Radius	Spherical head	Result	
	max. 1,6	max. 0,8	max. 0,2		
6057 - 1	0,5	0,5	0,1	Conform	
6057 - 9	1,0	0,5	0,1	Conform	
6057 - 15	0,7	0,4	0,1	Conform	
6057-22	0,5	0,4	0,1	Conform	
6057 - 30	0,7	0,3	0,1	Conform	
6057 - 36	0,8	0,4	0,1	Conform	
6057 - 39	0,6	0,3	0,1	Conform	
				54,0000	
	TRUMENT: ROUGHNESS	MEAS INSTRUMENT	SERIAL NO		
MODEL: MARSURF M	4 300 M		EXPIRING DATE	: 01/07/2017	

CONNEC	TING	ROD	SHAF	Г –	HARDNESS	
artsila Italia S n A	Trieste					

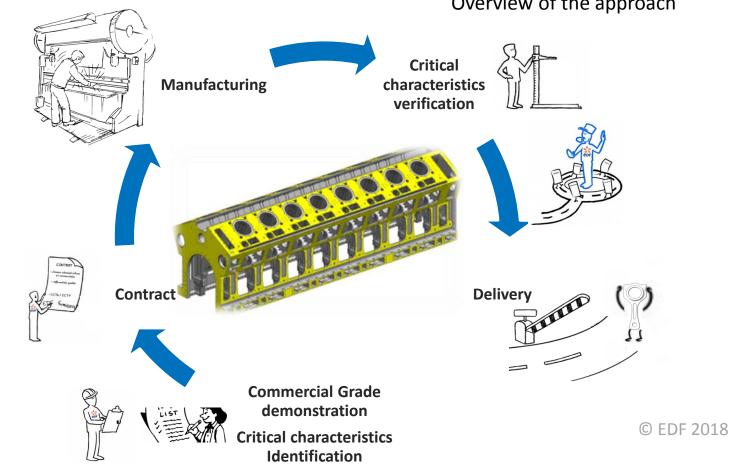
Inspections Date:	15/12/2016		Drawing I	Ref.: 107188547 rev. b 107188549 rev. b	
		INSP	ECTED PIECES		
	Foot	Shaft	Spher	ical Head	
Serial No.	Hardness [HB 10/3000/30]	Hardness [HB 10/3000/30]	Distance from	HV1	Result
	min. 250	min. 250	surface [mm]	700-800 at surface 640 at 2±0,5 mm	
			0,1	765	
			0,5	753	
(057.1	264	207	1,0	751	0.0
6057-1	304	364 387	1,5	710	Conform
			2,0	628	
			2,5	535	
			0,1	757	
			0,5	755	
6057-9	340	364	1,0	741	
0037-9	340	304	1,5	701	Conform
			2,0	601	1
			2,5	535	



Equipement : Corps de bielle / Con rod shaft							Référence / Reference : 107188547200						
Specification : 107188549 N° de série / Serial number :							6057 - 1						
N° op.	Caractéristique critique Critical characterictic	Requis WIT WIT	Requis EDF EDF Request	Essai CGD CGD test	Destructif Destructive	Réalisé par Performed by	Certificat WGLS WGLS certificate	N° rapport Report N° Std CGD		Visa Labo	Visa Wartsila	Visa EDF	
1	Analyse chimique Chemical analyses	Oui Yes	Oui Yes	Spectromètre à émission optique optical emission spectrometer	Oui Yes	WIT	Oui Yes		19915-54-976 (CO-CH-976	i dave (Serie)	apoll	NOT STIENDED	
2	Résistance à la traction Tensile strength	Oui Yes	Oui Yes	Essai de traction Tensile test	Oui Yes	WIT	Oui Yes		CUD-LE-DI	Mught	Solar lo	NOT	
3	Résilience Impact test	Oui Yes	Oui Yes	Essai Charpy KV à t* ambiante Charpy test KV room temperature	Oui Yes	WIT	Oui Yes		DB1E02(103 CGD-1H-111	10 11 0 11	24	12/12/16	
4	Contrôle dimensionnel Dimensional measurement	Oui Yes	Oui Yes	Mesure 3D 3D measurement	Non <i>No</i>	Mantovani	Oui Yes		CC 0-07-14	GROP	800	7.TUBEN>241 24140/1016	
5	Magnétoscopie (surface) Magnetic (surface) control	Oui Yes	Oui Yes	Banc de magnétoscopie Magnetic test bench	Non No	WIT	Oui Yes		JBDEOZLIOJ CCD-HT-LU	Stephen	Hope Uh	ATTENDED	
6	Test par ultrason (volume) Ultrasonic (volume) Test	Oui Yes	Oui Yes	Essai par ultrason Ultrasonic test	Non No	WIT	Oui Yes		DENESCIOS CCD-VT-AU	Sle	Hope off.		
7	Rugosité Roughness	Oui Yes	Oui Yes	Rugosimètre / visuel Roughness meter / visual	Non No	WIT	Non <i>No</i>		1945-24103 CGD-14-444		Stopen (1)	NOT DTIENDS	
8	Dureté Hardness	Oui Yes	Oui Yes	HB - HRC selon la zone (profil) HB - HRC depending on area (profile)	Oui Yes	WIT	Oui Yes		3846024103 CGA-46-10	HI AN	Septet	XDT ATENDED	

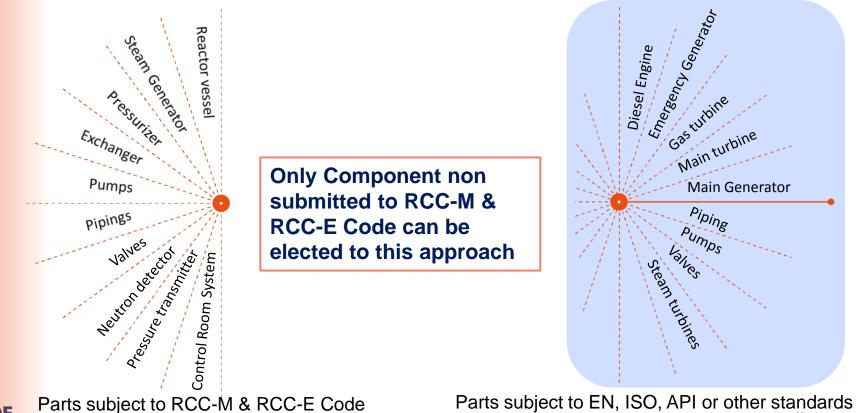


4. Alternative approach based in work done by EPRI Overview of the approach



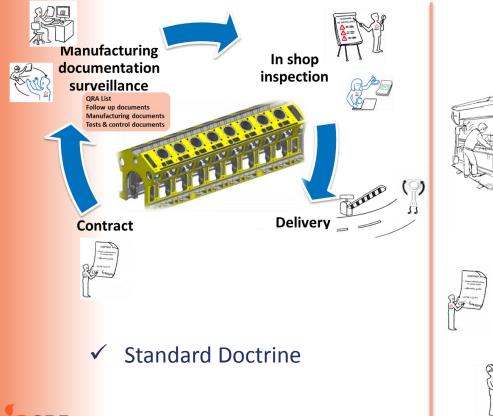
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# 5. Potentials Components

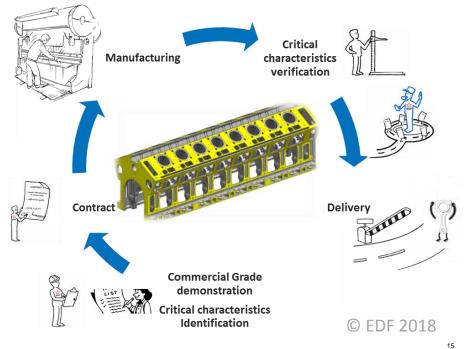




# 6. Summary



#### Alternative to standard Doctrine $\checkmark$



# **THANK YOU!**