
		PROJECT: ARUN 3 HEP (4x225 MW)				MANUFACTURING QUALITY ASSURANCE PLAN				MANUFACTURER: Bharat Heavy Electricals Limited, Bhopal		
SR NO	ITEM DESCRIPTION	CHARACTERISTICS	TRANS	TYPE OF CAPRICH	QUANTITY OF CHICKEN		REFERENCE MATERIAL	ISSUE DATE	FORGATE OF BHTOARD	AGENCY		REVISIONS
					MA	S				VI	CC	
1	2	3	4	5	6	7	8	9	10	11		

A. Draft Tube Liner & Pit Liner												
1.0 In-Coming Material- Plates for Fabrication of Pit Liner & DT Liner												
1.1	Plates for Fabrication of Pit Liner & DT Liner	Chemical Composition	MA	Test	Sample	Sample	Relevant material standard as per approved Drg		TC	P	V	V
		*Mechanical Properties	MA	Test	Sample	Sample	ASTM-A578 LEVEL B		TC	P	V	V
		UT (for plates thk > 12 mm)	MA	NDT	100%	100%	Relevant material standard as per approved Drg		TC	P	V	V
		Plate Thickness/ size visual check	MIN	ME/Vis	100%	100%						
2.0 In- Process and Final Inspection												
2.1	WPS, PQR & WQR	Review	MIN				DRG /ASME	DRG /ASME	TC	P	V	V
2.2	NDT	DPT (root run & final)	MA	NDT	100%	Random	DRG/ ASME Sec-VIII/ AA0622101		IR	P	W	W
		UT & MPI (For Flange welds- if fabricated in segments)	MA	NDT	100%	Random			IR	P	W	W
2.3	Assembly -DT liner	Final main Dimensions Matching of segments, proof assembly	MA	ME/Vis	100%	100%	DRG	DRG	IR	P	W	W
2.4	Assembly-Pit Liner	Proof assembly & final main dimensions of segment 1 & 2	MA	ME/Vis	100%	100%	-do-	-do-	IR	P	W	W
2.5	Painting & protection	Surface preparation, paint thickness & adhesion	MIN	ME	100%	100%	-do-	-do-	TC	P	V	V
*Mechanical properties test shall comprise of YS, UTS, %Elongation, Charpy Impact Test & Bend test in accordance with applicable standard.												

Prepared By:

Reviewed By:

Approved By:

  
 A. K. Sharma  
 Quality Assurance Engineer  
 Bharat Heavy Electricals Limited  
 Bhopal





		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>		<b>MANUFACTURING QUALITY ASSURANCE PLAN</b>						<b>MANUFACTURER:</b> Bharat Heavy Electricals Limited, Bhopal				
		<b>ITEM DESCRIPTION</b>		<b>SUB-ITEM</b>		<b>QAP &amp; REV</b>		<b>ISSUE DATE</b>						
		<b>VERTICAL FRANCIS TURBINE</b>		<b>Spiral Casing</b>		<b>QA/HT/1071 Rev -03</b>		<b>18.06.2019</b>						
S/N	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	PERCENT OF DEFECTS		AGENCY		REMARKS	
					M/C	S					M	C	S	
1	2	3	4	5	6		7	8	9		10		11	

### C. Spiral Casing & Spiral Inlet Pipe

1.0 In-Coming Material													
1.1	Plates for Fabrication Spiral Casing & Spiral Inlet Pipe	Chemical Composition	MA	Test	Sample	Sample	Relevant material standard as per approved Drg		TC	P	V	V	
		*Mechanical Properties	MA	Test	Sample	Sample			TC	P	V	V	
		UT (for plates thk > 12 mm)	MA	NDT	100%	100%	ASTM-A578 LEVEL B		TC	P	V	V	
		Plate Thickness/ size visual check	MIN	ME/Vis	100%	100%	Relevant material standard as per approved Drg		TC	P	V	V	
		Heat treatment	MIN	Review	100%	100%	-do-		Chart	P	V	V	
2.0 In- Process Inspection													
2.1	WPS, PQR & WQR & welder traceability	Review of WPS, PQR & WQR (Process parameter & welder traceability records to be maintained in register)	MIN	Review			DRG /ASME	DRG /ASME	ASME format /copy of record register	P	V	V	
2.2	Stress Relieving	Review of T-T Charts	MIN	Review	100%	100%	Drawing		Chart	P	V	V	
2.3	NDT	DPT of Root Run	MA	NDT	100%	100%	DRG/ ASME Sec-VIII		IR	P	W	V	
2.4	Final NDT	MPI, DPT & UT	MA	NDT	100%	100%	DRG/ ASME Sec-VIII		IR	P	W	W	
3.0 Final Inspection													
3.1	Level Check	Check of dummy on bed layout	MIN	Vis	100%	100%	DRG	DRG	IR	P	W	W	



Prepared By:

Reviewed By:

Approved By:







		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>		<b>MANUFACTURING QUALITY ASSURANCE</b> <b>PLAN</b>				<b>MANUFACTURER:</b> <b>Bharat Heavy Electricals</b> <b>Limited, Bhopal</b>			
		<b>ITEM DESCRIPTION</b> <b>VERTICAL FRANCIS TURBINE</b>		<b>SUB-ITEM</b> <b>Spiral Casing</b>		<b>QA/HT/1071</b> <b>Rev-03</b>		<b>ISSUE DATE</b> <b>18.06.2019</b>		<b>REMARKS</b>	
<b>SERIAL NO.</b>	<b>COMPONENT &amp; OPERATION</b>	<b>CHARACTERISTICS</b>	<b>CLASS</b>	<b>TYPE OF CHECK</b>	<b>QUANTITY OF CHECK</b>	<b>REFERENCE DOCUMENT</b>	<b>ACCEPTANCE NO.</b>	<b>FORMAT OF RECORD</b>	<b>AGENCY</b>	<b>REMARKS</b>	
1	2	3	4	5	6	7	8	9	10	11	

3.2	Dimension Check	Main dimensions (including diameter of ends & ovality of open ends)	MA	ME	100%	100%	-do-	-do-	IR	P	W	W
3.3	Assembly of spiral casing with stay ring, Match marking & Visual check	Trial assembly of spiral casing with stay ring. Check mismatch at segments joints and dimensions during trial assembly	MA	ME	100%	100%	-do-	-do-	IR	P	W	W
3.4	Painting & protection	Surface preparation, paint thickness & adhesion	MIN	ME	100%	100%	-do-	-do-	TC	P	V	V

\*Mechanical properties test shall comprise of YS, UTS, % Elongation, Hardness, Charpy Impact Test & Bend test in accordance with applicable standard

Prepared By: 	Reviewed By: 	Approved By:
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		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>		<b>MANUFACTURING QUALITY ASSURANCE</b> <b>PLAN</b>					<b>MANUFACTURER:</b> <b>Bharat Heavy Electricals</b> <b>Limited, Bhopal</b>		 बि.व्हा.ई.एल.	
SR NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY OF		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS
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1	2	3	4	5	6	7	8	9	10	11		

D. Stay Ring												
In-Coming Material												
1.1	Plates for Stay Ring	Chemical Composition	MA	Test	Sample	Sample	Relevant material standard as per approved Drg		TC	P	V	V
		*Mechanical Properties	MA	Test	Sample	Sample			TC	P	V	V
		UT (for plates thk > 12 mm)	MA	NDT	100%	100%	ASTM-A578 LEVEL B		TC	P	V	V
		Plate Thickness/ size visual check	MN	ME/Vis	100%	100%	Relevant material standard as per approved Drg		TC	P	V	V
		Heat treatment	MN	Review	100%	100%	-do-		Chart	P	V	V
In-Process and Final Inspection												
2.0	In-Process and Final Inspection		MN	-	-	-	DRG /ASME	DRG /ASME	TC	P	V	V
2.1	WPS, PQR & WQR	Review	MN	Review	100%	100%	Drawing		Chart	P	V	V
2.2	Stress Relieving	Review of T-T Charts	MN	Review	100%	100%	DRG/ ASME Sec-VIII		IR	P	W	W
2.3	NDT	UT & MPI / DPT	MA	NDT	100%	100%	DRG		IR	P	W	W
2.4	Dimensional & Visual Check	Final Main dimensions after machining	MA	ME	100%	100%	DRG		IR	P	W	W
2.5	Match Marking	Marking of D/S Line	MN	Vis	100%	100%	DRG		IR	P	W	W
2.6	Painting & protection	Surface preparation, paint thickness & adhesion	MN	ME	100%	100%	-do-		TC	P	V	V
2.7	Assembly	With head cover & pivot ring	MA	VIS	100%	100%	-do-		TC	P	W	W
*Mechanical properties test shall comprise of VS, UTS, % Elongation, hardness Charpy Impact Test & Bend test in accordance with applicable standard.												

\*Mechanical properties test shall comprise of VS, UTS, % Elongation, hardness Charpy Impact Test & Bend test in accordance with applicable standard.

Prepared By:	Reviewed By:	Approved By:
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		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>			<b>MANUFACTURING QUALITY ASSURANCE</b> <b>PLAN</b>				<b>MANUFACTURER:</b> Bharat Heavy Electricals Limited, Bhopal				
<b>एनर्जीपीन लिमिटेड</b>	<b>ITEM DESCRIPTION</b>	<b>SUB-ITEM</b>	<b>QAP &amp; REV</b>		<b>ISSUE DATE</b>								
	<b>VERTICAL FRANCIS TURBINE</b>	<b>Regulating &amp; Discharge Ring</b>	<b>QA/HT/1071</b> <b>Rev -03</b>		<b>18.06.2019</b>								
<b>S/N</b>	<b>COMPONENT &amp; OPERATION</b>	<b>CHARACTERISTICS</b>	<b>CLASS</b>	<b>TYPE OF CHECK</b>	<b>QUANTITY OF CHECK</b>		<b>REFERENCE DOCUMENT</b>	<b>ACCEPTANCE NORMS</b>	<b>FORNANT OF RECORD</b>	<b>AGENCY</b>		<b>REMARKS</b>	
					<b>N/C</b>	<b>S</b>				<b>M</b>	<b>C</b>	<b>S</b>	
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>			

E. Regulating Ring & Discharge Ring												
1.0 In-Coming Material												
1.1 Plates for Regulating Ring & Discharge Ring	Chemical Composition	MA	Test	Sample	Sample	Relevant material standard as per approved Drg		TC	P	V	V	
	*Mechanical Properties	MA	Test	Sample	Sample			TC	P	V	V	
	UT (for plates thk > 12 mm)	MA	NDT	100%	100%	ASTM-A578 LEVEL B		TC	P	V	V	
	Plate Thickness/ size visual check	MN	ME/Vis	100%	100%	Relevant material standard as per approved Drg		TC	P	V	V	
	Heat treatment	MN	Review	100%	100%	-do-		Chart	P	V	V	
2.0 In- Process and Final Inspection												
2.1 WPS, PQR & WQR	Review	MN	-	-	-	DRG /ASME	DRG /ASME	TC	P	V	V	
2.2 Stress Relieving	Review of T-T Charts	MN	Review	100%	100%	Drawing		Chart	P	V	V	
2.3 NDT	UT	MA	NDT	100%	100%	DRG/ ASME Sec-VIII		IR	P	W	W	
	DPT/ MPI	MA	NDT	100%	Random	DRG/ ASME Sec-VIII		IR	P	W	W	
2.4 Dimensional & Visual Check	Final Main dimensions	MA	ME	100%	100%	DRG	DRG	IR	P	W	W	
2.5 Painting & protection	Surface preparation, paint thickness & adhesion	MN	ME	100%	100%	DRG	DRG	TC	P	V	V	
*Mechanical properties test shall comprise of VS, UTs, % Elongation, Charpy Impact Test & Bend test in accordance with applicable standard.												







\*Mechanical properties test shall comprise of VS, UTS, % Elongation, Charpy Impact Test & Bend test in accordance with applicable standard.

Prepared By:	Reviewed By:	Approved By:
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		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>				<b>MANUFACTURING QUALITY ASSURANCE PLAN</b>				<b>MANUFACTURER:</b> <b>Bharat Heavy Electricals Limited, Bhopal</b>		
<b>एखणबील नलनलन</b>	<b>ITEM DESCRIPTION</b>	<b>SUB-ITEM</b>	<b>QAP &amp; REV</b>		<b>ISSUE DATE</b>		<b>REMARKS</b>					
			<b>QA/HT/1071 Rev -03</b>		<b>18.06.2019</b>							
<b>VERTICAL FRANCIS TURBINE</b>		<b>Top Cover &amp; Pivot Ring</b>										
<b>SER. NO.</b>	<b>COMPONENT &amp; OPERATION</b>	<b>CLASS</b>	<b>TYPE OF CHECK</b>	<b>QTY. OF MATERIAL CHECKED</b>		<b>REFERENCE DOCUMENT</b>	<b>ACCEPTANCE CRITERIA</b>	<b>TESTING METHOD</b>	<b>WGT. %</b>		<b>REMARKS</b>	
				<b>VIA</b>	<b>WGT. %</b>				<b>WGT. %</b>	<b>WGT. %</b>		
1	2	3	4	5	6	7	8	9	10	11		

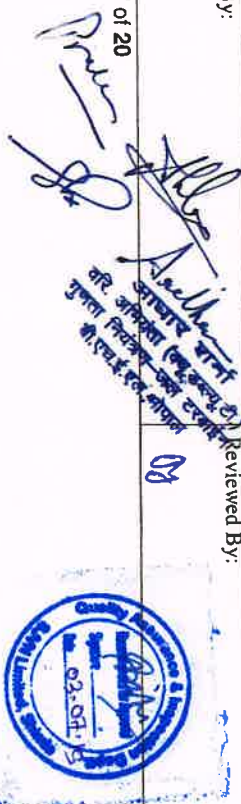
F. Top Cover (Head Cover) & Pivot Ring (Bottom Ring)													
1.0 In-Coming Material													
1.1	Plates for Top Cover & Pivot Ring	Chemical Composition	MA	Test	Sample	Sample	Relevant material standard as per approved Drg			TC	P	V	V
		*Mechanical Properties	MA	Test	Sample	Sample				TC	P	V	V
		UT (for plates thk > 12 mm)	MA	NDT	100%	100%	ASTM-A578 LEVEL B			TC	P	V	V
		Plate Thickness/ size . visual check	MN	ME/V/s	100%	100%	Relevant material standard as per approved Drg			TC	P	V	V
		Heat treatment	MN	Review	100%	100%	-do-			Chart	P	V	V
2.0 In-Process and Final Inspection													
2.1	WPS, PQR & WQR	Review	MN	-	-	-	DRG /ASME	DRG /ASME	TC	P	V	V	
2.2	Stress Relieving	Review of T-T Charts	MN	Review	100%	100%	Drawing			P	V	V	
2.3	NDT	UT	MA	NDT	100%	100%	DRG/ ASME Sec-VIII		IR	P	W	W	
		DPT/ MPI	MA	NDT	100%	Random	DRG/ ASME Sec-VIII		IR	P	W	W	
2.4	Dimensional & Visual Check	Final Main dimensions after machining	MA	ME	100%	100%	DRG	DRG	IR	P	W	W	
2.5	Upper Fixed Labyrinth Assembly	Proof Assembly with Top cover	MN	VIS	100%	100%	-do-	-do-	IR	P	W	W	
2.6		Shaft seal with Head cover	MA	ME	100%	100%	-do-	-do-	IR	As per approval of M/s SIVNL during detailed design.			
2.7	Painting & protection	Surface preparation, paint thickness & adhesion	MN	ME	100%	100%	-do-	-do-	TC	P	V	V	
*Mechanical properties test shall comprise of VS, UT/s, % Elongation, Hardness, Charpy Impact Test & Bend test in accordance with applicable standard.													
Prepared By:		Reviewed By:					Approved By:						
													
													

\*Mechanical properties test shall comprise of VS, UTS, % Elongation, Hardness, Charpy Impact Test & Bend test in accordance with applicable standard.

Prepared By:

Reviewed By:

Approved By:







PROJECT: ARUN 3 HEP (4x225 MW)		MANUFACTURING QUALITY ASSURANCE PLAN				MANUFACTURER: Bharat Heavy Electricals Limited, Bhopal		REMARKS	
ITEM DESCRIPTION		SUB-ITEM		QAP & REV		ISSUE DATE		FORNAT OF REPORT	
VERTICAL FRANCIS TURBINE		Labyrinths		QA/HT/1071 Rev -03		18.06.2019		M C S	
SR NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DEPARTMENT	ACCEPTANCE CRITERIA	REMARKS	
1	2	3	4	5	6	7	8	9	10
									11

#### H. Upper and Lower labyrinths (Wear rings) – Stationary and Rotating

1.0 In-Coming Material															
1.1	Material Testing	Chemical Composition		MA	Test	Sample	Sample	Relevant material standard as per approved DRG (Material shall be 13-4 Stainless steel)			TC	P	V	V	
		*Mechanical Properties		MA	Test	Sample	Sample				TC	P	V	V	
1.2	Heat Treatment	Review of T-T Charts		MA	Review	100%	100%	-do-	-do-		Chart	P	V	V	
1.3	Preliminary NDT & Defect excavation	NDT-UT/ MPI /DP as applicable		MA	NDT	100%	100%	-do-	-do-		IR	P	V	V	
1.4	Rectification welding	Review of WPS, PQR & WOR		MA	-	-	-	DRG /ASME	DRG /ASME		TC	P	V	V	
1.5	Stress Relieving	Post rectification weld		MIN	Review	100%	100%	-do-	-do-		Chart	P	V	V	
1.6	Final NDT	UT & MPI / DPT		MA	NDT	100%	100%	DRG/ Relevant Standard			IR	P	W	W	CHP at vendor's works
2.0 In- Process and Final inspection															
2.1	Dimensional and visual check	Final main dimensions, hole spacing, surface finish & ovality		MA	ME	100%	100%	DRG	DRG		IR	P	W	W	
2.2	Proof assembly	Assembly with respective main component		MA	ME	100%	100%	-do-	-do-		IR	P	W	W	
2.3	NDT after machining	DPT of machined areas		MIN	Review	100%	100%	-do-	-do-		IR	P	W	W	
* Mechanical properties shall comprise of YS, UTS, % Elongation, Hardness & Charpy Impact Test in accordance with applicable standard.															




\* Mechanical properties shall comprise of YS, UTS, % Elongation, Hardness & Charpy Impact Test in accordance with applicable standard.

Prepared By:

Reviewed By:

Approved By:



		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>				<b>MANUFACTURING QUALITY ASSURANCE</b> <b>PLAN</b>				<b>MANUFACTURER:</b> <b>Bharat Heavy Electricals</b> <b>Limited, Bhopal</b>			
 प्रमाणित लिफाफे			<b>ITEM DESCRIPTION</b>		<b>SUB-ITEM</b>		<b>QAP &amp; REV</b>		<b>ISSUE DATE</b>				
			<b>VERTICAL FRANCIS TURBINE</b>		<b>Guide Apparatus Assembly</b>		<b>QA/HT/1071</b> <b>Rev-03</b>		<b>18.06.2019</b>				
	<b>S/N</b>	<b>COMPONENT &amp; CORRELATION</b>	<b>CHARACTERISTICS</b>	<b>CLASS</b>	<b>TYPE OF CHECK</b>	<b>QUANTITY OF CHECK</b>		<b>REFERENCE DOCUMENT</b>	<b>ACCEPTANCE NOBARS</b>	<b>FORMAT OF RECORD</b>	<b>AGENCY</b>		<b>REMARKS</b>
						<b>NO</b>	<b>YES</b>			<b>MI</b>	<b>CI</b>	<b>SI</b>	
1	2	3	4	5	6		7		8	9	10		11




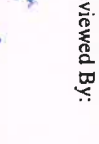


1. Guide Apparatus Assembly										
1.0	Final Assembly of Stay Ring with Head cover, Pivot ring, Regulating ring & Guide vanes- at shop stands without Servomotor									
1.1	Final Assembly- at shop stands without Servomotor (Guide vanes assembled with stay ring, top cover, pivot ring & regulating ring)	Guide Vane opening (A-zero) at Full Open, Full Closed and at 25%, 50% & 75% open position.	MA	VIS & ME	Sample	Sample	DRG/ Relevant Standard	DRG/ Relevant Standard	IR	P W W
		Guide Vane Top & Bottom clearances with Top Cover & Pivot Ring in fully closed condition of Regulating Ring.	MA	VIS & ME	100%	100%	-do-	-do-	IR	P W W
		Clearances between Bedding Faces of Guide Vanes in Closed Position.	MA	VIS & ME	100%	100%	-do-	-do-	IR	P W W
		Free Movement of Guide Vanes.	MA	VIS	100%	100%	-do-	-do-	IR	P W W
		Check for fit up, clearances & alignment of other components.	MIN	VIS	100%	100%	-do-	-do-	IR	P W W
		Match marking & Marking of D-S line	MIN	VIS	100%	100%	-do-	-do-	IR	P W W

Prepared By:	Reviewed By:	Approved By:

आचार्य भारती  
श्री. अशोक (सुपर ग्रेड 20)  
श्री. अशोक-कल टैलर  
श्री. अशोक-कल टैलर



PROJECT: ARUN 3 HEP (4x225 MW)			MANUFACTURING QUALITY ASSURANCE PLAN				MANUFACTURER:			
ITEM DESCRIPTION			SUB-ITEM		QAP & REV		ISSUE DATE		Bharat Heavy Electricals Limited, Bhopal	
VERTICAL FRANCIS TURBINE			Turbine Shaft		QA/HT/1071 Rev -03		18.06.2019		BHEL	
S/N	COMPONENT & OPERATION	CLASSIFICATION	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOCUMENT	APPROVAL	RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	10	11

1. Turbine Shaft														
1.0 In-Coming Material – Shaft Forging														
1.1	Material Testing	Chemical Composition (melt & product analysis)	MA	Test	Sample	Sample	Relevant material standard as per approved Drg			TC	P	V	V	
		Mechanical Properties	MA	Test	Sample	Sample				TC	P	V	V	
1.2	Heat Treatment	Review of T-T charts	MA	Review	100%	100%	-do-		-do-	Chart	P	V	V	
1.3	Hardness	Hardness Test	MA	Test	Sample	Sample	-do-		-do-	TC	P	V	V	
1.4	NDT of Rough machined forging	UT & MPI/DPT, Boroscopic examination	MA	NDT	100%	100%	ASME Section-III, AA19342			IR	P	W	W	
2.0 In-Process and Final Inspection														
2.1	Dialling of Shaft	Run-out check	MA	ME	100%	100%	DRG/ Relevant Standard			IR	P	W	W	
2.2	Concavity-Conventy	Check of coupling faces	MA	ME	100%	100%	-do-			IR	P	W	W	
2.3	Surface finish	Check for super finished surfaces	MA	ME	Random		-do-			IR	P	W	W	
2.4	NDT after finish machining	MPI, DPT	MA	NDT	As specified in drawing		DRG			IR	P	W	W	
2.5	Dimension & Visual check	Final main dimensions	MA	ME	100%	100%	DRG			IR	P	W	W	
2.6	Surface Protection	Paint & preservation	MIN	VIS	Random		DRG			DRG	TC	P	V	V
2.7	Assembly	<ul style="list-style-type: none"><li>Assembly of Runner &amp; Turbine shaft</li><li>Assembly of Turbine shaft &amp; generator shaft</li></ul>	MA	VIS	100%	100%	DRG			DRG	IR	P	W	W
Mechanical properties shall comprise of YS, UTS, % Elongation, Hardness & Charpy Impact Test in accordance with applicable standard.														
Prepared By:			Reviewed By:				Approved By:							
														
														



PROJECT: ARUN 3 HEP (4x225 MW)										MANUFACTURING QUALITY ASSURANCE PLAN										MANUFACTURER: Bharat Heavy Electricals Limited, Bhopal										BHEL									
ITEM DESCRIPTION										SUB-ITEM										QAP & REV										ISSUE DATE									
VERTICAL FRANCIS TURBINE										Runner										QA/HT/1071 Rev -03										18.06.2019									
CLASS										TYPE OF CHECK										REFERENCE DOCUMENT										ACCEPTANCE CRITERIA									
1										2										3										4									
5										6										7										8									
9										10										11										12									



K. Runner- Cast Fabricated															
In-Coming Material –Casting of Runner Crown, Band & Blades															
1.0	In-Coming Material														
1.1	Melt Analysis	Chemical Composition	MA	Test	Sample	Sample	Relevant material standard as per approved Drg			TC	P	V	V		
1.2	Heat Treatment	Review of T-T Charts	MA	Review	100%	100%	-do-		-do-	Chart	P	V	V		
1.3	Test piece marking	Keel Block identification	MA	Vis	-	-	-do-		-do-	-	P	V	V	Photographs to be submitted	
1.4	Mechanical test	*Mechanical Properties	MA	Test	Sample	Sample	-do-		-do-	TC	P	V	V		
1.5	Preliminary NDT & Defect excavation	Rectification NDT-UT/ MPI /DP as applicable	MA	NDT	100%	100%	-do-		-do-	IR	P	V	V	Photographs to be submitted	
1.6	Rectification welding	Review of WPS, PQR & WQR	MA	-	-	-	DRG /ASME		DRG /ASME	TC	P	V	V		
1.7	Stress Relieving	Post rectification weld	MN	Review	100%	100%	-do-		-do-	Chart	P	V	V		
1.8	Hardness	Weld repair hardness	MN	Test	Sample	Sample	-do-		-do-	TC	P	V	V		
1.9	Final NDT of casting	UT & MPI/DPT	MA	NDT	100%	100%	CCH 70.4			IR	P	W	W	CHP at vendor's works	
1.10	RT of Blade casting	Review of RT film	MA	NDT	Minimum 200 mm area from outer side			AA0622101			RT film	P	V	V	
2.0	In process inspection- machining of Runner Crown, Band & Blades														
2.1	Identification	Transfer of marking	MN	Vis	100%	100%	DRG		DRG	TC	P	W	V		
2.2	Machining (before fabrication)	Dimension, profile and surface finish check	MA	ME	100%	100%	DRG		DRG	IR	P	W	V		
2.3	NDT (machined area)	DPT & MPI	MA	NDT	100%	100%	DRG / CCH70.4			IR	P	W	V		
3.0	In process inspection- Welding of runner blade with crown and Band														

Prepared By:

Reviewed By:

Approved By:



		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>		<b>MANUFACTURING QUALITY ASSURANCE PLAN</b>				<b>MANUFACTURER:</b> <b>Bharat Heavy Electricals Limited, Bhopal</b>			
<b>ITEM DESCRIPTION</b>		<b>SUB-ITEM</b>		<b>QAP &amp; REV</b> <b>QA/HT/1071 Rev-03</b>		<b>ISSUE DATE</b> <b>18.06.2019</b>		<b>FORMAT OF RECORD</b>		<b>REMARKS</b>	
<b>VERTICAL FRANCIS TURBINE</b>		<b>Runner</b>		<b>QAP &amp; REV</b> <b>QA/HT/1071 Rev-03</b>		<b>ISSUE DATE</b> <b>18.06.2019</b>		<b>FORMAT OF RECORD</b>		<b>REMARKS</b>	
SR NO.	COMPONENT & OPERATION	CLASS	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	RECORD	NO.	DATE	TIME	REMARKS
1	2	3	4	5	6	7	8	9	10	11	

3.1	WPS, PQR & WQR	Review	MN				DRG /ASME	TC	P	V	V	
3.2	NDT	DPT of root run	MA	NDT	As per DRG		DRG/ ASME Sec-VIII	IR	P	W	V	
3.3	Stress Relieving	Review of T-T Charts	MN	Review	100%	100%	Drawing		P	V	V	
3.4	Template check	Dimensional Verification	MA	ME	100%	100%	DRG	IR	P	W	W	
3.5	Checking with template	Dimensional & profile check	MA	ME	100%	100%	DRG	IR	P	W	W	
3.6	Final NDT of weld joints	UT & MPI/DPT	MA	NDT	As per DRG		DRG/ ASME Sec-VIII / Gr. I of AA 0622101	IR	P	W	W	
4.0	In process- Final machining of runner after fabrication											
4.1	Dimensions, runout & visual check	Final main dimensions, run-out with fitted labyrinths	MA	ME	100%	100%	DRG/TS	DRG/TS	IR	P	W	W
4.2	Coupling bores & coupling face	Dimensions & Surface finish	MA	ME	100%	100%	-do-	-do-	IR	P	W	W
4.3	NDT after machining	DPT of coupling face	MN	Review	100%	100%	DRG	DRG	IR	P	W	W
5.0	Final inspection											
5.1	Balancing	Balancing at 25-30 rpm	MA	Test	100%	100%	DRG	DRG	TC	P	W	W
6.0	Runner Cone- Single piece casting											
6.1	Material Testing	Chemical Composition	MA	Test	Sample	Sample	ASTM 743 CA6NM	TC	P	V	V	
		Mechanical Properties	MA	Test	Sample	Sample	-do-	-do-	TC	P	V	V
6.2	NDT of casting	UT & MPI/DPT	MA	NDT	100%	100%	CCH 70.4	IR	P	V	V	
6.3	Dimensional and visual checks	Final main dimensions	MA	ME	100%	100%	DRG	DRG	IR	P	W	V
6.4	Proof Assembly	Assembly with runner	MN	VIS	100%	100%	DRG	DRG	IR	P	W	W
*Mechanical properties test shall comprise of YS, UTS, % Elongation, % Reduction in Area, Hardness, Charpy Impact Test as per applicable standard												
Note: Assembly of runner & turbine shaft already covered at page 12 of 22 in QAP for Turbine shaft												

\*Mechanical properties test shall comprise of YS, UTS, % Elongation, % Reduction in Area, Hardness, Charpy Impact Test as per applicable standard

Note: Assembly of runner & turbine shaft already covered at page 12 of 22 in QAP for Turbine shaft

Prepared By:

Reviewed By:

Approved By:

आचार्य राधा कृष्ण शर्मा  
वरिष्ठ अभियंता (विद्युत प्रणाली)  
भारतीय विद्युत निगम लि.  
नई दिल्ली-110001









		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>				<b>MANUFACTURING QUALITY ASSURANCE</b> <b>PLAN</b>				<b>MANUFACTURER:</b> <b>Bharat Heavy Electricals</b> <b>Limited, Bhopal</b>		
<b>ITEM DESCRIPTION</b>		<b>SUB-ITEM</b>		<b>QAP &amp; REV</b>		<b>ISSUE DATE</b>						
				<b>QA/HT/1071</b> <b>Rev -03</b>		<b>18.06.2019</b>						
<b>VERTICAL FRANCIS TURBINE</b>		<b>Guide Bearing Assembly</b>										
<b>S/N</b>	<b>COMPONENT &amp; OPERATION</b>	<b>CHARACTERISTICS</b>	<b>CLASS</b>	<b>TYPE OF CHECK</b>	<b>QUANTITY OF CHECK</b>		<b>REFERENCE DOCUMENT</b>	<b>ACCEPTANCE CRITERIA</b>	<b>FORMAT OF RECORD</b>	<b>AGENCY</b>		<b>REMARKS</b>
					<b>NO.</b>	<b>PERCENT</b>				<b>NAME</b>	<b>COMPANY</b>	
1	2	3	4	5	6	7	8	9	10	11		

3.0 Final Inspection of assembly													
3.1	Dimensional and visual checks of assembly	Final main dimensions of TGB housing.	MA	ME	100%	100%	DRG	DRG	IR	P	W	W	
3.2	Leakage test of cooler boxes of TGB	Hydrostatic test	MA	Test	100%	100%	-do-	-do-	IR	P	W	W	
3.3	Assembly	Turbine bearing (if integrated) & turbine shaft	MA	Test	100%	100%	-do-	-do-	IR	P	W	W	
3.4	Painting & protection	Surface preparation, paint thickness & adhesion	MN	ME	100%	100%	-do-	-do-	TC	P	V	V	
4.0 Turbine Guide Bearing Coolers													
4.1	Raw Material checks	Chemical composition, Mechanical Properties, NDT (as applicable)	MA	Test	Sample	Sample	DRG/ Relevant Standard	DRG/ Relevant Standard	TC	P	V	V	
4.2	Dimensions & Hydrostatic pressure test for coolers	Final Main dimensions and Pressure test	MA	Test	100%	20%	-do-	-do-	IR	P	W	W	Witness for 20 % at vendor's works record review for balance

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		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>				<b>MANUFACTURING QUALITY ASSURANCE PLAN</b>				<b>MANUFACTURER:</b> Bharat Heavy Electricals Limited, Bhopal		
<b>एकत्रीकरण विनिर्देश</b>	<b>ITEM DESCRIPTION</b>		<b>SUB-ITEM</b>		<b>QAP &amp; REV</b> QA/HT/1071 Rev -03		<b>ISSUE DATE</b> 18.06.2019					<b>REMARKS</b>
	<b>VERTICAL FRANCIS TURBINE</b>		<b>Shaft Seal Assembly</b>									
<b>SR</b>	<b>COMPONENT &amp; OPERATION</b>	<b>CHARACTERISTICS</b>	<b>CLASS</b>	<b>TYPE OF INSPECTION</b>	<b>QC/HT/ASME CHECK</b>	<b>RIB/RESC/EL PROJECT NO.</b>	<b>QC/HT/ASME NORMS</b>	<b>PROJECT OR BLACK BOX</b>	<b>Q/A APPROVAL</b>			<b>REMARKS</b>
800									<b>QA</b>	<b>HT</b>	<b>AS</b>	
1	2	3	4	5	6	7	8	9	10	11		

M. Shaft Seal Assembly													
1.0 In-Coming Material													
1.1	Material check for raw materials	Chemical Composition	MA	Test	Sample	Sample	Relevant material standard as per approved Drg		TC	P	V	V	
		Mechanical Properties	MA	Test	Sample	Sample	-do-		TC	P	V	V	
		UT (for plates thk > 12 mm)	MA	NDT	100%	100%	ASTM-A578 LEVEL B		TC	P	V	V	
		Plate Thickness/ size visual check	MN	ME/Vis	100%	100%	DRG/ Relevant Standard		TC	P	V	V	
		Heat treatment	MN	Review	100%	100%	-do-		Chart	P	V	V	
2.0	In-Process and Final Inspection												
2.1	WPS, PQR & WQR	Review	MN	-	-		DRG /ASME	DRG /ASME	TC	P	V	V	
2.2	Stress Relieving	Review of T-T Charts	MN	Review	100%	100%	Drawing		Chart	P	V	V	
2.3	NDT	DPT/ MPI & UT	MA	NDT	100%	100%	ASME Sec-VIII /DRG		IR	P	V	V	
2.4	Dimensional & Visual Check of assembly	Final Main dimensions, fit-up & clearances	MA	ME	100%	100%	DRG	DRG	IR	P	W	W	
2.5	Assembly of shaft seal with Head cover	Alignment, fit-up & match marking	MA	ME	100%	100%	DRG	DRG	IR	As per approval of M/s SJVNL during detailed design.			
2.6	Painting & protection	Surface preparation, paint thickness & adhesion	MN	ME	100%	100%	DRG	DRG	TC	P	V	V	

Prepared By:



Reviewed By:

Approved By:







		<b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>		<b>MANUFACTURING QUALITY ASSURANCE</b> <b>PLAN</b>				<b>MANUFACTURER:</b> <b>Bharat Heavy Electricals</b> <b>Limited, Bhopal</b>			
<b>ITEM DESCRIPTION</b>		<b>SUB-ITEM</b>		<b>QAP &amp; REV</b> <b>QA/HT/1071</b> <b>Rev -03</b>		<b>ISSUE DATE</b> <b>18.06.2019</b>		<b>FORMAT OF RECORD</b>		<b>REMARKS</b>	
<b>VERTICAL FRANCIS TURBINE</b>		<b>Pipes &amp; Valves</b>									
SR NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	10	11	

In- Process and Final inspection										
2.0	WPS, POR & WQR	Review	MN	-	-	DRG /ASME	DRG /ASME	TC	P	V
2.1	Stress Relieving	Review of T-T Charts	MN	Review	100%	100%	Drawing	Chart	P	V
2.2	NDT of weld joints	UT & DPT	MA	NDT	100%	100%	AA0622101 Gr-II /DRG	IR	P	W
2.3	Dimensional & Visual Check	Final Main dimensions including ovality	MA	ME	100%	100%	-do-	-do-	IR	P
2.4										
*Mechanical properties test shall comprise of YS, UTS, % Elongation, Charpy Impact Test & Bend test in accordance with applicable standard.										
P. Pipes- Oil, Water & Air										
1.1	Material Test	Chemical Composition & Mechanical Properties	MA	Test	Sample	Sample	Relevant material standard as per approved Drg	TC	P	V
1.2	Hydro test / NDT	Hydro Test or suitable NDT (as applicable)	MA	NDT / Test	100%	100%	-do-	-do-	TC	P
1.3	Dimensional & visual check	Dimension & Make verification	MN	ME /V/s	Random	-do-	-do-	Compliance Certificate	P	V
U. Valves- Oil, Water & Air										
1.1	Material Test	Chemical Composition & Mechanical Properties	MA	Test	Sample	Sample	TS/ DRG/ Relevant Standard	TS/ DRG/ Relevant Standard	TC	P
1.2	NDT (if applicable)	NDT on raw material components	MA	Test	Sample	Sample	-do-	-do-	TC	P
1.3	Hydro test	Pressure & operational Test	MA	Test	100%	100%	-do-	-do-	TC	P

Prepared By:	Reviewed By:	Approved By:
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आचार्य अर्जुन  
अति कृपया निम्नलिखित कार्य  
पुनरा निरीक्षण-पत्र जारी  
की जाये कि. धन्यवाद



PROJECT: ARUN 3 HEP (4x225 MW)		MANUFACTURING QUALITY ASSURANCE PLAN					MANUFACTURER: Bharat Heavy Electricals Limited, Bhopal		
ITEM DESCRIPTION		SUB-ITEM		QAP & REV		ISSUE DATE		REMARKS	
VERTICAL FRANCIS TURBINE		GV-Bushes & Testing Equipment		QA/HT/1071 Rev-03		18.06.2019			
S/N	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY OF CHECKS	REFERENCE DOCUMENT	ACCEPTANCE NOBAIN	FORWENT OF RECORD	REMARKS
1	2	3	4	5	6	7	8	9	10
									11

1.4	Dimensional & visual check	Dimension & Make verification	MN	ME /Vis	100%	100%	-do-	-do-	TC	P	V	V	
1.5	Painting & protection	Paint thickness & adhesion	MN	ME	100%	100%	-do-	-do-	TC	P	V	V	
1.6	DT Drain Valve Leak Proof Testing	Leak Proof Test	MN	ME	100%	100%	-do-	-do-	TC	P	W	W	
V. Guide Vane stem Bushes													
1.1	Material Test	Chemical Composition & Mechanical Properties	MA	Test	Sample	Sample	TS/ DRG/ Relevant Standard	TC	P	V	V		
1.2	Dimensional check	Final main dimensions	MA	ME /Vis	100%	100%	-do-	-do-	TC	P	V	V	
W. Various Testing equipment as per TS													
1.0	Mechanical equipment / Tools & Tackles as per TS												
1.1	Make Model & Type	MA	Review	100%	100%	TS/ DRG/ Relevant Standard	TC	P	V	V			
1.2	Approved data Sheet	MA	Review	100%	100%	TS/ DRG/ Relevant Standard	TC	P	V	V			
1.3	Compliance certificate	MA	Review	100%	100%	TS/ DRG/ Relevant Standard	TC	P	V	V			
2.0 Electrical equipment as per TS													
2.1	Make Model & Type	MA	Review	100%	100%	TS/ DRG/ Relevant Standard	TC	P	V	V			
2.2	Approved data Sheet	MA	Review	100%	100%	TS/ DRG/ Relevant Standard	TC	P	V	V			
2.3	Routine / Acceptance / Performance / Operational / Accuracy Test.	MA	Review	100%	100%	TS/ DRG/ Relevant Standard	TC	P	V	V			
2.4	Calibration certificate	MA	Review	100%	100%	TS/ DRG/ Relevant Standard	TC	P	V	V			

Prepared By:	Reviewed By:	Approved By:
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 <b>PROJECT: ARUN 3 HEP</b> <b>(4x225 MW)</b>		<b>MANUFACTURING QUALITY ASSURANCE</b> <b>PLAN</b>				<b>MANUFACTURER:</b> <b>Bharat Heavy Electricals</b> <b>Limited, Bhopal</b>							
<b>ITEM DESCRIPTION</b> <b>VERTICAL FRANCIS TURBINE</b>		<b>SUB-ITEM</b> <b>Instruments</b>		<b>QAP &amp; REV</b> <b>QA/HT/1071</b> <b>Rev -03</b>		<b>ISSUE DATE</b> <b>18.06.2019</b>		<b>FORMAT</b> <b>OF</b> <b>RECORD</b>		<b>AGENCY</b> <b>M I C S</b>		<b>REMARKS</b>	
<b>SIR</b> <b>NO.</b>	<b>COMPONENT &amp;</b> <b>OPERATION</b>	<b>CLASS</b>	<b>TYPE</b> <b>OF</b> <b>CHECK</b>	<b>QUANTITY</b> <b>OF</b> <b>CHECK</b>	<b>REFERENCE</b> <b>DOCUMENT</b>	<b>ACCEPTANCE</b> <b>NOBARS</b>	<b>FORMAT</b> <b>OF</b> <b>RECORD</b>	<b>AGENCY</b> <b>M I C S</b>	<b>REMARKS</b>				
1	2	3	4	5	6	7	8	9	10	11			

**X. Instruments: Pressure /DP Gauges, Level Switches/Indicators/relays/sensors/Indicators cum controller, Flow Relays/Meters, Pressure Switches, Pressure/DP Transducers, Electro-magnet Valve, Indicators/Recorders, Speed Measuring System & Speed Relay, Limit Switch, Thermocouples & RTDs, Temperature Gauges /Thermometers, Moisture Detector (as applicable)-**

1.1	Verification of Make / Model/ type/ Rating (as applicable)	MA	Vis	Sample	Sample	TS/ DRG/ Relevant Standard	TS/ DRG/ Relevant Standard	TC	P	V	V
1.2	Calibration certificate / Functional / operational check (as applicable)	MA	Test	-do-	-do-	-do-	-do-	TC / Compliance Certificate	P	V	V

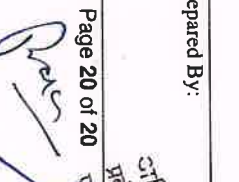
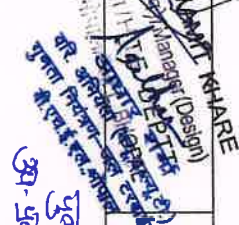
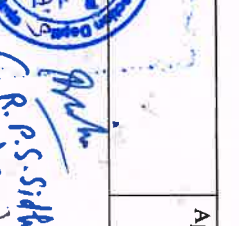
Notes: 1. Material of construction shall be as per approved drawing / Data sheet.  
 2. UT test of plates shall be applicable only for main item/ component/ shell/load bearing plates/plates subjected to internal or external pressure (stiffeners, ribs, off cuts shall thus be omitted for UT test).  
 3. Any test (Mechanical properties) if not conducted by Material Supplier / Material Manufacturer, the same shall be conducted by BHEL at its own (at BHEL Lab).

#### LEGENDS

M	MANUFACTURER	C	CONTRACTOR	S	SAPDC LTD.
P	PERFORM	V	VERIFICATION OF RECORDS	W	WITNESS / CHP
IR	INSPECTION REPORT	DRG	DRAWING	CHP	CUSTOMER HOLD POINT
MA	MAJOR	MN	MINOR	CR	CRITICAL
ME	MEASUREMENT	NDT	NON DESTRUCTIVE TESTING	HT	HEAT TREATMENT
Vis	VISUAL CHECK	TS	TECHNICAL SPECIFICATION	TC	TEST CERTIFICATE

NOTE: QAP SHALL BE READ IN CONJUNCTION WITH QUALITY ASSURANCE REQUIREMENT GIVEN AS PART OF TECHNICAL SPECIFICATION.

<b>MANUFACTURER / SUB-CONTRACTOR:</b>		<b>CONTRACTOR:</b>		<b>FOR SAPDC USE:</b>		<b>REFERENCE DOC NO.</b>	
<b>PREPARED BY:</b>	<b>REVIEWED BY</b>	<b>REVIEWED &amp; RECOMMENDED BY</b>	<b>REVIEWED BY</b>	<b>RECOMMENDED BY</b>	<b>APPROVED BY</b>		
<b>NAME, DESIGNATION &amp; SIGNATURE</b>	<b>NAME, DESIGNATION &amp; SIGNATURE</b>	<b>NAME, DESIGNATION &amp; SIGNATURE</b>	<b>NAME &amp; SIGNATURE</b>	<b>NAME &amp; SIGNATURE</b>	<b>SIGNATURE &amp; SEAL</b>		

<b>Prepared By:</b>	<b>Reviewed By:</b>	<b>Approved By:</b>
		

आ. प्र. सं. १८६८, गुडगाँव  
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CR.P.S. Sidhan  
 AGM  
 QAP-1