

#### 4.6 Electrical Power

Average power for the Electrical Power Test and also for the Heat Rate Test, if being done concurrently, is the sum of the adjusted Power for each test period.

$$P_{average} = \frac{\sum_{i=1}^n P_{i,measured}}{N}$$

The Electrical Power is, when taking into account the tolerances, between

$$P_{max} = P_{average} + \Delta P$$

And

$$P_{min} = P_{average} - \Delta P$$

The test is successfully passed if  $P_{max} > P_{guaranteed}$

The contractor is entitled to a possible bonus if  $P_{min} > P_{guaranteed}$ . If  $P_{guaranteed}$  is between  $P_{min}$  and  $P_{max}$ , neither penalty nor bonus will apply.

### 5 Gros Heat rate test

#### 5.1 General

The Heat rate test is preferably done concurrently with the electrical power test.

The engines involved in the test shall run for 2 (two) hours at full load prior to the start of the test in order to achieve stable conditions in all engine components and external systems.

For accuracy of the test it is important that all measurement readings are taken simultaneously.

The required measurements are done on an hourly basis and the readings recorded on a form. The period can differ somewhat from one hour without affecting the accuracy of the test. The Electrical Power is calculated from the produced electrical energy during each test period.

The point of measurement is at the respective Engine Control Panel PMU ( Alternator terminals ) , Fuel consumption is measured by Respective Engine gas flow meters.

Gas fuel samples are taken before and after the test. Two samples are taken at each sampling time. Both samples are sealed and signed, one is kept as a reference and the other is sent to an independent laboratory for analysis.

The gas fuel analysis should cover all the items stipulated in the fuel specification in agreement between the contractor and owner. The laboratory report shall include LHV and the tolerance on the LHV. The average LHV of the samples is used in all calculations.

The Heat Rate is not adjusted or recalculated for ambient conditions, but is a function of the power and is calculated from the graph shown in section 5.2. The average heat rate during the test is the average of the recalculated heat rates during each test period.

Same requirements for frequency, power factor and operation of equipment apply during the Heat Rate test as during the Electrical Power test.

Should the test be interrupted by an event not attributed to the Contractor, the test shall be resumed promptly after the cause of the interruption has been removed. The test will resume when the operating levels matches that at the time prior to the trip, and shall continue for the time remaining to be completed at the time of the interruption.

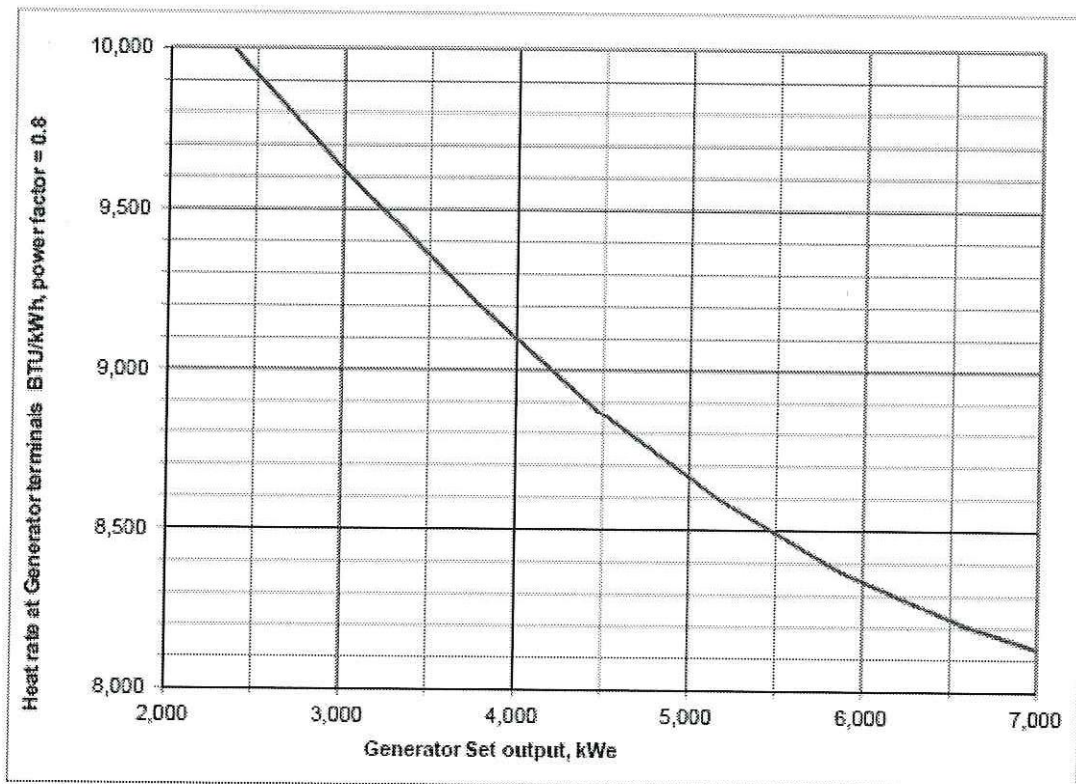
## 5.2 Adjustment of Heat Rate for ambient conditions

Heat rate is not adjusted or recalculated for variations in ambient conditions. Heat rate as a function of power during the performance test is given by the curve below. Heat rate (guaranteed) has to be checked for the adjusted Power during the heat rate test.

### Gas engine power adjustment

Heat rate as function of power

Manufacturer	WARTSILA	Engine compression ratio	10
Engine type	W 20V34LPG	ISO power	kW 7200
Number of cylinders	20	Nominal speed	rpm 720
Design stage	A	Altitude	m 541
Ethylene glycol in LT circuit %	mass 0		



Values in Graph

Generator Set output, kWe	2,374	3,067	3,767	4,476	5,174	5,869	6,566	6,995
Heat Rate, BTU/kWh, LHV	9,991	9,584	9,210	8,871	8,598	8,376	8,211	8,135

## (Draft) Test Procedures

The fuel flow is measured according to agreed point of measurement(s) and calculated for each test period separately.

$mf_{measured}$  = fuel flow to engine measured for the test duration

$$F_{net} = mf_{measured} * LHV_{test}$$

$$r_{measured} = F_{net} / E_{hr}$$

where

$E_{hr}$  = Produced electrical energy during Heat Rate test

### 5.3 Measuring tolerances in Heat rate test

Tolerance usage according to VDI-2048.

$mf_{tol}$  = Tolerance specified for the fuel flow metering unit

$$F_{tol} = 100 * \sqrt{(LHV_{tol} / 100)^2 + (mf_{tol} / 100)^2}$$

$$E_{tol} = 100 * \sqrt{(EMU_{tol} / 100)^2 + (I_{transf, tol} / 100)^2 + (U_{transf, tol} / 100)^2}$$

$$\Delta r = r_{measured} * \sqrt{(LHV_{tol} / 100)^2 + (mf_{tol} / 100)^2 + (E_{tol} / 100)^2}$$

### 5.4 Heat rate

The heat rate is the average of the measured heat rate for each period:

$$r_{average} = \frac{\sum_{i=1}^n r_{i, measured}}{N}$$

The Heat rate is between

$$r_{max} = r_{average} + \Delta r$$

$$r_{min} = r_{average} - \Delta r$$

The test is successfully passed if  $r_{min} < r_{guaranteed}$ .

The contractor is entitled to a possible bonus if  $r_{max} < r_{guaranteed}$ . If  $r_{guaranteed}$  is between  $r_{min}$  and  $r_{max}$ , neither penalty nor bonus will apply.





## 6. List of auxiliary equipment operational status during tests

This list is to be mutually agreed upon before the testing begins.

Auto Mode: Equipment is running continuously or intermittently, governed by the plant control system.

Shut down: Equipment is not running.

System	Equipment	Auto Mode	Shut down
Cooling system	Radiators	X	
Cooling system	Pre-heater unit		X
Lube oil system	Pre-lube pump unit		X
Lube oil system	Lube oil transfer pump unit		X
Lube oil System	Oil mist separator	X	
Air system	Starting air compressor		X
Air system	Instrument air compressor	X	
Charge air system	Charge air filter	X	
Exhaust gas system	Purge fan	X	
Plant	Control and monitoring	X	
Plant	Lighting	X	
Plant	Ventilation / air conditioning	X	
Plant	Overhead crane		X
....	....		
....	....		
....	....		

## 7. EMISSIONS TESTING BY THE BUYER

### 1 Objective

The objective of the Stack Emission Test is to verify compliance with the Stack Emissions Guarantee set forth in the Appendix A to Contract Exhibit 5, while utilizing the Project Gas.

As per the Contract Exhibit 5 , Emissions testing shall be performed by the Buyer.

### 2 Testing Procedures and Conditions

The emission performance figures provided in the Stack Emission Guarantee are valid for the emission measurement methods and standards specified in the Appendix A to Contract Exhibit 5 (Emission Guarantee document ). This document specifies testing procedures and additional requirements to be followed during the tests in order for the Stack Emission Guarantees to be valid.

Some measurement methods and standards allow different variations of how the measurements are performed for example depending on application. If the Stack Emission Guarantees or this document specifies the use of a specific variation to the method, this recommendation needs to be strictly adhered to. Any other variations of the method or use of an alternative method must be agreed mutually between both parties.

Compliance with the Stack Emission Guarantee will be demonstrated as far as practicable concurrently with the other performance tests of the Plant. Similar engines running on same conditions have same emission performance. In plants having multiple engines appropriate amount of engines will be tested and plant average stack emission will be calculated based on these measurements. This calculated plant average emission will be

seen sufficient for demonstrating the fulfilment of Stack Emissions Guarantee. An accredited, preferably third party, measurement consultant will be assigned to carry out the measurements and to issue a Stack Emission Test report.

The flue gas stack emission measurements will be performed at 100% engine power at stable running of the Engine if not otherwise mutually agreed. Prior to start of the flue gas emission (stack) measurements, the Engine shall be operated for a minimum of two hours at 100% load in order to obtain steady state conditions. Contractor shall have the right to inspect the Engines to be tested prior to the test and conduct corrective adjustments, repairs, etc., if needed.

In the flue gas (stack) emission measurements sufficiently long sampling periods and a sufficient number of samples shall be taken in order to get statistically representative results. Based on Wärtsilä experience, the following minimum requirements apply:

- Gaseous components (analyser procedures): Emissions are calculated based on a minimum averaging time of 60 minutes. The period can differ somewhat from one hour without affecting the accuracy of the test.
- Gaseous components (discrete sampling): The emissions are calculated based on the average of minimum three samples. A minimum sampling time of 30 minutes per sample is recommended. Note that some methods may necessitate shorter sampling times. In such cases, the sampling times shall be checked case by case.
- Particle emissions: The particle emissions are calculated based on the average of minimum three samples. For heavy fuel oil a minimum sampling time per sample of 30 minutes is recommended. For light fuel oil 60 minutes is recommended, while for gas fired engines a minimum sampling time of 90 minutes is recommended.

Longer sampling times might be needed, if required by the measurement method or if variations in the measured concentrations are expected. Longer sampling times are also recommended if the verification of the Guarantee requires accurate determination of very low concentrations.

The analysers typically report the emissions at actual conditions, such as for example ppm-v, at actual oxygen, wet. The measurement results have to be corrected to the same reference conditions (e.g. mg/Nm<sup>3</sup>. at 15 % O<sub>2</sub>, dry) where the Stack Emission Guarantees are specified before evaluation of compliance with the Guarantees can be made. These calculations are performed by the independent consultant. The measurement report shall include both the corrected emission and the uncorrected emission data including help variables such as oxygen and humidity used for correcting to reference conditions. At request the consultant will prepare a preliminary report / standard recording form at site.

Other data which is to be recorded during emission tests include fuel data, ambient conditions (temperature, humidity) and engine data (at minimum engine load during the test). Taking of the fuel samples is usually coordinated with other performance tests. This data is shall be appended to the measurement report.

### 3 Measurement Methods

The measurement methods and standards to be used are specified in combination with the stack emission guarantees. In this chapter basic measurement principles for most typical emission species are provided, as well as additional requirements that need to be followed in order for the stack emission guarantees to be valid and in order to have reliable measurement results. In case the measurement methods have not been specified in the stack emission guarantees, verification of the emission guarantees shall be performed according to the below recommendations.

The chemiluminescence analyser as described in the US EPA Method 7E and in other principally similar methods and standards will be used for nitrogen oxides (NO<sub>x</sub>) analyses.

The concentration of particulate matter (as dry dust) will be determined by a manual gravimetric method as described in the ISO 9096:2003(E) and in other principally similar standards. Many measurement methods and standards for particles provide procedures for both in-stack and out-stack sampling of particles. It is important



to note that the two variations will provide different results as a result of the temperature dependence of particle emissions. Therefore, the emissions guarantees are valid only for the procedure specified in the Stack Emission Guarantees. Unless specified differently in the Guarantees, the following apply:

- If the flue gas temperature exceeds 160 °C in the point of PM sampling, an in-stack filter shall be used for collecting the PM samples.
- In case the flue gas temperature is equal to or less than 160 °C at the point of PM sampling, a heated out-stack filter shall be applied.

For PM measurement of the flue gas from engines burning sulphur containing fuels, the filter material to be used for sampling must be inert enough. Quartz fibre is a recommended filter material. Glass fibre filters must not be used.

The particle emissions in the exhaust gas after a gas engine are generally on a low level and are therefore typically not verified.

Note that the weighing of the PM samples typically will take place at a laboratory outside the Job Site and hence no PM measurement results are available at the completion of the Stack Emission Test.

#### **4 Calibration**

Analyzers for measuring gaseous components shall be calibrated to ensure accurate measurements. The calibration of the analysers shall be carried out by using certified calibration gas.

As a minimum, one span gas (high-range gas) having a concentration near the measured concentration shall be used for each component. The zero gas can be purified ambient air or N<sub>2</sub>. The impurity concentration shall be less than 0.25 % of the span in the zero gas. The O<sub>2</sub> analyser will be calibrated using a calibration gas, such as N<sub>2</sub> and ambient air. N<sub>2</sub> is needed in setting the zero point and ambient air for setting the span.

The analysers for the gaseous components will be calibrated daily at the Job Site. Analysers shall be calibrated prior to commencing the measurements as well as after the measurements. The setting of the zero and span points shall be performed according to the emission measurement methods and standards. Unless otherwise specified by the measurement method or standards, the following recommendations shall apply:

- Instrument calibration drift of 2-5 % of calibration gas concentration: the results shall be corrected using the determined drift figures.
- If instrument calibration drift of more than 5 % of calibration gas concentration is determined, the reason for the drift shall be determined and the tests shall be re-performed.

Pitot tubes, thermal elements and manometers shall be calibrated before the shipment to the Job Site. The traceable calibration certificates for this equipment as well as for the calibration gases will be made available. The analytical balance, which is used in the laboratory for weighing the PM samples, shall be traceably calibrated. The relevant calibration certificates and calibration gas certificates shall be appended to the measurement report.

#### **5 Uncertainty Assessment and Acceptance**

Emission measurements involve significant measurement uncertainties. Therefore, the uncertainties need to be quantified and accounted for in a predefined way.

Uncertainties originate from the whole measurement chain including sampling point, sampling line, analyser tolerance, fuel heating value, density and fuel flow measurement. The document published by the WECC (Western European Calibration Co-operation) DOC.19 - 1990 "Guidelines for the Expression of the Uncertainty of Measurements in Calibration" gives detailed guidelines on calculating and assessing uncertainties. Measurement uncertainties shall be evaluated and reported by the measurement consultant carrying out the measurements.



(Draft) Test Procedures

Assessment of the fulfilment of Flue Gas Emission Guarantee shall be made according to Section 6.2 of the VDI 2048 document "Uncertainties of measurement during acceptance tests on energy-conversion and power plants". If the measured value minus the uncertainty is equal to or lower than the guaranteed value, as set forth in the Agreement, the Stack Emissions Guarantee shall be deemed as demonstrated and fulfilled.



## APPENDIX 5


Appendix 5.A	LPG Specification
Appendix 5.B	Lube Oil Specification
Appendix 5.C	Cooling Water Treatment
Appendix 5.D	Air Quality



## **APPENDIX 5.A LPG SPECIFICATION FOR FACILITY**

The LPG characteristic for the Wartsila 34LPG Generator Sets of the Facility must meet the below specifications.

[Place holder for Appendix 5A\_ Fuel Characteristics]

	© Wärtsilä Finland Oy Finland	FUEL CHARACTERISTICS						
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Subtitle Performance Manual	Product Wärtsilä 34LPG-A	Made	30.10.2013		Page 1 (2)	Document No DAAF066429	Rev -	
		Appd.	30.10.2013					
Revised date:	Changed by:		Approved by:			D-message No.: 241227		

### Maximum limits for gas fuel characteristics

The Wärtsilä 34LPG-A engine is designed and developed for continuous operation on liquefied petroleum gas (LPG), without reduction in the rated output, on gas qualities according to the following specification:

Property	Unit	Limit
Propane (C <sub>3</sub> H <sub>8</sub> ) content, min.	% v/v	97,0
Butane (C <sub>4</sub> H <sub>10</sub> ) + heavier alkanes content, max.	% v/v	3,0
Total alkenes content, max.	% v/v	2,0
Hydrogen sulphide (H <sub>2</sub> S) content, max.	% v/v	0,05
Hydrogen (H <sub>2</sub> ) content, max. <sup>1)</sup>	% v/v	Not allowed
Water and hydrocarbon condensates before the engine, max. <sup>2)</sup>	% v/v	Not allowed
Copper strip corrosion, max.	Rating	No. 1
Ammonia content, max.	mg/ m <sup>3</sup> <sub>N</sub>	25
Chlorine + Fluorine content, max.	mg/ m <sup>3</sup> <sub>N</sub>	50
Particles or solids content in engine inlet, max. <sup>3)</sup>	mg/ m <sup>3</sup> <sub>N</sub>	50
Particles or solids size in engine inlet, max. <sup>3)</sup>	µm	5
Gas inlet temperature	°C	0 - 60

**NOTE 1.** If there is hydrogen in the gas, the use of gas has to be considered case by case. W34 Product Management&Engineering is to be contacted for further evaluation.

**NOTE 2.** Dew point of liquefied petroleum gas (LPG) is below the minimum operating temperature and pressure.

**NOTE 3.** Content of gas in engine inlet.

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## **APPENDIX 5.B LUBE OIL CHARACTERISTIC FOR FACILITY**

The lube oil characteristics for the Wartsila 34LPG Generator Sets of the Facility must meet the below specifications.

[Place holder for Appendix 5B\_Lubricating Oil]



**4-Stroke Engines**  
Technical Services

WS02N003  
Issue 7, 30 December 2020

## Lubricating oils for WÄRTSILÄ® 34LPG, 34SG and 50SG engines

**Distribution to operators and owners of installations  
concerned**

### For your information

**Engines concerned**

WÄRTSILÄ® 34LPG, 34SG and 50SG engines.

**Reference**

02 Fuel, lubricating oil, cooling water.

**Introduction**

A new revision of "*Requirements and Oil Quality*" has been released.

**Validity / Issue**

Until further notice. Replacing issue 6 dated 8 April 2019.

Before taking any action, always check the available online systems for the latest revision of this document. Any locally stored or printed version is considered to be an uncontrolled document.

  
Dmr

## Document history

Issue	Date	Description	SBWT ID
1	31-05-2011	Initial release	
6	8-4-2019	Revision m of "Requirements and Oil Quality" released	002831
7	30-12-2020	Lists of validated lubricating oils updated.	003849

## Enclosures

Requirements and Oil Quality V92A0780, revision n, 4 pages.

## Contact

For services, spare parts and/or tools, please contact your nearest Wärtsilä representative or log in to Wärtsilä Online: [www.wartsila.com/wartsila-online](http://www.wartsila.com/wartsila-online)

If you do not have the contact details at hand, please follow the link:  
[www.wartsila.com/contact](http://www.wartsila.com/contact)


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Subtitle	Product  Wärtsilä 34SG Wärtsilä 34LPG Wärtsilä 50SG Wärtsilä 50LPG	Made	11.08.1998		Page  1 (4)	Document No  V92A0780	Rev  n
Instruction		Appd.	15.01.1999				
Revised date: 17.12.2020		Changed by:		Approved by:		Change notice No.: CN-A167103	

## REQUIREMENTS AND OIL QUALITY

### LUBRICATING OIL REQUIREMENTS AND QUALITY FOR WÄRTSILÄ® 34SG, WÄRTSILÄ® 34LPG, WÄRTSILÄ® 50SG AND WÄRTSILÄ® 50LPG ENGINES

#### Viscosity & Viscosity Index (VI)

Viscosity class SAE 40 and VI of min. 95

#### Alkalinity (Base Number, BN)

Lubricating oils with BN of ~ 4 - 7 mg KOH/g have to be used.

#### Sulphated ash level

Sulphated ash content of gas engine oil is a very important property. Too high ash content increases the risk of deposit formation, preignition and knocking, while too low ash content can lead to increased exhaust valve / valve seat wear. Low ash lubricating oils to be used have typically sulphated ash content of max. 0,6 % m/m.

#### Additives

The oils shall contain additives that give good oxidation stability, corrosion protection, load carrying capacity, neutralisation of acid combustion and oxidation residues and should prevent deposit formation on internal engine parts.

#### Foaming characteristics

Fresh lubricating oil shall meet the following limits for foaming tendency and stability, according to the ASTM D 892-18 test method:

Sequence I:	100/0 ml
Sequence II:	100/0 ml
Sequence III:	100/0 ml

#### Base oils

Use of virgin base stocks is only allowed, i.e. recycled or re-refined base oils are not allowed.

## CONDEMNING LIMITS FOR USED LUBRICATING OIL

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When estimating the condition of used lubricating oil, the following properties along with the corresponding limit values must be noted. If the limits are exceeded, measures must be taken. Compare also with guidance values for the fresh lubricating of the brand in use.





PROPERTY	UNIT	LIMIT	TEST METHOD
Viscosity	mm <sup>2</sup> /s at 40 °C	max. 50% increase	ASTM D 445
Viscosity	mm <sup>2</sup> /s at 100 °C	max. 25% increase	ASTM D 445
Water	% v/v or % m/m	max. 0,30	ASTM D 95 or D 6304C
Base Number	mg KOH/g	max. 50% depletion	ASTM D 2896
Total Acid Number	mg KOH/g	max. 2,5 mg KOH/g increase	ASTM D 664
Insolubles	% m/m in n-pentane	max. 1,0	ASTM D 893b
Oxidation	Abs/cm	max. 25	IR
Nitration	Abs/cm	max. 20	IR

## VALIDATED LUBRICATING OIL QUALITIES FOR WÄRTSILÄ® 34SG, WÄRTSILÄ® 34LPG, WÄRTSILÄ® 50SG AND WÄRTSILÄ® 50LPG

### NATURAL GAS AND LIQUEFIED PETROLEUM GAS OPERATION

There exists experience that lubricating oils manufactured from API \*) Group II or IV base oils are able to offer better cleanliness of exhaust gas boiler / economizer compared to lubricating oils manufactured from API Group I base oils and are thus recommended in the first place for such applications. In some cases also longer change intervals may be achieved by using API Gp II or IV based products.

\*) American Petroleum Institute

Table 1: Validated SAE 40 gas engine oils based on API Gp II and IV base oils:

SUPPLIER	BRAND NAME	BN	SULPHATED ASH (% m/m)
Shell	Mysella S5 N 40	4,5	0,48
Addinol Lube Oil GmbH	Gas Engine Oil NG 40	5,6	0,54
Bharat Petroleum Corp. Ltd.	MAK GES XLA 40	5,3	0,48
Chevron (Texaco + Caltex)	HDAX 5200 Low Ash Gas Engine Oil SAE 40	4,2	0,50
ENI S.p.A.	ENI Geum NG 40	5,4	0,50
Exol Lubricants Limited	Taurus GEO G240	5,5	0,49
ExxonMobil	Pegasus 805 Ultra	6,2	0,49
	Pegasus 1005	5,0	0,50
	Pegasus 1	6,5	0,49
Fuchs Petrolub SE	Titan Ganymet Pro LA SAE 40	5,5	0,50
Gazpromneft Lubricants Ltd.	G-Profi PSN 40	5,4	0,50
Idemitsu Kosan Co. Ltd.	Apolloil GHP 40L	4,7	0,45
Indian Oil Corporation Limited	Servo Green Edge	6,0	0,60
Lukoil	Efforce XDI 4004	5,1	0,48
MOL-LUB Ltd.	MOL GMO Longlife 40	6,6	0,50
Ori-Tech Oils Private Limited	Ori-Tech GEO 40 C	5,2	0,52



SUPPLIER	BRAND NAME	BN	SULPHATED ASH (% m/m)
Pakelo Motor Oil S.r.l.	Geoterm LA 4	6,6	0,50
Pertamina	NG Lube 40	5,1	0,53
Petrobras	Lubrax LA PRO 40	5,4	0,50
Petro-Canada	Sentron LD 5000	4,9	0,57
Petrogal	Galp Power Gas NGB 40	5,7	0,51
Petronas	GEO S 40	5,6	0,46
	GEO NG 40	5,4	0,48
Phillips 66	El Mar LA4 EXD GEO	5,5	0,50
Repsol	Super Long Life Gas 4005	5,7	0,50
Sasol	Gas Engine Oil LA 40	5,5	0,50
Total	Nateria X 405	5,2	0,45
	Nateria MX 40	7,2	0,51
YPF	Vectis G 640	5,6	0,50

Table 2: Validated SAE 40 gas engine oils based on API Gp I base oils:

SUPPLIER	BRAND NAME	BN	SULPHATED ASH (% m/m)
Shell	Mysella S3 N 40	5,0	0,45
Castrol	Duratec L	4,5	0,45
Chevron (Texaco + Caltex)	Geotex LA 40	5,2	0,45
ExxonMobil	Pegasus 705	5,3	0,49
	Pegasus 805	6,2	0,50
Lukoil	Efforce 4004	5,56	0,49
Petrogal	Galp GN 4005	5,2	0,45

## ADDITIONAL REQUIREMENTS AND RECOMMENDATIONS

### CHANGE OF LUBRICATING OIL BRAND

Top-up with another lubricating oil brand than being filled to the system is not allowed, except if the both two lubricating oils originate from the same manufacturer and are based on same base oils and additive technology. Otherwise the lubricating oil system has to be drained and then filled with another brand by following the procedure described here below.

In order to minimize the risk of lubricating oil foaming, deposit formation, blocking of lubricating oil filters, damage of engine components, etc., the following procedure should be followed when lubricating oil brand is changed from one to another:

- If possible, change the lubricating oil brand in connection with an engine (piston) overhaul
- Drain old lubricating oil from the lubricating oil system
- Flush and clean the lubricating oil system in case of an excessive amount of deposits on the surfaces of engine components, like crankcase, camshaft compartment, etc.
- Fill the lubricating oil system with fresh lubricating oil



If the procedure described above is not followed, responsibility of possible damage and malfunctions caused by lubricating oil change should always be agreed between the oil company and customer.

## USE OF NON-VALIDATED LUBRICATING OILS:

Before using a lubricating oil being not listed in the tables of this document, the engine manufacturer must be contacted. Lubricating oils that are not validated have to be tested according to Wärtsilä procedure.

If non-validated lubricating oils will be used during the engine warranty period and there exists no agreement with Wärtsilä about testing, the engine guarantee will not be valid.

Lubricating oil companies listed above along with other possible manufacturers and distributors undertake all responsibility for the performance of their validated lubricating oils in service to the exclusion of any liability of any Wärtsilä company belonging to Wärtsilä group. Further, they shall indemnify, compensate and hold harmless Wärtsilä and companies belonging to Wärtsilä group from and against any claims, damages and losses caused by the lubricating oils in question.

## LUBRICATING OILS FOR ENGINE TURNING DEVICE

Based on the turning device manufacturer's instructions EP-gear oils <sup>\*)</sup> having viscosity of 414 - 506 cSt at 40 °C = ISO VG 460 <sup>\*\*)</sup> are normally considered as suitable lubricating oils for turning device. The following products are fulfilling the requirements:

<sup>\*)</sup> EP = Extreme pressure

<sup>\*\*)</sup> ISO VG = Viscosity Grade categorisation specified by International Organization for Standardization

Table 3: Allowed lubricating oils for engine turning device:

LUBRICATING OILS FOR ENGINE TURNING DEVICE				
SUPPLIER	BRAND NAME	VISCOSITY cSt at 40 °C	VISCOSITY cSt at 100 °C	VISCOSITY INDEX (VI)
Shell	Omala S2 GX 460	460	30,8	97
BP	Energol GR-XP 460	460	30,5	95
Castrol	Alpha SP 460	460	30,5	95
Chevron (Texaco + Caltex)	Meropa 460	460	31,2	97
ENI S.p.A.	Blasia 320	300	23,0	95
ExxonMobil	Mobilgear 600 XP 460	460	30,6	96
Fuchs	Renolin CLP 460	460	30,4	95
Petro-Canada	Enduratex EP 460	452	30,4	97
Repsol	Super Tauro 460	460	30	92
RN-Lubricants	Rosneft Redutec CLP 460	429	27,7	89
Total / Lubmarine	Carter EP 460	470	30,3	93



## **APPENDIX 5.C COOLING WATER ADDITIVE SPECIFICATION FOR FACILITY**

The cooling water additive specifications for the W34LPG Generator Sets of the Facility must meet the below specifications.

[Place holder for Appendix 5C \_ Cooling Water]

## Cooling water treatment and analysing

**Distribution to operators and owners of installations concerned**

### For your information

#### Engines concerned

This bulletin is valid for:

- Sulzer Z40, ZA40, ZA40S, ZA50S
- Wärtsilä Vasa 32, 32LN
- Wärtsilä 16
- Wärtsilä 20, 20DF
- Wärtsilä 200, 220SG
- Wärtsilä 28SG
- Wärtsilä 26
- Wärtsilä 31, 31DF, 31SG
- Wärtsilä 32, 32DF, 32GD, 32LN
- Wärtsilä 34DF, 34LPG, 34SG
- Wärtsilä 38A, 38B, 38C
- Wärtsilä 46, 46GD
- Wärtsilä 46F, 46FDF
- Wärtsilä 50, 50DF, 50SG
- Wärtsilä 64

#### Reference

Cooling water system

#### Introduction

Correct cooling water treatment and follow-up of the cooling water condition are of utmost importance for keeping the cooling water systems of the engines in good condition.

#### Validity

Until further notice. Replacing issue 10, dated 27 September 2019.

In this issue, the following has been added in Table 2:

- Condemning values.
- Requirement for water hardness.

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## 1 Background

Correct cooling water treatment and follow-up of the cooling water condition are of utmost importance for keeping the cooling water systems of the engines in good condition. The corrosion processes that could occur due to a poor cooling water quality may under certain circumstances be local and by their nature proceed very rapidly. This may cause unexpected operating problems or engine failures even within relatively short periods of time, for example in the cylinder head exhaust valve seat pockets and other areas prone to corrosion (see further comments in chapter 4) in the cooling water systems of the engines.

Most of the cooling water additives which are validated by Wärtsilä are nitrite based (typically  $\text{NaNO}_2$ ) and today, most of the installations in operation are also using nitrite-based additives. Although there is a trend towards more environmentally friendly alternatives. These operating instructions and recommendations are mainly intended for installations using nitrite-based additives but certainly contain useful information also for users of other types of additives.

## 2 Purpose

To avoid unnecessary corrosion damages and operating problems in the cooling water systems of the engines.

  
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### 3 Instructions

#### 3.1 Raw water quality

The raw water quality for the cooling water circuits of an engine must meet the following specification:

**Table 1, Raw water quality**

Property	Unit	Limits for chemical use	Limits for WWCU <sup>1)</sup> use	Test method reference
pH <sup>1)</sup>	-	6.5 - 8.5	6.5 - 8.5	ASTM D 1287 or D 1293
Hardness	°dH	Max. 10	Max. 10	ASTM D 1126
Chlorides <sup>1)</sup>	mg/l	Max. 80	Max. 40	ASTM D 512 or D 4327
Sulphates	mg/l	Max. 150	Max. 100	ASTM D 516 or D 4327

<sup>1)</sup> Wärtsilä Water Conditioner Unit

<sup>1)</sup> If a Reverse Osmosis (RO) process is used, min. limit for pH is 6.0 based on the RO process operational principle. The use of water originating from RO process further presumes that for chloride a max. content of 80 mg/l when using chemicals and max. content of 40 mg/l when using WWCU is achieved.

Soft waters (like distilled, ion exchanged, reverse osmosis and rain water) with a total hardness close to 0 °dH (German degrees) can dissolve oxygen and carbon dioxide from the air, which quite rapidly lowers the pH levels and increases the corrosive effect of these waters. Thus, it is essential that additives are added as soon as possible after filling the cooling water system.

Suitable amounts of calcium and magnesium compounds (= total hardness) participates in forming a thin, corrosion protective layer on the heat exchanging surfaces of the cooling water system. Correct additive dosage and careful follow-up of the dosing levels are thus even more important with a very soft water compared to a normal quality tap/drinking water with a total hardness of 2 – 10 °dH.

The use of raw water qualities with a too high total hardness may on the other hand result in excessive deposit formations and reduced heat transfer properties. Water produced by one (1) stage reverse osmosis processes may sometimes contain too high chloride (and sulphates) contents and are in those cases not suitable as cooling water. Sometimes, it is possible to achieve a lower chloride level by using a two (2) stage RO process, but the outcome also depends on the RO process technology being used.

#### 3.2 Additive dosing

The cooling water additive dosage recommendations may vary, depending on additive type and manufacturer. The dosage recommendations for the cooling water additives validated by Wärtsilä are presented in section 5. There is no general dosage recommendation for the validated additives. Note that these recommendations apply for normal raw/cooling water properties, see also section 4 for further information. Generally, a slight overdosing is better than under-dosing, but an excessive additive (nitrite) dosage is not recommended economically or technically. Large (>2 – 3 times the maximum recommendation) overdosing may cause corrosion on copper, brass and other “soft alloys” in the system and possibly also problems with precipitation and deposit formations.

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### 3.3 Analysis and recommended levels

It is recommended to perform cooling water analysis, for example with test kits provided by the additive manufacturer, once (1) a week. The additive concentration of nitrite-based products may decrease quite rapidly, especially in the beginning after the initial dosing of a new or thoroughly cleaned system. When the properties of the cooling water are found to be stabilised, the analysis interval may under normal conditions gradually be prolonged, for example to 2 – 4 weeks.

It is also recommended to perform a more complete cooling water analysis 2 – 4 times / year to check that the test kit analysis results are correct and to be able to make a more complete cooling water condition evaluation. When samples are taken and sent for analysis, the sample bottles shall be fully filled up to minimise the amount of air in the bottle, and a suitable sample amount is 1 litre. The cooling water samples shall be taken from circulating water. Remember to flush the sampling pipes and valves properly before taking the sample. The samples should be kept in a cool and dark place during transportation and storage before the analysing. If special sample bottles are not available, the best alternative is an empty, clean drinking water bottle, since these are most likely free from bacteria and other contaminants.

Water and cooling water samples shall be analysed as soon as possible, preferably within a week after sampling. Some of the properties/compounds (pH, sulphates and iron for example) of the water may react or precipitate in the sample bottle and give false results.

Table 2 below shows the recommended values for the cooling water analysis to be checked regularly (weekly). Sudden changes in the trends of the analysed properties shall always be investigated and possible malfunctions and faults in the systems corrected.

#### **NOTE:**

If the recommended levels are exceeded, please contact Wärtsilä for further instructions.

**Table 2, Regularly (weekly) controlled cooling water properties**

Property	Recommended levels for optimal performance <sup>1)</sup>		Condemning limits
	Chemical use	WWCU use	
pH	8 – 11		< 7.5 and > 11.5
Nitrite (NO <sub>2</sub> )	470 – 2500 ppm <sup>2)</sup>		< 470 and > 2500 ppm <sup>2)</sup>
Chlorides (Cl)	< 50 mg/l	< 40 mg/l	> 80 mg/l
Sulphates (SO <sub>4</sub> )	< 100 mg/l		> 150 mg/l
Hardness (°dH)	< 10 °dH		> 10 °dH

<sup>1)</sup> For normal cooling water conditions, see also chapter 4.1 for recommendations for aggressive compounds and conditions.

<sup>2)</sup> The required nitrite content range is product specific and the additive dosage always has to fulfil the requirements included in Table 4.

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Table 3 gives recommended values for the additional properties that shall be performed during the more complete cooling water analysis, performed 2 – 4 times / year. Additional analysis may naturally be considered from case to case, if special issues have occurred.

**Table 3, Additional properties that shall be checked 2 – 4 times / year**

Property	Recommended levels for optimal performance
Iron (Fe)	< 1 mg/l <sup>1)</sup>
Nitrate (NO <sub>3</sub> )	< ≈ 50 - 200 mg/l <sup>2)</sup>
Calcium (Ca)	The total hardness (Ca + Mg)
Magnesium (Mg)	
Copper (Cu)	< 1 mg/l

<sup>1)</sup> The iron levels may be higher in new or recently overhauled systems, due to presence of smaller amounts of machining and installation debris, etc. These “initially high” iron contents should however gradually decrease to the typical levels. Observe that the total iron contents should be analysed not dissolved iron.

<sup>2)</sup> Constantly/rapidly increasing nitrate (NO<sub>3</sub>) levels, especially in combination with simultaneously decreasing nitrite (NO<sub>2</sub>) levels, indicate presence of possible bacterial/microbial activity in the systems. Bacterial contamination may come for example from salt water or some other dirty water contamination of the system. Nitrate (NO<sub>3</sub>) content in cooling water can vary significantly, since some products contain nitrate also as an original ingredient.

<sup>3)</sup> A total hardness of 10 °dH (German degrees) ↔ 178 mg/l (as CaCO<sub>3</sub>) and Mg = 4.3 mg/l ↔ 1 °dH and Ca = 7.1 mg/l ↔ 1 °dH

**NOTE:**

There are some chemical processes (deposition, corrosion and evaporation) in the cooling water system that can decrease or increase the concentration of certain elements (e.g. Ca, Mg, Cl). This can be one of the reasons for higher/lower levels found in the cooling water system compared to the raw water quality used.

## 4 Worth noticing

### 4.1 Aggressive compounds and conditions

Elevated amounts of sulphates, sulphides, halides and especially chlorides are extremely aggressive (corrosive) on iron. If there are high amounts of these aggressive ions present in the cooling water system, the nitrite dosage must be increased accordingly. The recommendations vary slightly between different additive manufacturers, but for increased chloride and sulphate contents the following formulas can be used as rules of thumb:

- Add 100 mg/l of nitrite (NO<sub>2</sub>) / 10 mg/l of chlorides (Cl), for Cl > 50 mg/l.
- Add 100 mg/l of nitrite (NO<sub>2</sub>) / 50 mg/l of sulphates (SO<sub>4</sub>), for SO<sub>4</sub> > 150 mg/l.

**CAUTION:**

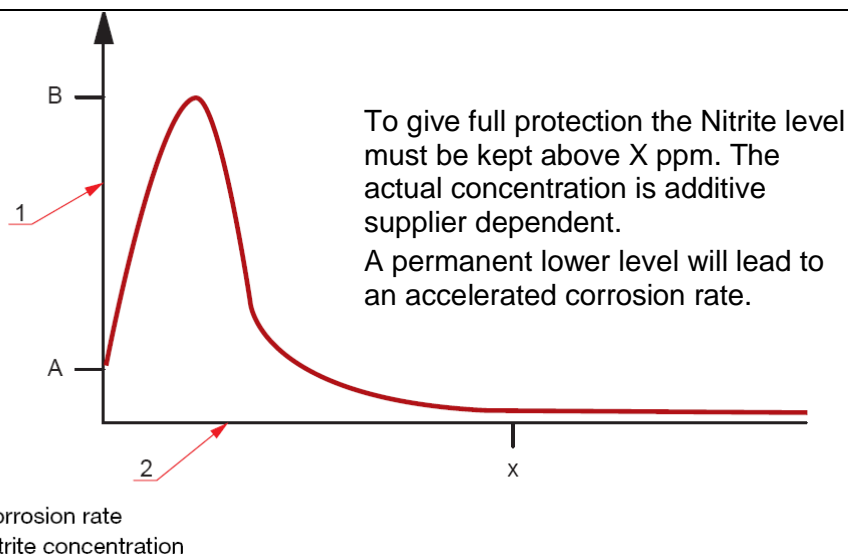
It is strongly recommended to change the cooling water immediately if the chloride content of the water exceeds 200 mg/l or if the sulphate content exceeds 400 mg/l.



The nitrite oxidation curve in Figure 1 shows a schematic graph of the corrosion rate as a function of the nitrite dosage. Observe that the position of the curve peak on the x-axis (= dangerous condition for corrosion) is not stable, but will shift depending on several external conditions in the cooling water, such as temperature, pH, chlorides and sulphates contents, etc. That is, if the chloride content of the cooling water is increased

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the additive (nitrite) dosage also must be increased to avoid the conditions of increased corrosion rate.



**Figure 1, Corrosion rate as a function of the nitrite concentration**

Chlorides and other corrosive ions tend to accumulate in cracks, under deposits etc. and may there reach considerably higher concentrations than in the "bulk phase". It is thus extremely important that all the surfaces of the system are cleaned properly before the corrosion protection additive is added to the system. Both oils/greases and scale/rust must be properly removed. There are cleaning products available on the market that combines or can be combined to provide both degreasing and descaling properties, such as the environmentally friendly BioCleaner products provided by Wärtsilä.

## 4.2 Additive characteristics

Nitrite based cooling water additives are so called anodic inhibitors and require proper dosing and maintenance to protect as intended. The nitrite of the additive is a salt and it will increase the electrical conductivity of the water. The non-additive originated conductivity is on the other hand one of the main parameters affecting the corrosion rate, if a corrosion process starts: the higher the conductivity, the higher the corrosion rate. From conductivity trend follow-up point of view, it is important to know the normal conductivity level of un-treated and treated cooling water. If the conditions (nitrite level, chlorides, pH, etc.) in the systems are such that the additive (nitrite based) is no longer able to protect the entire surface of the system, a rapid, local (pitting) corrosion in the unprotected areas may occur. The corrosion rate at the attacked areas will even be much higher than it would be with no additive at all present in the system.

Sensitive areas for corrosion would typically be:

- In crevices and under deposits.
- Areas of very low flow (the inhibitor is not properly taken to the metal surface).
- Areas of turbulent flow, such as a change of pipe cross-section, where it is more difficult to form a proper protective film.
- Areas that are typical problem areas for corrosion, such as welded sections, combinations of dissimilar metals, areas of increased mechanical stress, etc.

### 4.3 Powder form products

Nitrite based cooling water additives in powder form must be dissolved properly in water before adding to the system. To avoid possible dissolving problems resulting in under dosing, ensure enough mixing of the powder and the water in the maintenance tank.

### 4.4 Prolonged stops and mechanical design

During possible prolonged stops (> several months) of the engine, it is recommended to occasionally establish circulation of the cooling water and to keep the additive (nitrite) dosage at least at the maximum recommended level and preferably at 1.5 times the normal dosage.

It is also worth noticing that the mechanical design of the cooling water system (venting pipes to the expansion tank, expansion tank, air separator, etc.) must be according to the recommendations and specifications to avoid corrosion (cavitation) and other operational problems.

### 4.5 Alternative cooling water treatment additives and treatment systems

Organic Acid Technology (OAT) based products are more environmentally friendly alternatives to the traditional, nitrite-based cooling water additives. These are advisable to be used when aluminium and its alloys are present as engine parts.

As an alternative to the validated cooling water additives, the Wärtsilä Water Conditioner Unit (WWCU) can also be used to treat cooling water of engines' closed water circuits. WWCU is based on the Enwamatic EMM cooling water treatment system but includes several new features based on Wärtsilä design. The WWCU protects the engine from corrosion without any chemicals. It acts as a side stream filtration and water treatment unit and includes the following functions: corrosion protection, scale control, filtration, control of bacterial growth and air separation. The stricter raw water quality requirements compared to what is specified when cooling water additives are used shall be taken into account, see Table 1 in chapter 3.1. Due to a severe corrosion risk WWCU cannot be used in the cooling water systems containing aluminium or aluminium alloys as a construction material.

The WWCU can be a sensible alternative for the installations in which environmentally friendly solutions are appreciated.

The assembly, installation, operation and maintenance instructions of Wärtsilä shall always be followed. For more information about the WWCU, contact Wärtsilä and refer to solution name **WWCU**.

### 4.6 Mixing of different cooling water additives

Different cooling water additives shall not be mixed with each other. If it is desired to start to use another cooling water additive, the one being used shall be drained from the system before filling with another product. If the cooling water system is dirty, it shall be flushed with good quality water or if needed use additionally chemicals to remove possible deposits, like grease, oil, rust, etc. Many additives are chemically compatible with each other, but mixing can lead to e.g. polymers starting to loosen existing deposits from cooling water system, which can then drift in the system and stick to other surfaces, e.g. at the cylinder head and cause heat transfer decline, clogging of small bore channels and deposit formation leading to corrosion.

## 4.7 Warning for Aluminium parts

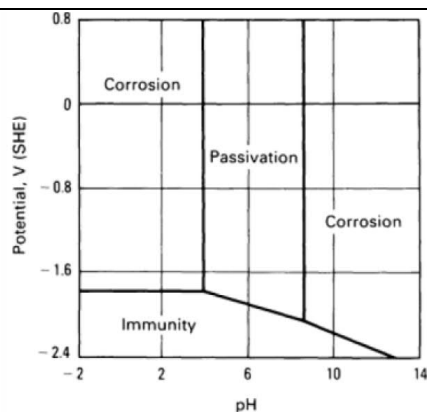
When aluminium alloys are present as engine parts, Sodium Nitrite/Borate based products are typically not good for protection (though some products can contain other inhibitors giving protection to Al as well). Neither molybdate based products nor metasilicate technology are good in this respect, since at the elevated temperatures in the HT-circuits, silicates can start to crystallize, resulting in a loss of Al protection and causing e.g. leakage in mechanical pump sealings. Organic acid technology is the only acceptable cooling water additive if Al alloys are used as construction material.

### NOTE:

In recently manufactured engines, the cooling water system does not have aluminium parts, but older engines may have. If in doubt, or if a change of additive type is planned, please contact Wärtsilä for advice. Additionally, it shall be checked that there are no aluminium / aluminium alloy components present in the external cooling water system when choosing a nitrite-based cooling water additive.

Aluminium has a very high resistance to corrosion. One reason for this is that aluminium is covered spontaneously by a thin but effective coating of oxide which protects the part from further oxidation. The aluminium oxide is impermeable and is integral with the base metal. If the coating of oxide is mechanically damaged, the coating will be renewed immediately. The conditions for thermodynamic stability of the oxide film are expressed by the Pourbaix diagram (potential versus pH) in Figure 2.

The diagram shows that aluminium is passive (protected by the oxide film) in the pH range of about 4 and 8.5. The limits of this range, however, vary somewhat with temperature, with the specific form of oxide film present, and with the presence of substances that can form soluble complexes or insoluble salt with aluminium.



**Figure 2, Pourbaix diagram for Aluminium with an  $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  film at 25°C. Potential values are for the standard hydrogen electrode (SHE) scale**

The most frequent types of corrosion are Galvanic Corrosion, Pitting and Crevice Corrosion. Galvanic corrosion takes place when two different metals are in contact with each other in the presence of an electrolyte. The less noble metal (anode) of the combination corrodes, while the noble (cathode) will be protected.

A small surface of the cathode and a large surface of the anode lead to a low corrosion. In a reverse case, the Aluminium will be attacked quickly. In most combinations with other metals, Aluminium is the less noble. Aluminium is therefore at greater risk of galvanic corrosion than that of the other materials.

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## 4.8 Use of glycol

### NOTE:

Do not use glycol in the cooling water unless it is necessary.

If a risk of freezing exists, glycol needs to be added to cooling water. Since glycol alone does not protect the engine and cooling water system against corrosion, additionally a validated cooling water additive must always be used. All the validated cooling water additives are compatible with glycol.

Ready-to-use mixtures containing both glycol and corrosion inhibitors are not allowed to use, since those are normally designed to be used as strong (30 –) 50% / 50% mixtures., Normally, a much lower glycol concentration is adequate to protect the cooling water system against freezing. But when decreasing the glycol amount, simultaneously also the concentration of corrosion inhibitors will decrease to too low level resulting in an increased risk of corrosion.

The amount of glycol in closed cooling water system shall always be minimised since glycol decreases the heat transfer capability of water. The engine may be subject to additional output derating when using glycol in the cooling water.

There are two types of glycol qualities, monopropylene glycol (MPG) and monoethyleneglycol (MEG) commercially available. Industrial qualities of both glycol types can be used, but MPG is the more environmentally friendly alternative.

## 5 Validated cooling water additives

Table 4 below presents the currently validated cooling water treatment products and the dosage recommendations.

**Table 4, Validated cooling water additives and dosage recommendations (for normal conditions)**

Manufacturer	Product designation	Dosage per 1 m³ of system capacity	Concentration of active corrosion inhibitor	Additive type
Alm International	Diaprosim RD11 (RD11M)	5 kg	1250 ppm as NO <sub>2</sub>	NaNO <sub>3</sub> + borate
Artego	Havoline XLI	50 – 100 litres	1.8 – 3.7 Brix° of A.C*	OAT**
Drew Marine	Liquidewt	8 – 12 litres	470 – 700 ppm as NO <sub>2</sub>	NaNO <sub>3</sub> + borate
	Maxigard	16 – 30 litres	640 – 1200 ppm as NO <sub>2</sub>	
Chevron (Texaco + Caltex)	Delo XLI Corrosion Inhibitor Concentrate	50 – 100 litres	1.8 – 3.7 Brix° of A.C*	OAT**
	XL Corrosion Inhibitor Concentrate			
GE Water and Process	CorrShield NT 4293	10 litres	670 – 1000 ppm as NO <sub>2</sub>	NaNO <sub>3</sub> + borate
	CorrShield NT 4200			
Korves Oy	Pekar J	20 litres	30 ppm as Mo	OAT**
Kuwait Petroleum (Danmark) A/S	Q8 Corrosion Inhibitor Long-Life	50 – 100 litres	1.8 – 3.7 Brix° of A.C*	OAT**
Marine Care B.V.	Caretreat 2 Diesel	6 – 10 litres	1500 – 2500 ppm as NO <sub>2</sub>	NaNO <sub>3</sub> + borate
Maritech AB	Marisol CW	6 – 9 litres	1000 – 1500 ppm as NO <sub>2</sub>	NaNO <sub>3</sub> + borate
Motul	HD Cool Power Ultra	50 – 100 litres	1.8 – 3.7 Brix° of A.C*	OAT**
Nalco Chemical Company	TRAC102	32 – 48 litres	1000 – 1500 ppm as NO <sub>2</sub>	NaNO <sub>3</sub> + borate
	TRAC118	2.25 – 3.40 litres	670 – 1000 ppm as NO <sub>2</sub>	
Solenis	Drewgard 4109	16 – 30 litres	640 – 1200 ppm as NO <sub>2</sub>	NaNO <sub>3</sub> + borate
Total	WT Supra	50 – 100 litres	1.8 – 3.7 Brix° of A.C*	OAT**
Vecom Marine Alliance	Cool Treat NCLT	6 – 10 litres	1500 – 2500 ppm as NO <sub>2</sub>	NaNO <sub>3</sub> + borate
	Cooltreat AL	50 – 100 litres	1.8 – 3.7 Brix° of A.C*	OAT**
Wilhelmsen Chemicals	Dieselguard NB	2.0 – 4.8 kg	1000 – 2400 ppm as NO <sub>2</sub>	NaNO <sub>3</sub> + borate
	Engine Water Treatment 9-108	2.25 – 3.40 litres	670 – 1000 ppm as NO <sub>2</sub>	
	Naffleet 2000	32 – 48 litres	1000 – 1500 ppm as NO <sub>2</sub>	
	Rocor NB liquid	9.5 – 24 litres	1000 – 2400 ppm as NO <sub>2</sub>	

\* Brix° of active compounds (A.C), measured with a supplier's refractometer.

\*\* Organic Acid Technology



- Note 1: For many products the recommended minimum and maximum limits are listed in the table above. Since the amount of active corrosion inhibitors, especially nitrites, is decreasing during the service of engines, the engine manufacturer recommends starting the dosage from the upper level of indicated range.
- Note 2: The nitrite content of nitrite-based cooling water additives tends to decrease in use. The risk of local corrosion increases substantially when nitrite content goes below the recommended limit.
- Note 3: Cooling water additive manufacturers can indicate the required nitrite content measured either as sodium nitrite,  $\text{NaNO}_2$  or as nitrite,  $\text{NO}_2$ . 1 mg/l as  $\text{NO}_2$  equals to 1.5 mg/l as  $\text{NaNO}_2$ .
- Note 4: Nitrite based cooling water additives are not offering a good protection against corrosion for aluminium and its alloys and thus the use of such products can't be recommended for cooling systems containing those construction materials.

## 6 Contacts

If technical support is needed, please create a **TechRequest** in Wärtsilä Online.

For services, spare parts and/or tools, please contact your nearest Wärtsilä representative or the Customer Support Centre (CSC):

[www.wartsila.com/csc](http://www.wartsila.com/csc)

  
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## APPENDIX 5.D AIR QUALITY SPECIFICATION

The combustion air entering the engine shall always be filtrated trough an air filter having the minimum filtrating class corresponding to F5 (EN779:2002). In applications where the engine is delivered with marine filters this is also the minimum requirement for air filters used in the process ventilation system. The filtration class F5 is corresponding to an efficiency rate of 70% for 5µm particles.

For plant applications where the outside dust levels can reach concentrations above 1-hour TSP of 1 mg/Nm<sup>3</sup>, the filtration system is to be done in two steps, one pre-filter system with higher dust handling capacities and a secondary filtration system.

The highest allowable concentration of harmful components in the engine intake air after filtration is:

- Sulphur Dioxide (SO<sub>2</sub>): 1.25 mg/Nm<sup>3</sup> or 0.43 vol-ppm
- Hydrogen Sulphide (H<sub>2</sub>S): 375 µg/Nm<sup>3</sup> or 0.25 vol-ppm
- Chlorides (Cl<sup>-</sup>): 1.5 mg/Nm<sup>3</sup> or 1.16 mass-ppm
- Ammonia (NH<sub>3</sub>): 94 µ/Nm<sup>3</sup> or 0.125 vol-ppm

Note! Nm<sup>3</sup> given at 0°C and 1013 mbar.

Measurements are to be performed during a 24 hour period and the highest 1 hour average is to be compared with the above mentioned boundary values. Weather conditions, such as wind speed, wind direction, ambient temperature and air humidity may vary considerably during one year. Therefore, a one day measurement may not reflect the most critical situation.

A detailed investigation concerning the filtration has to be done in installations, where the air includes components that are known to be caustic, corrosive or toxic.

## APPENDIX 6

### INDEXES AND FORMULAS

#### 1. Fixed Fee

The Fixed Fee is escalated yearly at each anniversary of the Execution Date ("**Adjustment Date**"), using the formula below:

$$AFF_x = AFF_{x-1} * (USCPI_x / USCPI_{x-1})$$

**Where:**

$AFF_x$  = shall mean the escalated Fixed Fee for the year commencing on the Adjustment Date.

$AFF_{x-1}$  = shall mean the escalated Fixed Fee in effect immediately prior to the escalation.

$USCPI_x$  = shall mean the USCPI corresponding to the Adjustment Date.

$USCPI_{x-1}$  = shall mean the USCPI corresponding to the previous Adjustment Date.

#### 2. Variable Fee for the Wartsila 34LPG Generator Set

The Variable Fee is escalated yearly at each anniversary of the Execution Date ("**Adjustment Date**"), using the formula below:

$$AVF_x = (AVF_{x-1} * (60\% * (EPPI_x / EPPI_{x-1}))) + (AVF_{x-1} * (40\% * (USCPI_x / USCPI_{x-1})))$$

**Where:**

$AVF_x$  = shall mean the escalated Variable Fee for the year commencing on the Adjustment Date.

$AVF_{x-1}$  = shall mean the Variable Fee in effect immediately prior to the escalation.

$EPPI_x$  = shall mean the EPPI corresponding to the Adjustment Date.

$EPPI_{x-1}$  = shall mean the EPPI corresponding to the previous Adjustment Date.

$USCPI_x$  = shall mean the USCPI corresponding to the Adjustment Date.

$USCPI_{x-1}$  = shall mean the USCPI corresponding to the previous Adjustment Date.

3. Overhaul Fee for the Wartsila 34LPG Generator Set

The Overhaul Fees is escalated yearly at each anniversary of the Execution Date ("**Adjustment Date**"), using the formula below:

$$AOH_x = (AOH_{x-1} * (XX * (EPPI_x / EPPI_{x-1}))) + (AOH_{x-1} * (YY * (USCPI_x / USCPI_{x-1})))$$

**Where:**

$AOH_x$  = shall mean the escalated Overhaul Fee for the year commencing on the Adjustment Date.

$AOH_{x-1}$  = shall mean the Overhaul Fee in effect immediately prior to the escalation.

$EPPI_x$  = shall mean the EPPI corresponding to the Adjustment Date.

$EPPI_{x-1}$  = shall mean the EPPI corresponding to the previous Adjustment Date.

$USCPI_x$  = shall mean the USCPI corresponding to the Adjustment Date.

$USCPI_{x-1}$  = shall mean the USCPI corresponding to the previous Adjustment Date.

XX = the applicable percentage multiplier for the EPPI indicated in the table below

YY = the applicable percentage multiplier for the USCPI in the table below

Engine Overhaul	XX	YY
32,000 hour	64%	36%
36,000 hour	59%	41%
48,000 hour	66%	34%



## **APPENDIX 7**

### **FORM OF ANNUAL OPERATING PLAN**

#### **1. GENERAL & ADMINISTRATION**

##### **1.1. Status of the Power Plant**

[Make a reference to the applicable agreement and summarize the status in general.]

##### **1.2. Subcontractors**

[List and describe functions that are planned to be subcontracted.]

##### **1.3. Reporting**

[List reports and describe content and distribution of e.g. daily and monthly reports generated in accordance with the Agreement.]

##### **1.4. Communication**

[Create a communication plan including contact persons and describing how communication is taken care off on different occasions (e.g. meetings, handling of legal notices, contacting authorities concerning safety and environmental issues.)]

#### **2. OPERATIONAL TARGETS AND PERFORMANCE**

[List and describe guaranteed performance parameters including applicable bonuses and penalties.]

#### **3. SAFETY AND ENVIRONMENTAL ISSUES**

##### **3.1. Safety**

[Describe applicable OH&S (Occupational Health and Safety) guidelines and responsibilities (including personnel and equipment).]

### 3.2. Environmental

[Describe applicable EMS (Environmental Management System) guidelines and responsibilities.]

## 4. CHANGE ORDERS

### 4.1. Facility Improvements

[List and describe available product upgrades that could improve the process or utilization and in majority would need to be planned into Owner's budget.]

## 5. ANNUAL DISPATCH PLAN (based on Owner's input)

[Bar graph(s) and list(s)]

[Fuel(s) and Lube Oil estimated consumption]

## 6. ANNUAL MAINTENANCE SCHEDULE

[List, according to annual maintenance schedule, all major equipment that will undergo scheduled maintenance during the Year. Accordingly describe parts availability and purchase requirement(s).]

## 7. ANNUAL TRAINING PROGRAM

[List annual training program for the personnel, target dates of training, etc.]

## 8. OTHER RELEVANT ACTIVITIES

[List and describe all other important milestones to achieve during the Year.]

**APPENDIX 8  
FORM OF TERMINATION/EXPIRY CERTIFICATE**

The Parties acknowledge and certify that:

- (i) The Agreement has expired/has been terminated with effect from [●].
- (ii) They have fulfilled all their obligations under the Agreement, except for the obligations set forth in this Certificate.
- (iii) The obligations still to be fulfilled under the Agreement are the following: Operating Partner [●], Owner [●].
- (iv) Except as set forth in (iii) above the Parties release each other from any further claims, demands or liabilities with respect to their obligations under the Agreement.
- (v) future service and spare part requirements will be handled by the following office,  
  
[insert name of the Party entity]  
[insert name of contact person/title]  
[insert telephone number]  
[insert facsimile]  
[insert e-mail]

The Parties have caused this Termination/Expiry Certificate to be executed by their duly authorized representatives as of [●].

**On behalf of Owner:**

**On behalf Operating Partner:**

**By:**

**By:**

**Title:**

**Title:**

**APPENDIX 9**  
**FORM OF PERFORMANCE TEST CERTIFICATE**

The Performance Test has been satisfactorily completed in accordance with the Agreement.

The measured results during the Electrical Capacity and Heat Rate Test are as follows:

[•]

The Parties acknowledge that based upon the above results [the Operating Partner is liable to pay Performance Liquidated Damages in the following amounts [•].The Performance Liquidated Damages shall be paid in accordance with Section 8.1.2 and 8.1.4.

For: **Operating Partner**

By: \_\_\_\_\_

Title: \_\_\_\_\_

Date

For **Owner**

By: \_\_\_\_\_

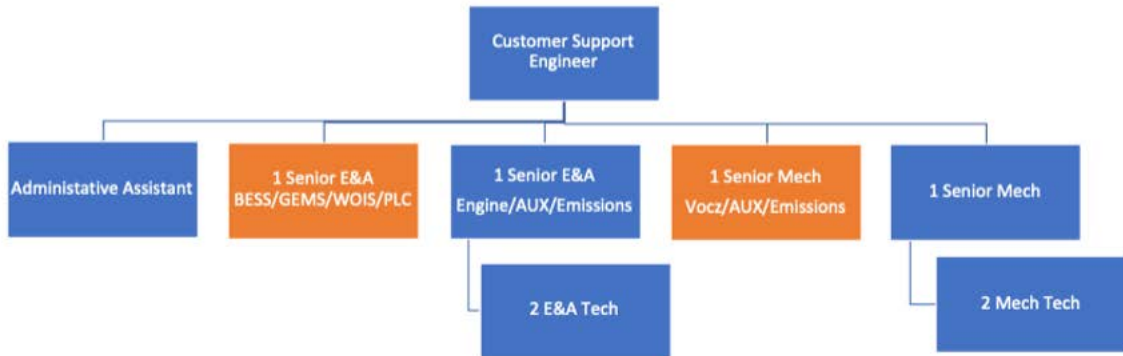
Title: \_\_\_\_\_

Date:

**APPENDIX 10**  
**ORGANIZATION CHART**

[Place holder for Organization Chart]





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For Phase 1 we have included the Customer Support Engineer, 1 x Senior E&A, 1 x Senior Mechanical, and 1 x Mechanical Technician. These positions are included in the Fixed Fee for the Phase 1. The remaining positions will be included into the Phase 2 Fixed Fee.

**APPENDIX 11**  
**OWNER'S SAFETY POLICY**

Place holder for USVI WAPA Documents

Occupational Health and Safety Policy – Incident Reporting and Investigation

Occupational Health and Safety Policy – Personal Protective Equipment

Occupational Health and Safety Policy – Welding Cutting and Hot Work

Occupational Health and Safety Policy – Lockout / Tagout

Occupational Health and Safety Policy – Change Management



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## Virgin Island Water and Power Authority

### Occupational Health and Safety Policy

### Incident Reporting and Investigation

INCIDENT- An incident is an unplanned, undesired event that can or has the potential to adversely affect the completion of a task.

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Rev.	Revision Date	Revision Description	Prepared	Checked	Approved
A	June 26, 21015	Issue for Comments	B. Poston <i>B. Poston</i>	X. Yang <i>X. Yang</i>	X. Yang <i>X. Yang</i>

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## 1.1 OBJECTIVE

The objective of this policy: Incident Reporting and Investigations are to provide specific guidance regarding our requirements (must/shall) and recommendations (may/should) for incident reporting and investigations for all WAPA personnel. It is also expected that all recommendations shall be given serious consideration with appropriate rationale with a viable justification when not utilized.

Accurate reporting and classification systems are an essential component of an effective injury surveillance, analysis, and prevention program. Accurate, consistent, and timely reporting and classification are critical for detecting early trends to:

- Identify potentially preventable incidents
- Prioritizing action steps (risk mitigation, elimination, or reduction)
- Assessing the effectiveness of these actions and programs

## 2.0 REFERENCES

OSHA 29 CFR Parts 1904 & 1952

International Petroleum Environmental Association (IPIECA)

American Petroleum Institute (API)

Oil and Gas Producers (OGP) guidelines

## 3.1 DEFINITIONS

Actual and Potential "Hurt-based Severity Level" Definitions		
Hurt Severity Levels	Actual Hurt (AHL) (How bad was it?)	Potential Hurt Level (PHL) (How bad could it have been?)
Level 5-Multiple Fatalities	Multiple Fatalities	Multiple fatalities or a safety event that could have reasonably resulted in an Actual Hurt Level (AHL) 5, but did not.
Level 4- Fatality	Fatality	Fatality or safety event that could reasonably have resulted in an Actual Hurt Level (AHL) 4 and a higher Potential Hurt Level (PHL) is <b>not</b> reasonable.

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Actual and Potential "Hurt-based Severity Level" Definitions		
Hurt Severity Levels	Actual Hurt (AHL) (How bad was it?)	Potential Hurt Level (PHL) (How bad could it have been?)
Level 3- Severe Hurt	<p>Illness or injury causing severe physical body damage with probable long term and /or significant life altering complications such as:</p> <ul style="list-style-type: none"><li>• Life-altering fractures, lacerations, or penetrations</li><li>• Amputations</li><li>• Significant third degree burns</li><li>• Disfigurement</li><li>• Loss/impairment of a body organ function</li><li>• Severe to complete loss of hearing</li><li>• Severe visual impairment to total blindness</li><li>• Confirmed debilitating ergonomic or Serious Illness Event (SIE) cases</li></ul>	<p>A safety event that could reasonably have resulted in an Actual Hurt Level (AHL)3 and a higher Potential Hurt Level (PHL)is <b>not</b> reasonable</p>

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Actual and Potential "Hurt-based Severity Level" Definitions		
Hurt Severity Levels	Actual Hurt (AHL) (How bad was it?)	Potential Hurt Level (PHL) (How bad could it have been?)
Level 2- Moderate Hurt	<p>Illness or injury causing significant physical body damage; reasonably expected to heal without significant life-altering complications in a moderate time period (weeks to months) such as:</p> <ul style="list-style-type: none"><li>• Fractures, loss of tooth/teeth</li><li>• Significant lacerations/penetrations</li><li>• Partial single digit amputations</li><li>• Significant second degree burns (blistering)</li><li>• Minor third degree burns</li><li>• Significant sprains and strains</li><li>• Major infections post-injury or from an occupational illness</li><li>• Dislocations</li><li>• Punctured ear drum or moderate to moderately severe hearing loss</li><li>• Moderate visual impairment or physical therapy</li><li>• Confirmed ergonomic or Serious Illness Event (SIE) cases requiring significant treatment, surgery</li></ul>	<p>A safety event that could reasonably have resulted in an Actual Hurt Level 2 and a higher Potential Hurt Level is <u>not</u> reasonable</p>

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Actual and Potential "Hurt-based Severity Level" Definitions		
Hurt Severity Levels	Actual Hurt (AHL) (How bad was it?)	Potential Hurt Level (PHL) (How bad could it have been?)
Level 1- Minor Hurt	<p>Illness or injury causing minor physical body damage; reasonably expected to heal without significant life-altering complications in a short time period (hours to days) such as:</p> <ul style="list-style-type: none"><li>• Minor chipping or cracking of a tooth/teeth</li><li>• Minor lacerations/penetrations that bleed freely</li><li>• Partial single digit amputations</li><li>• Minor second degree burns (blistering)</li><li>• Bruises</li><li>• Significant Sprains and Strains</li><li>• Minor infections post-injury or from an occupational illness</li><li>• Partial or self-resolving dislocations</li><li>• Confirmed to slight to mild hearing loss</li><li>• Mild eye injuries (corneal abrasion)</li><li>• Confirmed ergonomic or Serious Illness Event (SIE) cases requiring minor treatment</li></ul>	<p>A safety event that could reasonably have resulted in an Actual Hurt Level (AHL)<sup>1</sup> and a higher Potential Hurt Level is <b>not</b> reasonable</p>
Level 0- No Hurt	<p>No Hurt occurred (no physical body damage) but there are actionable learning's to take to possibly prevent future Hurt.</p>	<p>No hurt occurred (no physical body damage but there are actionable learning to take to possibly prevent future Hurts and a higher Potential Hurt Level (PHL) is <b>not</b> reasonable</p>
Unsafe Act/Unsafe Condition (UA/UC)/ Near Miss	<p>A hazardous behaviour or condition that could not be corrected immediately, no energy was expended and a sharable lesson exists.</p>	

#### 4.1 REQUIREMENTS

#### 4.2 Incident Reporting

Incidents and near misses **shall** be reported immediately by the affected person and documented by using the form OHS-IR-10 (See Appendix A) for health safety and security- related incidents



drafted by the affected



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person with assistance from the Supervisor. **"Draft written reports shall be submitted within 8 hours with telephone/email initial notification immediately to the relevant Manager and the Safety Manager. Contractor reporting shall be immediate verbal and a draft report submitted within 8 hours as well. Contractors shall utilize either their reporting form or the WAPA OHS-IR-10 as agreed upon in the contract."**

#### 4.3 Incident Investigations

Incidents **shall** be investigated as soon as possible/practical by the area Supervisor/Manager with support from the Safety Department.

- Actual or Potential Hurt levels (AHL / PHL) above 3 require a full root cause analysis. Incident investigations are conducted to achieve an understanding of the events as they occurred as well as events leading up to and following the event.
- Incident investigations are not intended to place blame on individuals but to establish facts and achieve lessons learned for sharing within the organization.

#### 4.4 Corrective Actions

Corrective actions are addressed in the specific responsibilities and shall be tracked for implementation, effectiveness in being about change to a given situation and recorded to further review as indicated. Furthermore, corrective actions and lessons learned shall be disseminated through the periodic newsletter.

#### 4.5 Training

Managers and Supervisors shall be trained in conducting Root Cause Analysis investigations (TAP ROOT®). Managers are responsible for ensuring their personnel are adequately trained in incident reporting and investigations as defined in this policy.

### 5.0 RESPONSIBILITIES

#### 5.1 Supervisor / Manager Responsibilities

**Shall** ensure incidents in draft are classified per the guidelines, with input from the Safety Department, as required.

**Shall** ensure the initial draft, final report, subsequent investigation, and further reviews are completed (as appropriate) and final documentation is accurate, complete and submitted in a timely manner.

**Shall** validate classification decision with their Safety Officer and Safety Manager if inconsistent with Safety Officer

**Shall** inform their personnel on the requirement for accurate reporting and recordkeeping to ensure compliance with local regulations and corporate guidance

**Shall** Ensure the Review Committee conducts quarterly reviews for your incidents to assist with classification / recordability consistency and accuracy.

**Shall** review, approve and schedule for implementation (if unable to correct within 48 hours) the corrective actions derived from the incident analysis activities, and commits resources to implementing these actions to completion. Ensure that implemented corrective actions are documented and such documentation is provided to the District Safety Officer.

**Shall** secure or direct to be collected, secured or preserved anything initially identified as evidence.

**Shall** collect the contact details of witnesses, for statements and interviews

**Shall** ensure adequate equipment is available to assist in conducting an investigation.

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## 5.2 Safety Manager Responsibilities

The Safety Manager upon receipt of a draft OHS-IR-10 **shall** contact the relevant Supervisor/Manager to set up a meeting and discuss the incident specifics in the report and its classifications, ensuing investigation and potential corrective actions. After agreement the report **shall** be resubmitted with changes as "final" by the Supervisor/Manager.

**Shall** ensure proper equipment is available to assist in conducting an investigation

**Shall** direct all incidents with a severity level of AHL/PHL of 3+ or higher to be investigated by the Supervisor/Manager with support from the Safety Department.

**Shall** review the investigation results and corrective actions implemented which will be agreed upon for implementation by the Supervisor/Manager and the Safety Manager.

**Shall** ensure follow-up corrective actions are tracked by the relevant Supervisor/Manager for implementation until completion with further review/audit by the Safety Department.

Review with the Supervisor/Manager is **REQUIRED** when a case is determined **NOT** to be recordable, and involves any of the following:

- Conflicting contemporaneous medical treatment recommendations
- Significant diagnosed injury or illness (AHL/PHL 3+) Questionable veracity/accuracy of claim by employee
- Visit to physician/health care provider for matters potentially work-related
- Medical removal criteria
- Limitations or restrictions
- Workers compensation claim granted (when determined)
- Pre-existing condition
- Hearing loss cases where retests are positive

## 5.3 Safety Officer Responsibilities

- Designated local Safety contact who will be the first point of contact for Safety matters including incident reporting and classification questions
- Ensures incident reports are completed and submitted in a timely manner by the Supervisor/Manager
- Participates in incident investigations and assists with evidence gathering and other ancillary duties as required

## 5.4 Incident Review Committee Responsibilities

- Comprised of staff designated by management with terms of 6 months
- Charged with reviewing the facts associated with cases with respect to the hurt based system and makes a classification/ recordability recommendation to the Safety Manager
- Conducts quarterly reviews of the reporting and records keeping program and data to assure the ongoing effectiveness of the records keeping process
- Recommends additional corrective actions based upon past cases or other industry best practices to the Safety Manager

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## 5.5 Document Management Responsibilities

- The Safety Department shall maintain a documentation management procedure to ensure initial and final reports of injuries/illnesses and subsequent supporting documentation is maintained in accordance with regulatory and management system requirements. (e.g., investigations, records keeping support documentation, changes in classification etc.)
- Maintains procedures to maintain OSHA 300/300A/301 forms and supporting documentation for 5 years
- An internal regulatory compliance assurance procedure which includes an annual review of the OSHA 300 log (or local equivalent) and reporting/recording process prior to signature and posting

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## APPENDIX A INCIDENT REPORTING FORM

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## Safety, Security and Health Incident Report

Photos Included		Draft		Final Approved					WAPA-OHS-IR-10-01
<b>1. GENERAL INFORMATION</b>									
Date of Incident		Time		Country		State			
Work Related		Location							
Actual Hurt Level		Potential Hurt Level		Classification					
<b>2. INCIDENT SUMMARY</b>									
Incident Summary (One Sentence)									
<div>Incident Description- (Include information leading to the incident, description of the event and steps taken to care for the injured person, assess incident for learning's, etc.)</div>									
Dropped Object?		Units		Mass in kg		Height (M)		Potential Fall Energy (Joules)	
Lone Worker		Witnessed Event			SSE's Involved				
Equipment Involved									
PPE Worn									
<b>3. IF ILLNESS OR INJURY</b>									
Name				Employee		SSE			
Nature of Illness/Injury									
Events Leading to Injury									
Primary Body Part Affected						Secondary Body Part Affected			
Medical Response Provided									
IP Status Update									
Medication Name and Dosage								US Prescription	
Alternative Evaluation				Highest Medical Consultation					
IP return to work?				Days Lost/Restricted					
<b>4. SECURITY</b>									
Security Category									
Agency Notified				Agency Name		Date Reported & Case No.			
Reporters Name						Name of Person Notified			
Date of Issue	5/19/2014	Revision #	1						

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## Safety, Security and Health Incident Report

### 5. INCIDENT / NEAR HURT INVESTIGATION SUMMARY (For all work related incidents)

Root Cause Analysis Tools	Ask Why 5 Times: <i>Required for all incidents</i>	TapRoot® or other Root Cause Analysis Tool? A TapRoot or similar must be completed for any incident with a Actual Hurt Level (AHL) of 2 or Potential of Hurt Level of 3+	
Primary Contributing Causal Factor (Root Cause)			
Other Significant Contributing Causal Factors			
Did pre-job planning (JSA etc.) identify the risk or hazard that ultimately caused the incident?			
Did the job require a Permit to Work (PTW)?		Was the Permit to Work (PTW) completed prior to the work?	
Corrective Actions ( <i>Must Address /Match Root Causal Factors</i> )	Person Responsible	Due Date	
<b>Note: Corrective Actions will be assessed by the QHSSE Manager and tracked to closure</b>			
Functional Leader Review	Name/Date	QHSSE Review	Name/Date

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## Safety, Security and Health Incident Report

### 6. ADDITIONAL NOTES

### 7. INCIDENT PHOTOS- *(Please minimize photos to the extent possible while maintaining clarity)*

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# Virgin Island Water and Power Authority

## Occupational Health and Safety Policy

### Personal Protective Equipment

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## 1.0 OBJECTIVE

The objective of this policy: Personnel Protective Equipment (PPE) is to provide specific guidance regarding our requirements (**must/shall**) and recommendations (*may/should*) for personal protective equipment for all WAPA personnel. It is also expected that all recommendations **shall** be given serious consideration with appropriate rationale with a viable justification when not utilized.

By properly assessing specific job hazards, and by selection, use and care of personal protective equipment (PPE) our ultimate objective is to eliminate all workplace injuries. Our emphasis *should* always be a constant drive towards eliminating human exposures to the hazard itself. Whenever hazards remain, proper PPE plays an important part in mitigating those hazards. Consequently, all sites where WAPA personnel are located **shall** be evaluated against this policy to ensure our minimum criteria are met.

## 2.1 REFERENCES

- US OSHA 29 CFR 1910.132 Personal Protective Equipment Standard
- ANSI Z87.1
- ANSI Z87.1
- ANSI Z49.1
- NFPA 70E
- ASTM F1506-10a
- NFPA 2112
- ANSI Z41.1
- ANSI Z89.1-1997, Type 1 Class E

## 3.1 EXPECTATIONS, REQUIREMENTS & RECOMMENDATIONS

This policy is intended to primarily address operations-based work environments and is not intended to address office based environments.

## 3.2 Job Hazard Analysis (JHA)

**Shall** be utilized to identify when and what type PPE is required and **shall** be documented and maintained for each job task using form OHS-JHA-01 (See Appendix A). JHA's are required for each task in compliance with the policy: Hazard/Risk Management and Mitigation and submitted by the worker to their immediate supervisor for approval and signature. The Supervisor shall then forward the completed JHA to the Area Manager for review and then forwarded to the Safety Manager for review and acceptance.

## 3.3 Pre-job Hazard Analysis (PHA)

**Shall** be completed by the relevant Area Manager using OHS-PRA-01 (See Appendix B) and forwarded to the Safety Department for review and acceptance. This **shall** be done prior to the work commencing as early as possible to facilitate the review to ensure we are providing the correct PPE for the workforce assigned to that job. Identified risks at the project level are to be recorded.

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### 3.4 PPE Training

Every worker **shall** be trained upon initial employment and every third year thereafter in the correct use and care of PPE. Supporting documentation is maintained by the site Safety Officer. This includes but not limited to:

- When PPE is necessary
- What PPE is necessary including the proper fitting of selected PPE
- Proper selection and use including proper cleaning, sanitizing and maintained in a reliable condition
- Limitations
- Care instructions
- Management Expectations: Personal Protective Equipment

PPE retraining **shall** be conducted when the previous training becomes obsolete, or the workplace changes result in a change in the type of PPE worn. Additionally, when or if an employee cannot demonstrate proper use, care or adequate skill and understanding the requirements for PPE use additional training **shall** be provided.

### 3.5 Personal Protective Equipment Specifics

PPE is provided by WAPA at no cost to employees. PPE **shall** be worn at all times where PPE is indicated or required for use as a condition of employment. The PPE selected by management based on the hazards assessment shall be communicated to all affected personnel. Any personnel who wish to wear and provide their own PPE at their own cost *may* do so provided it meets the WAPA regulatory standards. Personal Protective Clothing **shall** meet or exceed internationally recognized standards such as those listed in section **2.0 References**.

- Personal Protective Clothing **shall** be clearly marked to facilitate identification number and manufacturer.
- Specific Personal Protective Clothing **shall** be evaluated in the pre-job planning process.
- Appropriate clothing for the specific job task *should* be worn until the task is completed.
- When evaluating the tasks during the pre-job planning, the evaluation **shall** address the hazard of chemical splash or exposure, hydrocarbon flash fire, arc flash and expected weather during the work shift.
- Personal Protective Clothing **shall** be well maintained, and laundered according to the manufacturer's directions.

### 3.6 PPE Acquisition and Resupply

#### 3.5.1 New Hire Employee

Upon hire new personnel **shall** submit their sizes to the Area Managers for ordering PPE. Area Managers **shall** order their personnel's PPE through the established process.

#### 3.5.2 Quantities

Each full time employee upon initial hire **shall** receive the following sets of uniforms, sets of gloves, pair of safety glasses (general) and hard hat in accordance with the Collective Bargaining Agreement.

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### 3.5.3 Resupply

The employee's in accordance with the Union Bargaining Agreement **shall** be entitled to receive a resupply of their original allotment except the hard hat liner only will be replaced. Hard hats **shall** be replaced at 5 year intervals.

### 3.5.4 Third Party Personnel (Contractors)

Third Party personnel are provided PPE by their employers but are required to maintain compliance with this policy PPE which includes the WAPA regulatory standards as a condition of business with WAPA. Upon initial contract, third party personnel **shall** ensure they have PPE which meets the WAPA requirements prior to starting work.

### 3.5.5 PPE Daily Visual Inspections

PPE **shall** be conducted by all personnel and any items found to be excessively worn or damaged **shall not** be used and reported to their immediate supervisor for replacement.

### 3.5.6 Ensuring Compliance

Area Managers are responsible for reviewing personnel under their charge their PPE status in compliance with this policy and reporting their assessments the Safety Manager along with any immediate corrective actions taken to ensure they are in compliance with this policy. The Safety Department **shall** conduct periodic compliance audits as part of their regular audit schedule and **shall** report instances of non-compliance to the Area Manager responsible via a non-compliance report (NCR). Area Managers **shall** review the NCR and submit proposed corrective actions to the Safety Manager within 10 days of receiving the report for approval. Once approved, Area Managers **shall** implement corrective actions and the Safety Department **shall** follow-up for effectiveness during site visits.

## 3.6 Eye and Face Protection Specifics

Eye and face protection **shall** meet or exceed American Standard: (ANSI) Z87.1.

- Eye and Face PPE **shall** be clearly marked to facilitate identification number and manufacturer
- Specific eye and face protection **shall** be evaluated in the pre-job planning process. (E.g. chemical resistant, impact resistant, UV resistant etc.) Specific eye and face protection for the specific job task *should* be worn until the task is completed and then replaced with standard general purpose safety glasses or the appropriate eye wear for the next task to be completed
- When evaluating the tasks during the pre-job planning, individuals **shall** address the hazard of introducing a particle or chemical into the eye themselves (e.g. wiping eyes with a rag or glove, mud dripping behind glasses, particles in poorly stored PPE, particles in clothing or in hair when changing clothes)
- Eye and face protection **shall** be well maintained, (e.g. clean and scratch free etc.) to allow for a clear field of vision at all times
- All eye and face protection **shall** be appropriately stored to prevent exposure to dust, chemical, grime, weather deterioration, etc.
- Tinted eye protection *should not* be worn at night or in a dark environment, unless the job task requires a tinted lens, e.g. welding, cutting, etc. Clear lenses *should* be used during night time or dark operations, unless the JHA indicates that tinted lenses are necessary as

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a mitigation step for a hazard. Proper ranges of visible light transmission or tinted and clear lenses can be found in the ANSI Z87.1

### 3.6.1 Prescription Eyewear

Individuals requiring corrective lenses for job tasks *should* either wear:

- Prescription safety glasses with side shields
- Safety glasses or goggles specifically designed/approved to be worn Over the Glasses (OTG)
- Prescription (RX) inserts- These types of safety glasses have the RX loaded onto the insert that seats inside the safety glasses. Once the outer glasses are scratched, the inexpensive eyewear framework can be replaced while maintaining the RX insert
- Those who wear contact lenses **shall** not wear them in a work environment that could allow for chemical dust or dust exposure to the contact lenses
- When welding, cutting, or brazing, workers shall wear eye protection that utilizes the proper shade of lens as determined by the ANSI Z49. Workers should start with a shade that is too dark to see the welding zone, then go to a lighter shade that gives sufficient visibility of the weld zone without going beyond the minimum table (Table 1).

Table 1- Welder Filter Shades

Operation	Recommended Filter Shade
Torch Soldering	2
Torch Brazing	3
Light Cutting (up to 1")	3
Medium cutting (1'-6")	5
Heavy Cutting (More than 6")	5
Gas Welding (light, up to 1/8")	5
Gas Welding Medium (1/8" to 1/2")	5

- Individuals wearing welding hoods shall wear safety glasses under welding helmets and welding face shields, as the lens of these helmets is designed to protect the wearer against arc rays and small sparks, not slag chips, grinding fragments, wire wheel bristles, or other flying debris
- Individuals who are working near welder/welding shall wear safety eyewear with appropriately shaded lens designed to protect against high intensity light sources (welders flash)
- Performing activities with/or around flying particles, debris or dust can lead to accumulation on the outside of the glasses, goggles and or the face. Individuals *should* make every effort to ensure that particles do not enter the eye while removing eye and/or face protection. Eye and face protection *should not* be removed until the worker leaves the immediate work environment to a safe location free from hazards

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### 3.7 Hand Protection Specifics

It is fully acknowledged that the use of any glove will not prevent all hand injuries. The primary focus *should* always be to eliminate hand exposure to pinch points, crush points, impact zones, etc. It is further acknowledged that there will be times when gloves will need to be temporarily removed (for some small, specific task). However it is expected that, prior to a workers' removing his/her gloves, any potential hand injury risks present in the workplace **shall** be appropriately evaluated and mitigated.

- Gloves **shall** be worn when entering the work environment and during all work-related activities. Gloves *should not* be removed until a worker leaves the work environment
- Job tasks **shall** be designed so that an individual's hands cannot come into contact with any sharp object (e.g., a knife lying in a sink full of dish water)
- When using any type of cleaning solvent or chemical, the appropriate chemical handling glove **shall** be worn. (Note: Individuals shall review the SDS to determine the appropriate level of PPE required, including gloves)

Gloves **shall** be used, maintained, and discarded according to the manufacturer's recommendations.

As new gloves, and new glove designs come into the market place; please provide feedback the Safety team on evaluation of new products.

### 3.8 Foot Protection Specifics

Foot Protection **shall** meet or exceed American Standard (ANSI) Z41.1.

- Foot protection **shall** be above the ankle and may be either pull on or lace up type and **shall** provide ankle protection and have soles with defined heels.
- Foot protection **shall** be made of leather or other non-porous material.
- Foot protection **shall be** clearly marked to facilitate identification number and manufacturer.
- Specific foot protection **shall** be evaluated in the pre-job planning process.
- Appropriate foot protection for the specific job task *should* be worn until the task is completed.
- When evaluating the tasks during the pre-job planning, individuals **shall** address the walking and working surface, hazard of chemical splash or exposure, and expected weather during the work shift.
- Foot Protection **shall** be well maintained according to the manufacturer's directions.
- Protective footwear made of canvas, nylon, or soft porous leather **shall** not be used.

### 3.9 Head Protection Specifics

Head protection primarily comprises of an appropriate "Hard Hat" or "Safety Helmet". Head protection is an integral part of the personal protective gear ensemble and its use is a requirement for all WAPA personnel.

- Head protection **shall** be worn when entering the work environment and during all work-related activities. Head protection *should not* be removed until a worker leaves the work environment.
- Workers **shall** not reverse the bill, nor apply any non-required stickers or other modification. Head band suspensions systems **shall** be replaced annually.
- Head Protection **shall** be used, maintained, and discarded according to the manufacturer's recommendations

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### 3.10 Incidents Involving PPE

Incident reports (Form OHS-IR-10, See Appendix C) **shall** capture the details of all incidents and **shall** have included information about the use of personal protective equipment. Corrective actions *should* consider improvements about the use and type of personal protective equipment including the following questions:

- Did pre-job planning specify PPE requirements?
- Was PPE being worn at the time of the incident?
- Was the PPE used correctly?
- Area of the body affected by the incident?

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APPENDIX A JOB HAZARD ANALYSIS FORM

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## Job Hazard Analysis Worksheet

**JOB OR TASK TO BE PERFORMED:** \_\_\_\_\_

Supervisor: \_\_\_\_\_

Unit/Area: \_\_\_\_\_

Date: \_\_\_\_\_ Time: \_\_\_\_\_

Permit # 's: \_\_\_\_\_

SAFETY GLASSES ☐ HEARING PROTECTION ☐ FACE SHIELD ☐ LEATHER GLOVES ☐ FALL PROTECTION ☐ CHEMICAL GLOVES ☐

### PRE-JOB PREPARATION

<b>SEQUENCE OF JOB STEPS</b> List the steps required to perform this job in the order they are to be carried out.	<b>POTENTIAL HAZARDS</b> Against each task list the hazard that could cause injury or environmental incident when the task is performed (Be specific)	<b>HAZARD CONTROL</b> List the control measures required to eliminate or minimize the risk from the identified hazard.	<b>WHO IS RESPONSIBLE?</b> Write the name of the person that will do or ensure each control is in place
Additional Job Considerations	Potential Hazards	Hazard Control	Who is Responsible?

### WORK CREW SIGNATURES

1. \_\_\_\_\_  
 2. \_\_\_\_\_  
 3. \_\_\_\_\_  
 4. \_\_\_\_\_

5. \_\_\_\_\_  
 6. \_\_\_\_\_  
 7. \_\_\_\_\_  
 8. \_\_\_\_\_

## Certification of Hazard Assessment

### Permits

\_\_\_\_\_ Safe Work Authorization  
\_\_\_\_\_ Hot Work  
\_\_\_\_\_ Confined Space Entry  
\_\_\_\_\_ Posted at Jobsite  
\_\_\_\_\_ Lockout/Tagout

### Personal Protective Equipment

\_\_\_\_\_ Work Gloves \_\_\_\_\_ Chem. Gloves  
\_\_\_\_\_ Safety Glasses \_\_\_\_\_ Mono Goggles  
\_\_\_\_\_ Hard Hat \_\_\_\_\_ Chem. Goggles  
\_\_\_\_\_ Steel Toe Footwear  
\_\_\_\_\_ Hearing Protection (Ear Plugs)  
\_\_\_\_\_ Fall Protection  
\_\_\_\_\_ Burning Goggles \_\_\_\_\_ Welding Hood  
\_\_\_\_\_ Face Shield \_\_\_\_\_

### Tools

\_\_\_\_\_ Current Inspection  
\_\_\_\_\_ Proper Tools for the Job  
\_\_\_\_\_ Good Tool Condition  
\_\_\_\_\_ Qualification Required  
\_\_\_\_\_ Radio (Communications)  
\_\_\_\_\_ Other \_\_\_\_\_

### Barricades

\_\_\_\_\_ Red-Danger-Do Not Enter  
\_\_\_\_\_ Yellow-Caution  
\_\_\_\_\_ Updated Tags  
\_\_\_\_\_ Fixed or Hard Barricades

### Welding

\_\_\_\_\_ Welding Leads Inspected  
\_\_\_\_\_ Combustibles  
\_\_\_\_\_ Spark Containment  
\_\_\_\_\_ Welding Screens (Personnel Protection)  
\_\_\_\_\_ Grounding  
\_\_\_\_\_ Flash Arrestors Installed  
\_\_\_\_\_ Machine in Good Condition  
\_\_\_\_\_ Bottles Secure  
\_\_\_\_\_ Sewer Covers  
\_\_\_\_\_ Fire Watch

### Electrical

\_\_\_\_\_ Try Start/Stop Switch  
\_\_\_\_\_ GFCI Test  
\_\_\_\_\_ Assured Grounding  
\_\_\_\_\_ Extension Cord Inspection  
\_\_\_\_\_ Plugs Taped

### Excavation

\_\_\_\_\_ Call 811  
\_\_\_\_\_ Shored/Sloped  
\_\_\_\_\_ Daily Inspection  
\_\_\_\_\_ Competent Person Inspection

### Emergency Equipment

\_\_\_\_\_ Fire Monitors  
\_\_\_\_\_ Fire Extinguishers  
\_\_\_\_\_ Safety Shower  
\_\_\_\_\_ 1 1/2" Charged Fire Hose

### Hazards (Chemicals)

\_\_\_\_\_ Chemical Burns - skin/eyes  
\_\_\_\_\_ Flammable  
\_\_\_\_\_ Ingestion  
\_\_\_\_\_ Inhalation  
\_\_\_\_\_ Skin Contamination  
\_\_\_\_\_ Other \_\_\_\_\_

### Hazards (Body)

\_\_\_\_\_ Fall Potential  
\_\_\_\_\_ Pinch Points  
\_\_\_\_\_ Slip-Trip Potential  
\_\_\_\_\_ Overhead Lifts

### Hazards (Environmental)

\_\_\_\_\_ Airborne Particulates  
\_\_\_\_\_ Electrical Shock  
\_\_\_\_\_ Heat Stress  
\_\_\_\_\_ Heavy Objects  
\_\_\_\_\_ Hot, Cold Surfaces or Materials  
\_\_\_\_\_ Inadequate Lighting  
\_\_\_\_\_ First Opening of Equipment  
\_\_\_\_\_ Blinds Installed  
\_\_\_\_\_ Valves Blocked  
\_\_\_\_\_ Line or Equipment Cleared  
\_\_\_\_\_ Sharp Objects  
\_\_\_\_\_ Process Equipment

### **EMERGENCY ALARMS**

Alarm Code: \_\_\_\_\_

Evacuation: \_\_\_\_\_

All Clear: \_\_\_\_\_

### Access

\_\_\_\_\_ Scaffold (Properly Inspected \_\_\_\_\_)  
\_\_\_\_\_ Ladder Tied Off With Wire  
\_\_\_\_\_ Aerial Lift  
\_\_\_\_\_ Personnel Basket (Inspected & Approved)  
\_\_\_\_\_ Special Provision  
\_\_\_\_\_ Other \_\_\_\_\_

### Process Equipment

\_\_\_\_\_ Valves Locked  
\_\_\_\_\_ Tags Hung  
\_\_\_\_\_ Blinds Installed and Tagged  
\_\_\_\_\_ Verified

### Lifting

\_\_\_\_\_ Forklift  
\_\_\_\_\_ Cherry Picker  
\_\_\_\_\_ Load Chart  
\_\_\_\_\_ Angle  
\_\_\_\_\_ Crane  
\_\_\_\_\_ Chain fall  
\_\_\_\_\_ Proper Rigging Practices  
\_\_\_\_\_ Manual Lifting  
\_\_\_\_\_ Condition of Equipment  
\_\_\_\_\_ Rigging Inspected

Wind Direction: \_\_\_\_\_

Weather: \_\_\_\_\_

Assembly Point: 1st \_\_\_\_\_

2nd \_\_\_\_\_

Evacuation Route: \_\_\_\_\_

### JOB EXECUTION

SUPERVISOR: AUDIT THE JOB WHILE IN PROGRESS

Time: \_\_\_\_\_

**Ensure employees have read and understand the requirements of the permit.**  
I certify that, to the best of my knowledge, the above hazard assessment complies with OSHA's personal protective equipment standard (29 CFR §1910.132(d) (2)).

Print Name: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

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## APPENDIX B PROJECT ASSESSMENT FORM

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<PROJECT NAME>

## PROJECT RISK ASSESSMENT (PRA)

<mm/dd/yyyy>

### VERSION HISTORY

Revision	Author	Revision Date	Approval	Approval Date	Reason

### Table of Contents

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<b>3.0</b>	<b>PROCEDURE .....</b>	<b>1</b>
<b>4.0</b>	<b>RISK ASSESSMENT APPROVAL .....</b>	<b>5</b>

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## 1.0 INTRODUCTION

A risk is an event or condition that, if it occurs, could have a positive or negative effect on a project's objectives. Risk Management is the process of identifying, assessing, responding to, monitoring, and reporting risks. This Project Risk Assessment defines how risks associated with the <Project Name> project will be identified, analyzed, and managed. It outlines how risk management activities will be performed, recorded, and monitored throughout the lifecycle of the project and provides templates and practices for recording and prioritizing risks.

The Project Risk Assessment is created by the project manager in the Planning Phase of the project and is monitored and updated throughout the project. The intended audience of this document is the project team, project sponsor and management.

## 2.0 DEFINITIONS

- **Quantitative Risk Analysis**-The analysis of risk events that have been prioritized using a qualitative risk analysis process and their effect on project activities will be estimated, a numerical rating applied to each risk based on this analysis.
- **Qualitative Risk Analysis**- The probability and impact of occurrence for each identified risk will be assessed by the project manager, with input from the project team using the following approach:

## 3.0 PROCEDURE

The project/operations manager working with the project team will ensure that risks are actively identified, analyzed, and managed throughout the life of the project. Risks will be identified as early as possible in the project so as to minimize their impact.

The steps for accomplishing this are outlined in the following sections. The *<project manager or other designee>* will serve as the Risk Manager for this project.

**Risk Identification-** will involve the project/operations manager and staff, appropriate stakeholders, and a Risk Review Team as defined in OHS-POL-001-Hazard-Risk Mitigation as required and will include an evaluation of occupational safety factors, environmental factors, operational impact the project scope. Careful attention will be given to the project deliverables, assumptions, constraints, cost/effort estimates, resource plan, and other key project documents.

**Risk Analysis-** All project risks identified will be assessed to identify the range of possible project outcomes. Qualification will be used to determine which risks are the top risks to pursue and respond to and which risks can be deemed as minimal with little or no impact.

### **Impact**

Identified risks that fall within the RED and YELLOW zones will have risk response planning which includes both risk mitigation and a risk mitigation steps documented on the Risk Management Log (OHS-RML-01).

### **Risk Assessment Matrix (RAM)**



		Probability				
Severity		Frequent A	Likely B	Occasional C	Seldom D	Unlikely E
Catastrophic	I	1	1	1	2	M
Critical	II	1	2	2	3	4
Marginal	III	2	3	3	4	4
Negligible	IV	3	4	4	4	4
1 – High-High Risk		2 - High Risk		3 - Moderate Risk		4 - Low Risk

**1 – High-High:** Loss of ability to accomplish the job if hazards occur during job. A frequent or likely probability of catastrophic loss or frequent probability of critical loss exists.

**2 - High:** Significant degradation of job performance capabilities in terms of the required performance standard, inability to accomplish all parts of the job, or inability to complete the job to standard if hazards occur during the job. Occasional to seldom probability of catastrophic loss exists.

**3 - Moderate:** Expected degraded job performance capabilities in terms of the required performance standard will have a reduced performance capability if hazards occur during the job. An unlikely probability of catastrophic loss exists. The probability of a critical loss is seldom. Marginal losses occur with a likely or occasional probability. A frequent probability of marginal losses exists.

**4 - Low:** Expected losses have little or no impact on accomplishing the job. The probability of critical loss is unlikely, while that of marginal loss is seldom or unlikely. The probability of a negligible loss is likely or less.

#### Probability

Probability	Definitions
-------------	-------------

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A	Very likely- Possibility of repeated incidents
B	Somewhat likely- Possibility of isolated incidents
C	Unlikely- Possibility of occurring under the right circumstances
D	Very Unlikely- Not likely to occur
E	Practically Impossible- A few times or not at all.

**Risk Response Planning-** Each major risk (those falling in the Red & Yellow zones) will be assigned to a project team member for monitoring purposes to ensure that the risk will not “fall through the cracks”.

For each major risk, one of the following approaches will be selected to address it:

- Avoid – eliminate the threat by eliminating the cause
- Mitigate – Identify ways to reduce the probability or the impact of the risk
- Accept – Nothing will be done
- Transfer – Make another party responsible for the risk (buy insurance, outsourcing, etc.)

For each risk that will be mitigated, the team will identify ways to prevent the risk from occurring or reduce its impact or probability of occurring. This may include prototyping, adding tasks to the project schedule, adding resources, etc. For each major risk that is to be mitigated or that is accepted, a course of action will be outlined for the event that the risk does materialize in order to minimize its impact.

## **RISK MONITORING, CONTROLLING, AND REPORTING**

The risk on a project will be tracked, monitored and reported throughout the project lifecycle using OHS-RML-01 and submitted to the Safety Department being updated and revised as required throughout the project lifecycle.

#### 4.0 RISK ASSESSMENT APPROVAL

The undersigned (Risk Management team and the Safety Manager) acknowledge they have reviewed the Project Risk Assessment (PRA) for the \_\_\_\_\_ project. Changes to this Risk Management Plan will be coordinated with and approved by the undersigned or their designated representatives. *[List the individuals whose signatures are required. Add additional lines for signature as necessary.]*

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

Role: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

Role: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

Role: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

Role: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

Role: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

Role: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

Role: \_\_\_\_\_



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## APPENDIX C INCIDENT REPORTING FORM

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## Safety, Security and Health Incident Report

Photos Included		Draft		Final Approved				WAPA-OHS-IR-10-01
<b>1. GENERAL INFORMATION</b>								
Date of Incident		Time		Country		State		
Work Related		Location						
Actual Hurt Level		Potential Hurt Level		Classification				
<b>2. INCIDENT SUMMARY</b>								
Incident Summary (One Sentence)								
<div>Incident Description- (Include information leading to the incident, description of the event and steps taken to care for the injured person, assess incident for learning's, etc.)</div>								
Dropped Object?		Units		Mass in kg		Height (M)		Potential Fall Energy (Joules)
Lone Worker		Witnessed Event			SSE's Involved			
Equipment Involved								
PPE Worn								
<b>3. IF ILLNESS OR INJURY</b>								
Name				Employee		SSE		
Nature of Illness/Injury								
Events Leading to Injury								
Primary Body Part Affected					Secondary Body Part Affected			
Medical Response Provided								
IP Status Update								
Medication Name and Dosage							US Prescription	
Alternative Evaluation				Highest Medical Consultation				
IP return to work?				Days Lost/Restricted				
<b>4. SECURITY</b>								
Security Category								
Agency Notified	Agency Name			Date Reported & Case No.				
Reporters Name				Name of Person Notified				
Date of Issue	5/19/2014	Revision #	1					

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## Safety, Security and Health Incident Report

### 5. INCIDENT / NEAR HURT INVESTIGATION SUMMARY (For all work related incidents)

Root Cause Analysis Tools	Ask Why 5 Times: <i>Required for all incidents</i>	TapRoot® or other Root Cause Analysis Tool? A TapRoot or similar must be completed for any incident with a Actual Hurt Level (AHL) of 2 or Potential of Hurt Level of 3+	
Primary Contributing Causal Factor (Root Cause)			
Other Significant Contributing Causal Factors			
Did pre-job planning (JSA etc.) identify the risk or hazard that ultimately caused the incident?			
Did the job require a Permit to Work (PTW)?		Was the Permit to Work (PTW) completed prior to the work?	
Corrective Actions ( <i>Must Address /Match Root Causal Factors</i> )	Person Responsible	Due Date	
<b>Note: Corrective Actions will be assessed by the QHSSE Manager and tracked to closure</b>			
Functional Leader Review	Name/Date	QHSSE Review	Name/Date

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## Safety, Security and Health Incident Report

### 6. ADDITIONAL NOTES

### 7. INCIDENT PHOTOS- *(Please minimize photos to the extent possible while maintaining clarity)*

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## Virgin Island Water and Power Authority

### Occupational Health and Safety Policy

#### Welding Cutting and Hot Work

Document Number:			WAPA-OHS-SM-PP-007		
Rev.	Revision Date	Revision Description	Prepared	Checked	Approved
A	August 12, 2015	Issue for Comments	B. Poston	X. Yang	X. Yang

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Welding Cutting and Hot Work



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## 1.0 OBJECTIVE

The objective of this policy: Welding, Cutting and Hot Work is to provide specific guidance regarding our requirements (**must/shall**) and recommendations (*may/should*) for safety around welding and cutting operations for all WAPA personnel. It is also expected that all recommendations **shall** be given serious consideration with appropriate rationale with a viable justification when not utilized.

Welding, Cutting and Hot Work is one of the core components to the WAPA Occupational Health and Safety Program. The requirements of this policy require proper risk analysis and mitigation of the identified risks around such work as well as the training for the workers who perform such tasks as well as their assistants. This policy also requires a sound hot work permit system be maintained to properly mitigate the hazards associated with hot work (welding, cutting) operations.

## 2.1 REFERENCES

- 29 CFR 1910.252 Welding, Cutting and Brazing
- NFPA 51B- Standard for Fire Prevention during Welding, Cutting and Other Hot Work
- WAPA Hot Work Procedure

## 3.0 APPLICABILITY

This policy shall be applicable to all WAPA personnel including contractors while working in a WAPA facility through equipment servicing, maintenance or repairs. All Hot Work shall be conducted by permit only.

## 4.1 RESPONSIBILITIES

### 4.2 Safety Manager/Safety Officer

- Issues and implements this policy throughout the facility and ensure that it meets regulatory requirements including annual reviews
- Ensures an assessment of the hazards associated with welding, cutting and hot work are assessed for the facilities with designated to work areas designated and a site specific permit system in accordance with the WAPA hot work permitting system
- Ensures affected personnel are adequately equipped and trained in the requirements for the mitigation of the hazards associated with hot work, welding and cutting operations
- Ensures all personnel are trained to the awareness level on hot work, welding and cutting hazards
- Maintains a hot work permit file system for review

### 4.3 Manager/ Supervisor

- Ensures that the hot work program is implemented and utilized in their respective areas
- Ensures personnel are trained and knowledgeable in the management of hot work including the hot work permit system.
- Serves as the authorizer of hot work operations within their area of responsibility
- Establishes a specific area within their area of responsibility for hot work operations

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- Determines the area specific flammable materials, hazardous processes or other life potential fire hazards present or likely to be present in the work location
- Ensures that combustibles within their area of responsibility are properly protected during hot work operations
- Ensures a fire watch is utilized as required
- Coordinates their needs with the Safety Advisor

#### **4.4 Contractor Representative**

- The contractor representative is responsible for ensuring their personnel understand and follow the requirements of the WAPA Hot Work program. If the contractor desires to use their program it **must** be submitted to the WAPA HSE Manager for review and approval.

#### **4.5 Affected Personnel (Hot Work Permit Operators)**

- Responsible for completing, having signed off, posting and closing the hot work permit
- Fully qualified to perform hot work
- Responsible for ensuring all safety precautions are in place and effective for hot work
- Responsible for ensuring hot work operations are ceased when conditions change outside of the permit parameters

#### **4.6 Fire Watch**

- A designated individual dedicated to monitor hot work for the potential of fires or any change in the conditions of the permit that can create a new or increased hazard of fire with the ability to stop the work if a condition develops.
- In the event and fire hazards existing within 35' of the hot work area which cannot be removed or otherwise mitigated to a safe level the fire watch **must** also remain at the location for at least 30 minutes after work has stopped to ensure no potential for fire exists.

#### **5.1 HOT WORK PROCESS**

The specifics surrounding the Hot Work process is defined in the WAPA document Hot Work which includes:

- Atmospheric testing of the Hot Work site
- Issuance of the Hot Work Permit
- Training
- Audit Requirements
- Authorization and Isolation for Hot Work
- Preparing for Hot Work

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# Virgin Island Water and Power Authority

## Occupational Health and Safety Policy

### Lockout / Tagout

Document Number:			WAPA-OHS-SM-PP-008		
Rev.	Revision Date	Revision Description	Prepared	Checked	Approved
A	August 12, 2015	Issue for Comments	B. Poston	X. Yang	X. Yang

*DMR*  
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Property of VIWAPA



Document Number: WAPA-OHS-SM-PP-008  
Date: August 12, 2015  
Pages: 2 of 5

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Document Title:  
Revision: A

Lockout / Tagout



Document Number: WAPA-OHS-SM-PP-008  
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## **1.0 OBJECTIVE**

The objective of this policy: Energy Isolation- Hazardous Energy Control is to provide specific guidance regarding our requirements (must/shall) and recommendations (may/should) for the isolation of and making safe potential hazardous energy source for all WAPA personnel. It is also expected that all recommendations shall be given serious consideration with appropriate rationale with a viable justification when not utilized.

The isolation of hazardous energy sources is the core components to the WAPA Occupational Health and Safety Program. The requirements of this policy require proper risk analysis and mitigation of the identified risks around such work as well as the training for the workers who perform such tasks. This also includes the contractors who work on WAPA facilities. This policy also requires that a sound hot energy isolating program be maintained to properly mitigate the hazards associated with hazardous energy.

## **2.1 REFERENCES**

- 29CFR 1910.147
- WAPA- Hazardous Energy Control Program
- WAPA Transmission and Distribution Division Lockout & Tagout Standard Operating Plan

## **3.0 APPLICABILITY**

This policy shall be applicable to all WAPA personnel including contractors while working in a WAPA facility who may be exposed to hazardous energy. Specific exclusions for specific operations specified in the WAPA Hazardous energy control program are found in the procedure itself.

## **4.1 RESPONSIBILITIES**

### **4.2 Safety Manager/Safety Officer**

- Issues and implements this policy throughout the facility and ensure that it meets regulatory and corporate requirements including annual reviews
- Ensures an assessment of the hazards associated with hazardous energy are assessed for the facilities in accordance with the procedure and the standard
- Ensures affected personnel are adequately equipped and trained in the requirements for the mitigation of the hazards associated with hazardous energy
- Ensures all personnel are trained to the awareness about hazardous energy hazards
- Other responsibilities as defined in the WAPA Hazardous energy control program

### **4.3 Manager/Supervisor**

- Ensures that the policy and program is implemented and utilized in their respective areas
- Ensures personnel are trained and knowledgeable in the management of hazardous energy
- Other responsibilities as defined in the WAPA Hazardous energy control program

### **4.4 T&D Department**

- Prepares all switching orders for the production department, opens and closes all bus fuses and installs proper grounding devices to make the system electrically safe in accordance with the procedure

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#### 4.5 Equipment Owners

- Specific duties as assigned in the procedure

#### 5.1 ENERGY ISOLATION PROCESS

The specifics surrounding the Energy Isolation Process are defined in the WAPA Hazardous Energy Isolation Control Program includes:

- Energy isolation process
- Training
- Audit Requirements
- Turnarounds
- Operation responsibilities in the T&D Lockout Tagout Standard Plan
- Transmission and Distribution Division Lockout & Tagout Standard Operating Plan

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**Virgin Island Water and Power Authority**

**Occupational Health and Safety Policy**

**Change Management Process (ChaMP)**

**WAPA-OHS-SM-PP-017**

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## 1. Scope and Authority

This element identifies VIWAPA's Change Management Process (ChaMP) procedure as part of its Safety Management System (SMS) Program and applies to all VIWAPA operations. VIWAPA is responsible for the development and implementation of written ChaMP procedure for changes and modifications to facilities and operations personnel that occur on VIWAPA facilities.

## 2. Operations

The Change Management Process (ChaMP) procedure applies to changes in facilities (equipment, operating procedures, materials and operating conditions) as well as changes in operating personnel. Whenever these changes are planned procedure is or if they occur out of operational necessity, the Change Management Process must be implemented **prior to the change**.

### 2.1 Changes in Facilities

Changes in facilities arise whenever the process or mechanical design is altered, changes in produced fluids occur, process additives are obtained, product specifications change, by-products or waste products are generated, design inventories change, instrumentation and control systems are modified, or materials of construction change.

2.1.1 Projects that involve production or process tie-ins to existing facilities, reconfigurations or modifications.

- 2.1.2 Modifications of existing facilities that result in changes to facility or equipment design, structural support, layout or configuration.
- 2.1.3 Projects to increase facility through-put.
- 2.1.4 Significant changes in operating conditions (flow rates, pressures, liquid levels, temperatures or process conditions).
- 2.1.5 Equipment changes, including the addition of new equipment or modifications (alarms, instrumentation, control schemes, etc.).
- 2.1.6 Modifications of the process or equipment that causes changes in the facility's pressure relief (PSV) requirements.
- 2.1.7 Bypass connections around equipment that is normally in service.
- 2.1.8 Mechanical changes that would not normally appear on a process or instrument diagram: replacements, temporary installations, temporary changes in operating procedures, alternate set-ups, temporary electrical equipment or utility connections (other than emergency situations).

**NOTE**

Construction of new production or process facilities are covered by the Pre-Start-up Review and Hazards Analysis.

- 2.1.9 Operations outside the scope of current operating procedures.
- 2.1.10 Changes made in the process or mechanical design or in operating procedures that result from a hazards analysis, audit or annual review.
- 2.1.11 Introduction of new or different process chemicals (corrosion control agents, anti-foulants, anti-foam, etc.).

2.1.12 Temporary changes in production installations and procedures.

2.1.13 New facilities will need to have facility siting and quantitative risk assessment updated.

## **2.2 Changes in Personnel**

Changes in personnel, including contract personnel, occurs whenever there is a change in the organization or in personnel that supervise or operate the facility.

- Supervisory changes of the plant.
- Changes in contract operators (one company to another).
- Routine personnel vacancies and replacements, rotation and shift or tour changes do not require ChaMP action.

**NOTE** Includes organizational changes, particularly those brought about by acquisition or purchase of a facility (company or plant).

## **2.3 Replacement-In-Kind (RIK)**

2.3.1 Replacement-In-Kind (RIK) for Changes in Facilities is the exchange or replacement of one piece of equipment or component by another of similar specifications and performance characteristics (size, pressure rating, temperature rating, flow rating, metallurgy, etc.).

2.3.2 Replacement-In-Kind (RIK) for Changes in Personnel is the substitution of one person for another of similar.

2.3.3 Qualifications, training and experience (vacancies and replacements, rotation, shift or tour).

2.3.4 Situations involving replacement-in-kind require no further action or documentation.

## 2.4 Procedure

This ChaMP procedure and associated ChaMP Form address the technical basis for the change; the impact the change will make on health, safety and the coastal and marine environments; the time period to implement the changes; and the management and field approval process. Refer to **Attachment A: VIWAPA Change Management Process (ChaMP) Form**.

When preparing the ChaMP Form, consider the effects of the proposed change on unrelated upstream and downstream facilities; revisions on operating procedures, safe work practices and training; revisions of the safety and environmental information; the communications required for that change; and the impact the change will make on affected personnel.

2.4.1 Initiator of ChaMP completes the following:

- ChaMP Type: select either Facilities or Personnel
- Plant or Location name
- District
- Name of person initiating ChaMP
- Date initiated

2.4.2 Initiator of ChaMP completes and attaches supporting evidence for the following:

- Section I: Technical Basis
- Section II: Risk Ranking

- Section III: Safety, Environmental, & Health Impacts
- Section IV: PSI Update
- Section V: Mechanical Integrity
- Section VI: Training
- Attaches all documents and/or drawings related to change to Form.

#### 2.4.3 Approval Process

Personnel authorized to approve changes are the Chief Operating Officer, Director of the Division, the Manager/Superintendent of the Department and a Safety Department representative.

Each officer verifies that the ChaMP Form is complete, and all necessary documents and/or drawings are attached. Provides approval by signing and dating form.

2.4.3.1 Once ChaMP has been approved, affected personnel are made aware of and/or trained in the operation of the equipment or system associated with the change prior to the start-up of the equipment or system.

2.4.3.2 Once work is done, a Hazards Analysis may be required to verify that no new hazards result from the work; refer to Hazards Analysis process.

2.4.3.3 For ChaMP resulting in a change in the Operating Procedures, changes are made and documented on the cover sheet of the procedure.

---

**NOTE** A ChaMP Form may be required for edits to Operating Procedures.

2.4.3.4 The ChaMP initiator places the ChaMP Form and related documents and attachments in an SMS file on the facility; the ChaMP Form must be available for inspection upon request.

### **3. Training**

- 3.1 Train all affected employees and contract personnel every five (5) years on the contents of this element; refer to the Training element.
- 3.2 Train all affected, newly-hired employees and contract personnel within 30 days after date of hire on the contents of this ChaMP; refer to the Training documentation.
- 3.3 Train or inform affected employees of any changes to this ChaMP within 30 days after the ChaMP changes have been approved and completed.

### **4. Recordkeeping**

- 4.1 Copies of the ChaMP form are maintained on the facility for 30 days, then placed in the SMS file and retained for six (6) years.

### **5. Attachments**

- 5.1 Change Management Process (ChaMP) Form.



# VIWAPA CHANGE MANAGEMENT PROCESS (ChaMP)



**ChaMP Type:** Facilities ☐ Personnel ☐

**Plant or Location Name:** \_\_\_\_\_

**District:** St. Croix ☐ St. Thomas ☐ St. John ☐ Water Island ☐

**Initiator:** \_\_\_\_\_ **Date:** \_\_\_\_\_

## I TECHNICAL BASIS

### 1. The purpose

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### 2. Description of the change

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### 3. Describe how the change will result in the intended purpose

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### 4. Explain how the change is safe to implement

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## II

### RISK RANKING

#### 1. Determine level of risk: Likelihood vs Severity (PHA)

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## III

### SAFETY, ENVIRONMENTAL & HEALTH IMPACTS

#### 1. Safety Impacts

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#### 2. Environmental Impacts

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#### 3. Health Impacts

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## IV

### PSI UPDATE (Attach Proof)

#### 1. P & ID

Yes ☐

No ☐

#### 2. As Built Drawings

Yes ☐

No ☐

#### 3. One Lane Diagrams

Yes ☐

No ☐

#### 4. Upper/Lower Limits

Yes ☐

No ☐

#### 5. Other

---

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**V****MECHANICAL INTEGRITY****1. Equipment Identification Serial #, Service #, etc.**

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**2. Description of inspection or test performed**

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**3. RAGAGEP followed**

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**4. Results of test inspection**

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**5. Name of person performing test inspection**

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**6. Date of test inspection**

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**VI****TRAINING****1. Information only**☐**2. Proof of understanding required**☐**Change in policy**☐**Change in procedure**☐**Change in PSI**☐**Change in process**☐**Change in tasks/functions**☐

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**VII**  
**APPROVALS**

\_\_\_\_\_  
**MANAGER/SUPERINTENDENT**

\_\_\_\_\_  
**DATE**

\_\_\_\_\_  
**DIRECTOR**

\_\_\_\_\_  
**DATE**

\_\_\_\_\_  
**CHIEF OPERATING OFFICER**

\_\_\_\_\_  
**DATE**

\_\_\_\_\_  
**SAFETY**

\_\_\_\_\_  
**DATE**

**VIII**  
**PSSR**

**Full PSSR required**

YES ☐

NO ☐

**Mini PSSR required**

YES ☐

NO ☐

**IX**  
**ChaMP DOCUMENT AUTHORIZATION**

**Form Number:**

WAPA-ChaMP-001

**Document Number:**

WAPA-OHS-SM-PP-017

**Date Form Created:**

10-Oct-18

**Approved By:**

  
\_\_\_\_\_  
**Mr. Gregory Magras**  
**Safety Manager**  
**VI Water & Power Authority**

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## APPENDIX 12

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## APPENDIX 13. FORM OF OPERATOR PARENT COMPANY GUARANTEE

### PARENT COMPANY GUARANTY

This Guaranty (the "Guaranty") is executed as of \_\_\_\_\_, 2023, by WÄRTSILÄ CORPORATION, a company organized and existing under the laws of Finland, with principal offices at Hiililaiturinkuja 2, 00180 Helsinki, Finland ("Guarantor"), in favor of US VIRGIN ISLANDS WATER AND POWER AUTHORITY, an autonomous governmental instrumentality incorporated and existing under the laws of the United States Virgin Islands, with its principal place of business in 9720 Estate, St. Thomas, Virgin Islands 00801 (the "Owner").

WHEREAS, in connection with the Shared Operations and Management Agreement (the "Agreement") dated as of June 1<sup>st</sup>, 2023 by and between Owner and Wärtsilä Caribbean, Inc. ("Operator"), a company organized and existing under the laws of Puerto Rico and a wholly owned subsidiary of Guarantor, Owner has required Operator to furnish to Owner, a guaranty of performance of all of Operator's obligations under the Agreement;

WHEREAS, this Parent Company Guarantee shall replace the one before and as such, the previous Parent Company Guarantee is agreed to expire immediately at the signing of this new Parent Company Guarantee and;

WHEREAS, Guarantor, by virtue of its ownership of Operator, will benefit from Operator's performance of its obligations under the Agreement;

NOW, THEREFORE in consideration of the premises set forth herein and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Guarantor covenants and agrees as follows:

#### 1. Guaranty

Subject to the last sentence of Section 2(a), Guarantor hereby guarantees to Owner the full and punctual payment and performance by Operator of any and all obligations whatsoever to be performed, by Operator under the Agreement in all respects in accordance with the terms of the Agreement to the extent not so performed by Operator. This Guaranty is in no way conditioned upon any requirement that Owner first attempt to enforce any of the guaranteed obligations against Operator. In the event of a default in performance of any guaranteed obligation by Operator, Guarantor, subject to Guarantor's rights under Section 2 hereof, shall promptly perform or cause to be performed such guaranteed obligation upon receipt of written notice of such default and demand for performance from Owner.

Notwithstanding anything else, Guarantor's liability shall in no case exceed the maximum liability of Operator under the Shared Operation and Management Agreement **WHICH SHALL BE LIMITED**

**TO AND SHALL IN NO EVENT EXCEED THIRTY PERCENT (30%) OF THE ANNUAL TURNOVER.** In no event shall the Guarantor be liable for special, incidental, consequential, exemplary, indirect or punitive damages or loss of profit.

2. Obligations Unconditional

(a) Except as set forth in the last sentence of this paragraph (a), the obligations of Guarantor under Section 1 hereof are absolute and unconditional, irrespective of the insolvency, bankruptcy, reorganization, dissolution or liquidation of Operator or any change in ownership of Operator or any assignment by Operator to any of its Affiliates or other parties. Any provision herein to the contrary notwithstanding, Guarantor expressly reserves to itself all rights, setoffs, counterclaims and other defenses which Operator is or may be entitled to under the Agreement.

(b) Without limiting the foregoing, Guarantor hereby consents to:

- i) the waiver by Owner of the payment, performance or observance of any of the covenants, terms or agreements of Operator set forth in the Agreement;
- ii) the modification, postponement or extension of time for payment of any amounts due or of the time for performance of any of the covenants, terms or agreements of Operator set forth in the Agreement;

3. Guaranty Reinstatement

Subject to the last sentence of Section 2 (a), the obligations of Guarantor hereunder shall be automatically reinstated if and to the extent that for any reason any performance by or on behalf of Operator in respect of the guaranteed obligations is rescinded or must be otherwise repaid or restored to Operator by any holder of any of the guaranteed obligations, whether as a result of any proceedings in bankruptcy or reorganization or otherwise.

4. Subordination

So long as any guaranteed obligation remains unsatisfied, any claims of Guarantor resulting from the performance of any of the guaranteed obligations hereunder (whether or not demanded by Owner) against Operator shall be subordinate to any claims of Owner against Operator, and in the event any consideration is received by Guarantor in respect of any such subordinated claim, it shall be subject to recovery by Owner whether in insolvency proceedings or otherwise. In any insolvency proceedings of any nature (including bankruptcy), Owner shall be entitled to enforce said subordinated claims, to collect assets distributed on account thereof, to vote such claims, and to otherwise take any such action therein that Guarantor might otherwise take.

## 5. Remedies

In the event Guarantor fails to pay or perform any of its obligations hereunder, including the failure to make payment when due, Owner may avail itself of all available remedies, in law or equity, to enforce its rights hereunder.

## 6. Demand by Owner

Owner shall have the right, in its sole judgment and discretion, from time to time, but subject to the terms of this Guaranty, including Section 1 and Section 2 hereof, to make demand for performance and to proceed against Guarantor for the performance of any guaranteed obligation owed to Owner pursuant to this Guaranty, or to proceed from time to time against Guarantor for the performance of any and all such guaranteed obligations, as Owner may determine.

## 7. Successors and Assigns

The guaranty hereunder is a continuing guaranty and shall apply to all guaranteed obligations whenever arising and shall inure to the benefit of the successors or assigns of Owner and be binding upon Guarantor and its successors and assigns, provided, however, that neither Guarantor nor Owner may make an assignment or other transfer of this Guaranty or any interest herein by operation of law or otherwise unless it has obtained a prior written consent of the other party to this Guaranty for such assignment or other transfer. Guarantor hereby irrevocably consents to the assignment of this Guaranty by Owner coincident with any assignment of the Agreement by Owner permitted thereunder.

## 8. Notices

All notices to Guarantor required to be served under this Guaranty shall be in a written form and shall be served by commercial overnight delivery services or by registered mail and shall be addressed as follows:

Wärtsilä Corporation

Hiililaiturinkuja 2

FIN-00180 Helsinki, Finland

ATTN: Group General Counsel

or at such other address as Guarantor may from time to time designate in writing to Owner. All notices required to be served under this Guaranty will be effective when received by the addressee.

9. No Waiver Amendments

No amendment of this Guaranty shall be effective unless the same shall be in writing and signed by Guarantor and Owner. No waiver of any provision of this Guaranty shall be effective unless signed by Owner.

10. Governing Law

This Guaranty shall be governed by, and construed in accordance with, the laws of the State of New York, USA.

11. Termination

Subject to Section 3 hereof, this Guaranty, and the obligations of Guarantor hereunder, shall terminate after full performance of all the guaranteed obligations and the expiration of any period during which the guaranteed obligations are capable of being revived, whichever is later, and in any case latest on the third anniversary date of the Effective Date under the Agreement.

IN WITNESS WHEREOF, Guarantor has caused this Guaranty to be duly executed as of the day and year first above written.

For and on behalf of

WÄRTSILÄ CORPORATION

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## APPENDIX 14. INSURANCES

### OPERATOR INSURANCE REQUIREMENTS.

**Liability and Workers Compensation Insurance Requirements**

During Operation, Operator is to carry the liability and workers' compensation insurances set out below. Subcontractors are to carry the same coverages but required limits may be amended at the discretion of the Contractor for subcontractors to reflect the size of their contracts, subject to a minimum limit of \$1,000,000 each for Commercial General Liability, Automobile Liability and Employers Liability. After receipt of evidence of insurance for any subcontractor, WAPA reserves the right to require limits up to those required for the Contractor.

Once operations have begun, Contractor and/or its general contractor shall have in place and at all times maintain the below liability and workers' compensation insurances.

Coverage Type	Minimum Limit		Maximum Deductible or Retentions	
Commercial General Liability	\$2,000,000*	Combined single limit per occurrence and in the aggregate where applicable	\$250,000	Per occurrence
Automobile Liability	\$2,000,000*	Combined single limit per accident	\$250,000	Per accident
Employers Liability	\$2,000,000*	Each accident for bodily injury by accident Each employee and policy limit for bodily injury by disease	\$100,000	Each accident or employee (for disease)
Workers Compensation	Statutory requirements	Per occurrence	N.A.	N.A.
Professional Liability	\$2,000,000*	Per occurrence and in the aggregate	\$250,000	Per occurrence

Combination of primary and excess or umbrella liability policies. Any combination of primary and excess limits is acceptable if the total equals or exceeds the specified amount.

Liability Insurance Terms and Conditions		
a.	Occurrence Basis	The primary General Liability policy and any Excess or Umbrella Liability policy that provides additional limits over the primary General Liability policy shall be "occurrence-based" policies. The Professional Liability will be a Claims-made policy.

## OWNER INSURANCE REQUIREMENTS

A.	Property Insurance Requirements					
WAPA shall provide property insurance for the Facility. Property insurance shall be on an “all risk” basis, including coverage for boiler and machinery (machinery breakdown) perils to the extent those perils are present. The property insurance must be in place prior to commencement of the Work and must remain in place through testing and acceptance of the Work by WAPA.						
1.	Builder’s Risk Property Insurance					
	Coverage Type		Minimum Limit		Maximum Deductible or Retentions	
	Earth Movement including Earthquake, Volcanic Activity, and Subsidence.		Replacement Value of Insurable Real and Personal Property	Annual Aggregate	5% of Replacement Value	Per Occurrence
	Hurricane/ Windstorm			Annual Aggregate	5% of Replacement Value	Per Occurrence
	Flood including Tsunamis			Annual Aggregate	5% of Replacement Value	Per Occurrence
	Debris Removal		20% of Replacement Value	Per occurrence	Included	
	Ordinance or Law		10% of Replacement Value	Per occurrence	Included	
	Expediting Expense		20% of Replacement Value	Per occurrence	Included	
	All Other Perils (including boiler and machinery perils where applicable)		Replacement Value of Insurable Real and Personal Property	Per occurrence	\$1,000,000	Per Occurrence
B.	Requirements Applicable to All Property Insurance Policies					
	1.	Additional Insured and Loss Payee	Contractor must be named as an additional insured and a loss payee to the extent of Contractor’s insurable interest.			
	2.	Waiver of Subrogation	Each property policy must contain a standard waiver of subrogation clause waiving the insurance company’s right of subrogation against any insured party.			

## APPENDIX 15. LIQUIDATED DAMAGE CALCULATION

For the calculation of Liquidated Damages, the file is a “live” file that is updated on a quarterly bases and reported on a biannual bases. The attached excel file is an example of the document at the signing of this Agreement, including applicable formulas for calculating liquidated damages throughout the term of the Agreement.

[Place holder for LD calculation file]

CHARGES FOR SERVICES

Recurring Fees (FY2023)		Amount
5.3	Monthly Operating Fee	\$ 162,147.71
	Fixed Fee	\$ 50,147.28
	Variable Fee (per Unit, per Running hr.)	\$ 46.57
5.3	Overhaul Fees	
	31,000hr. Overhaul Fee (per Unit)	\$ 772,441.00
	36,000hr. Overhaul Fee (per Unit)	\$ 132,767.00
	48,000hr. Overhaul Fee (per Unit)	\$ 171,679.00
	60,000hr. Overhaul Fee (per Unit)	\$ 115,058.00
	64,000hr. Overhaul Fee (per Unit)	\$ 840,719.00
5.3	Monthly Benchmarkable Costs	\$ 12,000.00
	Operator's External Cost (Less Housing) (\$)	\$ 8,000
	External Cost Multiplier (X)	1.2 (Max 2)
	Operator Housing Expense (\$)	\$ 12,000.00
	Num. of On-Island Operators	4
	Housing Cost per Operator (\$)	\$ 3,000.00
5.3	Annual Recovery Guarantee Fee	\$ 53,859.06
5.3	Payment Security	\$ 462,484.06

shall be used by Operator in the event that the Owner does not pay the Operating Fees. If any portion of the Owner Payment Security is used by Operator to pay for Operating Fees, the Owner shall replenish the amount used such that at all times the Payment Security is equal to three (3) months' Operating Fee.

Liquidated Damages and Bonuses		Amount
5.3.1	Annual Availability Liquidated Damages	\$ 1,500.00
	Percent (%) Availability Below Annual Guarantee	1.5%
	LD Rate per 0.1% Short (to VMM/HR)	\$ 15,000.00
5.3.2	Heat Rate Liquidated Damages	
	LD Rate per 0.1% Below Guarantee (based on VMM/HR)	\$ 1,500.00
	Guaranteed Average Heat Rate (Btu/Wh) + 1.5% Aging Factor	8,400
	Q1 Recorded Heat Rate (Btu/Wh)	8,100
	Q2 Recorded Heat Rate (Btu/Wh)	8,100
	Q3 Recorded Heat Rate (Btu/Wh)	8,100
	Q4 Recorded Heat Rate (Btu/Wh)	8,100
5.3.3	Lube Oil Consumption Liquidated Damages	
	LD Rate per 0.1 g/KWH (based on VMM/KWH)	\$ 6,000.00
	Guaranteed Annual Lube Oil Consumption (g/KWH)	5.0
	Actual Annual (g/KWH) Consumption (g/KWH)	6.12
5.3.4	Electrical Capacity Liquidated Damages	
	LD Rate per KW Below Guarantee (based on VMM/KW)	\$ 1,500.00
	Guaranteed Electrical Capacity (KW)	25,750
	Q1 Recorded Electrical Capacity (KW)	25,750
	Q2 Recorded Electrical Capacity (KW)	25,750
	Q3 Recorded Electrical Capacity (KW)	25,750
	Q4 Recorded Electrical Capacity (KW)	25,750

Currently proposed to be paid to Owner on an annual basis. Can we propose a 6-month payment period  
such that reimbursements coincide with the LEAC  
Rings? The revised 6-month LD calculation would then be:  
 $(\text{RM}_Q - \text{dRM}_Q) + (\text{RM}_{Q2} - \text{dRM}_{Q2}) / 2$   
1.5% annual threshold before LD kicks in

Currently proposed to be paid to Owner on an annual basis. Can we propose a 6-month payment period  
such that reimbursements coincide with the LEAC  
Rings? The revised 6-month LD calculation would then be:  
 $(\text{EGC} - \text{EC}_{Q1}) + (\text{EGC} - \text{EC}_{Q2}) / 2$

Supplemental Calculations

Annual Availability	8,760
Period Hours (hrs)	660
Estimated Scheduled Maintenance (hrs.)	0%
Unit Forced Outage Rate (%)	8.6%
Net Projected Operating Hours (per Unit)	99%
Availability Percentage w/o Planned Maintenance (%)	91.5%
Availability Percentage w/ Planned Maintenance (%)	90% during OHI periods.
Warranty Proposed Annual Availability	Warranty Calculation for Annual Availability (Running Hrs. + Standby Hrs.) / Period Hrs.

Heat Rate Guarantee	
Electrical Power Output - Performance Test (kW)	6,000
Electrical Power Output - Guaranteed (kW)	7,027
LHV Heat Rate - Guaranteed (Btu/Wh)	8,283
Heat Rate Correction Factor (Btu/Wh)	12.1%
Adjusted Guaranteed Heat Rate (Btu/Wh)	8,400

Fixed Fee	80815
Prior Year's Fixed Fee (AFF x1)	80815
Prior Year's USCP (USCP x1)	80815
Current Year's USCP (USCP x1)	80815
Adjusted Fixed Fee (AFF x1)	80815
Change (\$)	80815
Variable Fee	
Prior Year's Variable Fee (AVF x1)	40.57
Prior Year's EPP (EPP x1)	104.30
Prior Year's USCP (USCP x1)	0.000
Current Year's EPP (EPP x1)	104.30
Current Year's USCP (USCP x1)	0.000
Escalated Variable Fee (AVF x1)	80815

Variable Engine Overhaul Fee					
Prior Year's EPP (EPP x1)	104.30	80			Current Year's
Prior Year's USCP (USCP x1)	0.00	80			
Current Year's EPP (EPP x1)	104.30	80	Engine Overhaul Multiple	Multiple	Overhaul Fee
Current Year's USCP (USCP x1)	0.00	80	Interval (hrs.)	(F) (F)	(AVF x1) (AVF x1)
			32,000	1.0%	10%
			36,000	1.0%	11%
			48,000	1.0%	11%
			60,000	1.0%	11%
			64,000	1.0%	10%

Liquidated Damages Rate Structure	
Item	
<b>AVLD</b>	<b>Annual Availability Liquidated Damages</b>
AVLD1	LD Rate per 0.1% below GAV up to 2%
AVLD2	LD Rate per additional 0.1% below GAV less 2% and up to 5%
AVLD3	LD Rate per additional 0.1% below GAV less 5% and up to 10%
AVLD4	LD Rate per additional 0.1% below GAV less 10% and up to 15%
AVLD5	LD Rate per additional 0.1% below GAV less 15% and up to 20%
AVLD6	LD Rate per additional 0.1% below GAV less 20%
<b>HRLD</b>	<b>Heat Rate Liquidated Damages (per Unit)</b>
HRLD1	LD Rate per BTU/kWh up to 500 BTU/kWh Above Guarantee less 1.5%
HRLD2	LD Rate per BTU/kWh up to 1,000 BTU/kWh Above Guarantee less 1.5%
HRLD3	LD Rate per BTU/kWh up to 1,500 BTU/kWh Above Guarantee less 1.5%
HRLD4	LD Rate per BTU/kWh up to 2,000 BTU/kWh Above Guarantee less 1.5%
HRLD5	LD Rate per BTU/kWh if in excess of 2,000 BTU/kWh Above Guarantee less 1.5%
<b>LOLD</b>	<b>Lube Oil Consumption Liquidated Damages (per Unit)</b>
LOLD1	LD Rate per 0.1 g/kWh above Guaranteed Consumption
<b>ECLD</b>	<b>Electrical Capacity Liquidated Damages</b>
ECLD1	LD Rate per kW Below Guarantee up to 500kW
ECLD2	LD Rate per additional kW Below Guarantee less 500kW and up to 1MW
ECLD3	LD Rate per additional kW Below Guarantee less 1MW and up to 2MW
ECLD4	LD Rate per additional kW Below Guarantee less 2MW and up to 5MW
ECLD5	LD Rate per additional kW Below Guarantee less 5MW

#### Annual Availability Liquidated Damages

**LD** = Liquidated Damages

**GAV** = Guaranteed Annual Availability %

**AV** = Annual Availability %

whereas,

if  $GAV - AV \leq 2\%$ ,  $LD = (GAV - AV) / 0.1 \times AVLD1$

if  $GAV - AV \leq 5\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + ((GAV - AV - 2) \div 0.1 \times AVLD2)$

if  $GAV - AV \leq 10\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + (3 \div 0.1 \times AVLD2) + ((GAV - AV - 5) \div 0.1 \times AVLD3)$

if  $GAV - AV \leq 15\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + (3 \div 0.1 \times AVLD2) + (5 \div 0.1 \times AVLD3) + ((GAV - AV - 15) \div 0.1 \times AVLD4)$

if  $GAV - AV \leq 20\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + (3 \div 0.1 \times AVLD2) + (5 \div 0.1 \times AVLD3) + (5 \div 0.1 \times AVLD4) + ((GAV - AV - 20) \div 0.1 \times AVLD5)$

if  $GAV - AV > 20\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + (3 \div 0.1 \times AVLD2) + (5 \div 0.1 \times AVLD3) + (5 \div 0.1 \times AVLD4) + (5 \div 0.1 \times AVLD5)$

#### Heat Rate Liquidated Damages (per Unit)

**LD** = Liquidated Damages

**GHR** = Guaranteed Heat Rate

**HR\_Qx** = Quaterly Heat Rate

**HR\_Sx** = Semi-Annual Heat Rate =  $(HR\_Qx1 + HR\_Qx2) \div 2$

whereas,

if  $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 500 \text{ BTU/kWh}$ ,  $LD = HR\_Sx - (GHR + (GHR \times 1.5\%)) \times HI$

if  $HR\_Sx - (GHR + (GHR \times 1.5\%)) > 500 \text{ BTU/kWh}$ ,  $LD = (500 - (GHR + (GHR \times 1.5\%))) \times HI + (HR\_Sx - (GHR + (GHR \times 1.5\%))) \times HI$

if  $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 1500 \text{ BTU/kWh}$ ,  $LD = HR\_Sx - (GHR + (GHR \times 1.5\%)) \times HI$   
 if  $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 2000 \text{ BTU/kWh}$ ,  $LD = HR\_Sx - (GHR + (GHR \times 1.5\%)) \times HI$   
 if  $HR\_Sx - (GHR + (GHR \times 1.5\%)) > 2000 \text{ BTU/kWh}$ ,  $LD = HR\_Sx - (GHR + (GHR \times 1.5\%)) \times HI$

#### **Lube Oil Consumption Liquidated Damages (per Unit)**

**LD** = Liquidated Damages

**GC** = Guaranteed Annual Consumption

**ALOC** = Annual Lube Oil Consumption

whereas,

if  $ALOC - GC > 0.5 \text{ g/kWh}$ ,  $LD = ((ALOC - GC) \div 0.1) \times LOLD1$

#### **Electrical Capacity Liquidated Damages**

**LD** = Liquidated Damages

**GEC** = Guaranteed Electrical Capacity (kW)

**EC\_Qx** = Quaterly Electrical Capacity (kW)

**EC\_Sx** = Semi-Annual Electrical Capacity (kW) =  $(EC\_Qx1 + EC\_Qx2) \div 2$

whereas,

if  $GEC - EC\_Sx \leq 500 \text{ kW}$ ,  $LD = (GEC - EC\_Sx) \times ECLD1$

if  $GEC - EC\_Sx \leq 1000 \text{ kW}$ ,  $LD = (500 \times ECLD1) + ((GEC - EC\_Sx - 500) \times ECLD2)$

if  $GEC - EC\_Sx \leq 2000 \text{ kW}$ ,  $LD = (500 \times ECLD1) + (500 \times ECLD2) + ((GEC - EC\_Sx - 1000) \times ECLD3)$

if  $GEC - EC\_Sx \leq 5000 \text{ kW}$ ,  $LD = (500 \times ECLD1) + (500 \times ECLD2) + (1,000 \times ECLD3) + ((GEC - EC\_Sx - 2000) \times ECLD4)$

if  $GEC - EC\_Sx > 5000 \text{ kW}$ ,  $LD = (500 \times ECLD1) + (500 \times ECLD2) + (1,000 \times ECLD3) + (3,000 \times ECLD4)$

Amount	
\$ 15,000.00	---
\$ 15,653.09	---
\$ 16,421.87	---
\$ 17,258.24	---
\$ 18,094.60	---
\$ 19,230.84	---
\$ 1,500.00	---
\$ 2,041.75	---
\$ 2,854.38	---
\$ 3,937.89	---
\$ 4,383.87	---
\$ 6,000.00	
\$ 1,300.00	---
\$ 1,674.63	---
\$ 2,059.28	---
\$ 2,449.40	---
\$ 2,951.98	---

Upper GAV Limit (%)	Lower GAV Limit (%)
100%	92%
92%	90%
90%	87%
87%	82%
82%	77%
77%	72%
72%	0%
Upper Limit (BTU/kWh)	Lower Limit (BTU/kWh)
8,906	8,406
9,406	8,906
9,906	9,406
10,406	9,906
13,500	10,406

Upper Capacity Limit (kW)	Lower Capacity Limit (kW)
21,000	20,500
20,500	20,000
20,000	19,000
19,000	16,000
16,000	-

$(-10) \div 0.1 \times \text{AVLD4}$   
 $(\text{AVLD4}) + ((\text{GAV}-\text{AV}-15) \div 0.1 \times \text{AVLD5})$   
 $(\text{AVLD4}) + (5 \div 0.1 \times \text{AVLD5}) + ((\text{GAV}-\text{AV}-20) \div 0.1 \times \text{AVLD6})$

RLD1  
 RLD2

[Redacted]

[Redacted]



Projected Annual Fuel Expense At Lower Limit (\$M)	Delta (\$M)	Delta (%)	Tier Cost per 0.1% (\$)
\$ 56,713.76	N/A	N/A	N/A
\$ 56,840.07	\$ 126.31	-0.22%	\$ 631.53
\$ 57,035.99	\$ 195.93	-0.34%	\$ 653.09
\$ 57,420.39	\$ 384.39	-0.67%	\$ 768.78
\$ 57,838.57	\$ 418.18	-0.72%	\$ 836.37
\$ 58,256.75	\$ 418.18	-0.72%	\$ 836.37
\$ 66,380.81	\$ 8,124.05	-12.24%	\$ 1,136.23
Add. BTU Required	Add. Fuel Required (gal)	FYTD Avg \$/gal LPG	Add. Fuel Cost (\$)
28,053,900,000	107,446.44	\$ 1.26	\$ 135,438.14
56,107,800,000	214,892.87	\$ 1.26	\$ 270,876.28
84,161,700,000	322,339.31	\$ 1.26	\$ 406,314.42
112,215,600,000	429,785.75	\$ 1.26	\$ 541,752.56
285,800,228,406	1,094,614.87	\$ 1.26	\$ 1,379,781.48

Projected Annual Fuel Expense At Lower Limit (\$M)	Delta (\$M)	Delta (%)	Tier Cost per kW (\$)
\$ 56,597.24	\$ -	0%	
\$ 56,784.55	\$ 187.31	-0.33%	\$ 374.63
\$ 57,169.20	\$ 384.65	-0.67%	\$ 384.65
\$ 58,339.57	\$ 1,170.37	-2.01%	\$ 390.12
\$ 66,380.81	\$ 8,041.23	-12.11%	\$ 502.58

Tier Cost per BTU/kWh (\$)	
\$	270.88
\$	541.75
\$	812.63
\$	1,083.51
\$	445.99

## Liquidated Damages Rate Structure

Item	
<b>HRLD</b>	<b>Heat Rate Liquidated Damages (per Unit)</b>
HRLD1	LD Rate per BTU/kWh up to 500 BTU/kWh Above Guarantee less 1.5%
HRLD2	LD Rate per BTU/kWh up to 1,000 BTU/kWh Above Guarantee less 1.5%
HRLD3	LD Rate per BTU/kWh up to 1,500 BTU/kWh Above Guarantee less 1.5%
HRLD4	LD Rate per BTU/kWh up to 2,000 BTU/kWh Above Guarantee less 1.5%
HRLD5	LD Rate per BTU/kWh if in excess of 2,000 BTU/kWh Above Guarantee less 1.5%
<b>ECLD</b>	<b>Electrical Capacity Liquidated Damages</b>
ECLD1	LD Rate per kW Below Guarantee up to 500kW
ECLD2	LD Rate per additional kW Below Guarantee less 500kW and up to 1MW
ECLD3	LD Rate per additional kW Below Guarantee less 1MW and up to 2MW
ECLD4	LD Rate per additional kW Below Guarantee less 2MW and up to 5MW
ECLD5	LD Rate per additional kW Below Guarantee less 5MW

### Heat Rate Liquidated Damages (per Unit)

**LD** = Liquidated Damages

**GHR** = Guaranteed Heat Rate

**HR\_Qx** = Quaterly Heat Rate

**HR\_Sx** = Semi-Annual Heat Rate =  $(HR\_Qx1 + HR\_Qx2) \div 2$

whereas,

if $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 500$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$
if $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 1000$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$
if $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 1500$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$
if $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 2000$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$
if $HR\_Sx - (GHR + (GHR \times 1.5\%)) > 2000$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$

### Electrical Capacity Liquidated Damages

**LD** = Liquidated Damages

**GEC** = Guaranteed Electrical Capacity (kW)

**EC\_Qx** = Quaterly Electrical Capacity (kW)

**EC\_Sx** = Semi-Annual Electrical Capacity (kW) =  $(EC\_Qx1 + EC\_Qx2) \div 2$

whereas,

if $GEC - EC\_Sx \leq 500$ kW,	LD = $(GEC - EC\_Sx) \times ECLD1$
if $GEC - EC\_Sx \leq 1000$ kW,	LD = $(500 \times ECLD1) + ((GEC - EC\_Sx - 500) \times ECLD2)$
if $GEC - EC\_Sx \leq 2000$ kW,	LD = $(500 \times ECLD1) + (500 \times ECLD2) + ((GEC - EC\_Sx - 1000) \times ECLD3)$
if $GEC - EC\_Sx \leq 5000$ kW,	LD = $(500 \times ECLD1) + (500 \times ECLD2) + (1,000 \times ECLD3) + ((GEC - EC\_Sx - 2000) \times ECLD4)$
if $GEC - EC\_Sx > 5000$ kW,	LD = $(500 \times ECLD1) + (500 \times ECLD2) + (1,000 \times ECLD3) + (2,000 \times ECLD4) + ((GEC - EC\_Sx - 5000) \times ECLD5)$

Amount
\$1,500.00
\$2,068.40
\$2,920.99
\$4,057.78
\$4,518.61
\$1,300.00
\$1,674.63
\$2,059.28
\$2,449.40
\$2,951.98



\$0.00	
8,406	
Q1	Q2
8100.64	8231.00
8165.82	
-366.50	

5%)) x HRLD1

5%)) x HRLD2

5%)) x HRLD3

5%)) x HRLD4

5%)) x HRLD5

\$0.00	
20575	
Q1	Q2
21000.00	20750.00
20875.00	
-300.00	

*Performance Test every three month*

000) x ECLD3)

+ ((GEC - EC\_Sx - 2,000) x ECLD4)

+ (3,000 x ECLD4) + ((GEC - EC\_Sx - 5,000) x ECLD5)

Total to Pay	\$0.00
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## Liquidated Damages Rate Structure

Item	
<b>HRLD</b>	<b>Heat Rate Liquidated Damages (per Unit)</b>
HRLD1	LD Rate per BTU/kWh up to 500 BTU/kWh Above Guarantee less 1.5%
HRLD2	LD Rate per BTU/kWh up to 1,000 BTU/kWh Above Guarantee less 1.5%
HRLD3	LD Rate per BTU/kWh up to 1,500 BTU/kWh Above Guarantee less 1.5%
HRLD4	LD Rate per BTU/kWh up to 2,000 BTU/kWh Above Guarantee less 1.5%
HRLD5	LD Rate per BTU/kWh if in excess of 2,000 BTU/kWh Above Guarantee less 1.5%
<b>ECLD</b>	<b>Electrical Capacity Liquidated Damages</b>
ECLD1	LD Rate per kW Below Guarantee up to 500kW
ECLD2	LD Rate per additional kW Below Guarantee less 500kW and up to 1MW
ECLD3	LD Rate per additional kW Below Guarantee less 1MW and up to 2MW
ECLD4	LD Rate per additional kW Below Guarantee less 2MW and up to 5MW
ECLD5	LD Rate per additional kW Below Guarantee less 5MW

### Heat Rate Liquidated Damages (per Unit)

**LD** = Liquidated Damages

**GHR** = Guaranteed Heat Rate

**HR\_Qx** = Quaterly Heat Rate

**HR\_Sx** = Semi-Annual Heat Rate =  $(HR\_Qx1 + HR\_Qx2) \div 2$

whereas,

if $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 500$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$
if $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 1000$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$
if $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 1500$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$
if $HR\_Sx - (GHR + (GHR \times 1.5\%)) \leq 2000$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$
if $HR\_Sx - (GHR + (GHR \times 1.5\%)) > 2000$ BTU/kWh,	LD = $HR\_Sx - (GHR + (GHR \times 1.5\%))$

### Electrical Capacity Liquidated Damages

**LD** = Liquidated Damages

**GEC** = Guaranteed Electrical Capacity (kW)

**EC\_Qx** = Quaterly Electrical Capacity (kW)

**EC\_Sx** = Semi-Annual Electrical Capacity (kW) =  $(EC\_Qx1 + EC\_Qx2) \div 2$

whereas,

if $GEC - EC\_Sx \leq 500$ kW,	LD = $(GEC - EC\_Sx) \times ECLD1$
if $GEC - EC\_Sx \leq 1000$ kW,	LD = $(500 \times ECLD1) + ((GEC - EC\_Sx - 500) \times ECLD2)$
if $GEC - EC\_Sx \leq 2000$ kW,	LD = $(500 \times ECLD1) + (500 \times ECLD2) + ((GEC - EC\_Sx - 1000) \times ECLD3)$
if $GEC - EC\_Sx \leq 5000$ kW,	LD = $(500 \times ECLD1) + (500 \times ECLD2) + (1,000 \times ECLD3) + ((GEC - EC\_Sx - 2000) \times ECLD4)$
if $GEC - EC\_Sx > 5000$ kW,	LD = $(500 \times ECLD1) + (500 \times ECLD2) + (1,000 \times ECLD3) + (2,000 \times ECLD4) + ((GEC - EC\_Sx - 5000) \times ECLD5)$

Amount
\$1,500.00
\$2,068.40
\$2,920.99
\$4,057.78
\$4,518.61
\$1,300.00
\$1,674.63
\$2,059.28
\$2,449.40
\$2,951.98



\$0.00	
8,406	
Q3	Q4
8100.64	8231.00
8165.82	
-366.50	

5%)) x HRLD1

5%)) x HRLD2

5%)) x HRLD3

5%)) x HRLD4

5%)) x HRLD5

\$0.00	
20575	
Q3	Q4
21000.00	20750.00
20875.00	
-300.00	

*Performance Test every three month*

000) x ECLD3)

+ ((GEC - EC\_Sx - 2,000) x ECLD4)

+ (3,000 x ECLD4) + ((GEC - EC\_Sx - 5,000) x ECLD5)

Total to Pay	\$0.00
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Liquidated Damages Rate Structure	
Item	
<b>AVLD</b>	<b>Annual Availability Liquidated Damages</b>
AVLD1	LD Rate per 0.1% below GAV up to 2%
AVLD2	LD Rate per additional 0.1% below GAV less 2% and up to 5%
AVLD3	LD Rate per additional 0.1% below GAV less 5% and up to 10%
AVLD4	LD Rate per additional 0.1% below GAV less 10% and up to 15%
AVLD5	LD Rate per additional 0.1% below GAV less 15% and up to 20%
AVLD6	LD Rate per additional 0.1% below GAV less 20%
<b>LOLD</b>	<b>Lube Oil Consumption Liquidated Damages (per Unit)</b>
LOLD1	LD Rate per 0.1 g/kWh above Guaranteed Consumption

#### Annual Availability Liquidated Damages

**LD** = Liquidated Damages

**GAV** = Guaranteed Annual Availability %

**AV** = Annual Availability %

whereas,

if  $GAV - AV \leq 2\%$ ,  $LD = (GAV - AV) / 0.1 \times AVLD1$

if  $GAV - AV \leq 5\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + ((GAV - AV - 2) \div 0.1 \times AVLD2)$

if  $GAV - AV \leq 10\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + (3 \div 0.1 \times AVLD2) + ((GAV - AV - 5) \div 0.1 \times AVLD3)$

if  $GAV - AV \leq 15\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + (3 \div 0.1 \times AVLD2) + (5 \div 0.1 \times AVLD3) + ((GAV - AV - 10) \div 0.1 \times AVLD4)$

if  $GAV - AV \leq 20\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + (3 \div 0.1 \times AVLD2) + (5 \div 0.1 \times AVLD3) + (10 \div 0.1 \times AVLD4) + ((GAV - AV - 15) \div 0.1 \times AVLD5)$

if  $GAV - AV > 20\%$ ,  $LD = (2 \div 0.1 \times AVLD1) + (3 \div 0.1 \times AVLD2) + (5 \div 0.1 \times AVLD3) + (10 \div 0.1 \times AVLD4) + (15 \div 0.1 \times AVLD5) + ((GAV - AV - 20) \div 0.1 \times AVLD6)$

#### Lube Oil Consumption Liquidated Damages (per Unit)

**LD** = Liquidated Damages

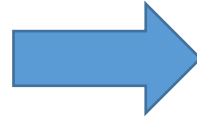
**GC** = Guaranteed Annual Consumption

**ALOC** = Annual Lube Oil Consumption

whereas,

if  $ALOC - GC > 0.5 \text{ g/kWh}$ ,  $LD = ((ALOC - GC) \div 0.1) \times LOLD1$

Amount
\$15,000.00
\$15,653.09
\$16,421.87
\$17,258.24
\$18,094.60
\$19,163.56
\$6,000.00



\$0.00	
91.5	-1.12 %
92.5	
-1.02	

AVLD3)

$(\text{GAV-AV-10}) \div 0.1 \times \text{AVLD4}$

$5 \div 0.1 \times \text{AVLD4} + ((\text{GAV-AV-15}) \div 0.1 \times \text{AVLD5})$

$5 \div 0.1 \times \text{AVLD4} + (5 \div 0.1 \times \text{AVLD5}) + ((\text{GAV-AV-20}) \div 0.1 \times \text{AVLD6})$

\$0.00
0.5
0.124
-0.38

Total to Pay	\$0.00
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## **APPENDIX 16. WARTSILA CARIBBEAN REGISTRATION**

**[Place holder for Wartsila Caribbean Business License in USVI]**



THE GOVERNMENT OF THE VIRGIN ISLANDS  
DEPARTMENT OF LICENSING AND CONSUMER AFFAIRS  
**BUSINESS LICENSE**

**KNOW ALL BY THIS PRESENT**

That, in accordance with the applicable provisions of Title 3 Chapter 16 and Title 27 V.I.C. relating to the licensing of businesses and occupations, and compliance having been made with the provisions of 10 V.I.C. Sec. 41 relating to the Civil Rights Act of the Virgin Islands, the following license is hereby granted.

<b>Licensee:</b> WARTSILA CARIBBEAN, INC.	
<b>Trade Name:</b> WARTSILA CARIBBEAN, INC.	
<b>Mailing Address</b>	<b>Physical Address</b>
ROAD 887 KM 0.6, STREET A LOT PARQUE INDUSTRIAL PARK JULIO N CAROLINA 00987	72 KRONPRINDSENS GADE WATERFRONT CENTER SUITE A CHARLOTTE AMALIE ST. THOMAS VI 00802
<b>Business No:</b> 45053	<b>License No:</b> 3-45053-1L
<b>Types of License(s)</b> Engine Repair, Except Automotive Consultant - Equipment Maintenance Repair & Main of Misc. Items	

As provided by law, the authorized licensing authority shall have the power to revoke or suspend any License issued hereunder, upon finding, after notice and adequate hearing, that such revocation or suspension is in the public interest; provided, that any persons aggrieved by any such decision of this office shall be entitled to a review of the same by the Territorial Court upon appeal made within (30) days from the date of the decision; provided, further, that all decisions of this office hereunder shall be final except upon specific findings by the Court that the same was arrived at by fraud or illegal means.

**2023**

If a renewal is desired, the holder is responsible for making application for same without any notice from this office. It is the responsibility of the Licensee to notify the Department in writing within (30) days, when a license is to be cancelled or placed in inactive status. Failure to do so will result in the assessment of penalties as authorized by law.

**Valid from** 05/01/2023 until 05/31/2024  
**Printed on** 05/15/2023  
**Issued at** St. Thomas, V.I.  
**Fee** 585.00

*Dmr*  
Dmr

*Richard Guglietta*

Commissioner, Department of Licensing and Consumer Affairs

**THIS LICENSE MUST BE PROMINENTLY DISPLAYED AT PLACE OF BUSINESS**

## APPENDIX 17. OWNER STANDARD TERMS AND CONDITIONS

**BUSINESS LICENSE:** The Operator must comply with all Virgin Islands' business licensing laws in connection with its business operation(s). Operator shall further ensure that all subcontractors hired in connection with the performance of this contract comply with all Virgin Islands business license requirements. All necessary and applicable license(s) for Operator and its subcontractor(s) shall be obtained by the Operator and copies presented to the Operating Officer concurrent with its execution of the Contract. Failure by Operator to present business license(s) for itself and its subcontractors at the time of execution of the contract by the Operator may, at the sole option of the Owner, be grounds to rescind the OMA award.

### **DRUG AND ALCOHOL TESTING FOR OPERATOR EMPLOYEES:**

The use of drugs, alcohol, and unauthorized substances are prohibited on Owner business locations, power generating, transmission and distribution, and potable water facilities, workplaces, worksites, and parking areas (hereinafter "Premises").

- Drugs are any drug or controlled substance which is not legally obtainable under both local and/or federal law, including but not limited to marijuana, opiates, PCP (phencyclidine), cocaine, heroin, amphetamines, barbiturates, benzodiazepines, narcotics, hallucinogens, inhalants, designer drugs, and/or any substances and/or paraphernalia that are prohibited by federal or local law.
- Unauthorized substances are over-the-counter or prescription drugs that are used, possessed, purchased, transferred, dispensed, or distributed in the manner outlined below:
  - a. prescription drugs that are not prescribed and/or prescribed on an invalid prescription;
  - b. prescription drugs that are prescribed at non-therapeutic levels or used in a manner or quantity other than as set forth in the prescription;
  - c. over-the-counter drugs in a manner or quantity other than set forth in the directions; or
  - d. over-the-counter or prescription drugs in a manner that contradicts the direction or instructions for use.
- Alcohol is a colorless volatile flammable liquid that is produced by the natural fermentation of sugars and is the intoxicating constituent of wine, beer, spirits, and other drinks.

**Operator (and its subcontractors or agents) shall have in place during the performance of the work a Drug, Alcohol, and Unauthorized Substance Testing Policy for their respective employees, which policy shall include reasonable suspicion and post-accident testing.**

The Owner reserves the right to notify the Operator if the Owner suspects that the Operator's employee, agent or subcontractor employee performing work on the Owner's Premises may be under the influence. If notified, the Operator shall immediately assess the employee and invoke reasonable suspicion or post-accident testing, if testing is determined to be warranted per the Operator's Policy. The Operator shall provide the Owner with a written report advising of the results of its investigation into the Owner's

complaint and the status of the employee involved in the investigation. Any Operator employee, or employee of a subcontractor, or agent of the Operator that fails a drug, alcohol, or unauthorized substance test shall not be allowed to return to the Owner's Premises until the Operator provides written verification to the Owner that the employee has passed a subsequent test and is appropriately fit for duty. Provided however, the Owner may require the removal from the jobsite any employee of Operator or subcontractor or agent if in the judgment of the Operating Officer such removal is necessary to protect the interest of the Owner.

A copy of the Operator, Subcontractor or Agent's Drug, Alcohol, and Unauthorized Substance Policy must be presented upon contract execution.

**GROSS RECEIPT TAXES:** Title 33, Section 44 of the Virgin Islands Code, as amended, requires that the Owner, when making a payment under this Contract, to deduct and withhold from such payments, gross receipts taxes as required by the Virgin Islands law at 33 VIC Section 43(a) for each payment for Work performed in the Virgin Islands.

Notwithstanding any other provisions of this contract to the contrary, it is agreed between the Parties that that for the purposes of complying with Title 33, Section 44 of the Virgin Islands Code, the Owner shall withhold and forward to the V.I. Bureau of Internal Revenue such amounts as required by 33 VIC Section 43(a) or any amendments thereto. Despite the requirements under Title 33, Section 44, the Operator agrees that calculation and payment of gross receipts taxes shall be the sole responsibility of the Operator. The Owner shall not be responsible in any manner for any miscalculation, or change in law or additional assessments that may affect the amount due herein. In the unlikely event any overpayment is made to the V.I. Bureau of Internal Revenue, the Operator shall seek repayment from V.I. Bureau of Internal Revenue and not the Owner. Upon written request of the Operator directed to the Owner's Comptroller, the Owner agrees to provide Operator with documentation confirming that gross receipts withheld under this agreement were paid to the V.I. Bureau of Internal Revenue in accordance with the provisions herein.

In the event the contract is amended and the consideration herein increases or decreases, the appropriate amount of Gross Receipt Taxes to reflect the increase or decrease in the consideration will be adjusted.

**INSURANCE:** The Operator shall, at its expense, before any Work is commenced, cause to be issued and maintained throughout the duration of the Term, insurance as described in Appendix 14 of the Agreement. A copy of the insurance certificate must be presented to the Owner's Contracting Officer upon execution of the contract.

## APPENDIX 18. RESPONSIBILITY MATRIX

Shared Operation and Maintenance Agreement By and Between

Owner and Operator

**3.2** The tables below establish the responsibilities of the Parties for the Covered Equipment (to include the generator sets under this appendix) in regards to the Planned Maintenance intervals as detailed in Appendix 20. The tables detail the Owner and Operator responsibilities for (i) Planned Maintenance spare parts, (ii) Unplanned Maintenance spare parts, (iii) Technical Advisor Planned Maintenance, (iv) Technical Labor Planned Maintenance, (v) Technical Advisor Unplanned Maintenance, (vi) Technical Labor Unplanned Maintenance, (vii) Workshop Services Planned Maintenance, for each maintenance interval detailed in Appendix 19 and (viii) Workshop Services Unplanned Maintenance.

**Responsibility matrix for the Facility**

<b>Owner Responsibility</b>	<b>Operator Responsibility</b>	<b>Scope of Supply – 50 hour Maintenance Interval</b>
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance
X		Technical Labor Planned Maintenance
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X If Applicable	Workshop Services Planned Maintenance
	X If Applicable	Workshop Services Unplanned Maintenance



<b>Owner Responsibility</b>	<b>Operator Responsibility</b>	<b>Scope of Supply – 500 hour Maintenance Interval</b>
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance
X		Technical Labor Planned Maintenance
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X If Applicable	Workshop Services Planned Maintenance
	X If Applicable	Workshop Services Unplanned Maintenance

<b>Owner Responsibility</b>	<b>Operator Responsibility</b>	<b>Scope of Supply – 2,000 hour Maintenance Interval</b>
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance
X		Technical Labor Planned Maintenance
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X If Applicable	Workshop Services Planned Maintenance
	X	Workshop Services Unplanned Maintenance

	If Applicable	
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Owner Responsibility	Operator Responsibility	Scope of Supply – 4,000 hour Maintenance Interval
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance
X		Technical Labor Planned Maintenance
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X If Applicable	Workshop Services Planned Maintenance
	X If Applicable	Workshop Services Unplanned Maintenance

Owner Responsibility	Operator Responsibility	Scope of Supply – 8,000 hour Maintenance Interval
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance
X		Technical Labor Planned Maintenance
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X	Workshop Services Planned Maintenance

	If Applicable	
	X	
	If Applicable	Workshop Services UnPlanned Maintenance

Owner Responsibility	Operator Responsibility	Scope of Supply – 12,000 hour Maintenance Interval
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance
X		Owner Technical Labor Planned Maintenance tasks 8000 hours and below
	X	Operator Technical Labor Planned Maintenance tasks above 8000 hours
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X	
	If applicable	Workshop Services Planned Maintenance
	X	
	If Applicable	Workshop Services Unplanned Maintenance

Owner Responsibility	Operator Responsibility	Scope of Supply – 16,000 hour Maintenance Interval
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance

X		Owner Technical Labor Planned Maintenance tasks 8000 hours and below
	X	Operator Technical Labor Planned Maintenance tasks above 8000 hours
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X If applicable	Workshop Services Planned Maintenance
	X If Applicable	Workshop Services Unplanned Maintenance

Owner Responsibility	Operator Responsibility	Scope of Supply – 24,000 hour Maintenance Interval
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance
X		Owner Technical Labor Planned Maintenance tasks 8000 hours and below
	X	Operator Technical Labor Planned Maintenance tasks above 8000 hours
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X If applicable	Workshop Services Planned Maintenance
	X	Workshop Services Unplanned Maintenance

	If Applicable	
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Owner Responsibility	Operator Responsibility	Scope of Supply – 32,000 hour Maintenance Interval
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance
X		Owner Technical Labor Planned Maintenance tasks 8000 hours and below
	X	Operator Technical Labor Planned Maintenance tasks above 8000 hours
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X If applicable	Workshop Services Planned Maintenance
	X If Applicable	Workshop Services Unplanned Maintenance

Owner Responsibility	Operator Responsibility	Scope of Supply – 48,000 hour Maintenance Interval
	X	Covered Equipment Planned Maintenance spare parts
	X	Covered Equipment Unplanned Maintenance spare parts
	X	Technical Advisor Planned Maintenance
X		Owner Technical Labor Planned Maintenance tasks 8000 hours and below

	X	Operator Technical Labor Planned Maintenance tasks above 8000 hours
	X	Technical Advisor Unplanned Maintenance
	X	Technical Labor Unplanned Maintenance
	X If applicable	Workshop Services Planned Maintenance
	X If Applicable	Workshop Services Unplanned Maintenance

## APPENDIX 19. WORKSHOP SERVICES

### Shared Operation and Maintenance Agreement by and between Owner and Operator

The tables below establish the responsibilities of the Parties for Workshop Services under this Agreement. Operator's responsibility for Workshop Services shall be limited to the Planned Maintenance intervals set forth under Appendix 20 which includes the following standard overhaul services, at the Owner's workshop according to OEM instructions, for cylinder heads, charge air cooler components, and turbocharger cartridges.

1. Standard overhaul services of cylinder heads shall include: (i) dismantling and cleaning of the inner side, inlet valves, and exhaust valves; (ii) inspection and cleaning of cooling water spaces if deposits are thicker than 1 mm; (iii) pressure test cylinder head grind all seats; (iv) replace the o-rings in the valve guides; (v) grind and reinstall valves; (vi) paint and preserve the cylinder head for shipping; (vii) provide measurement form records for cylinder head.
2. Standard overhaul services of charge air coolers shall include: (i) disassembly of end plates; (ii) cleaning of charge air cooler and end plates in an ultrasonic tank or flushing bath; (iii) pressure testing of individual tubes; (iv) assembly of end plates with new gaskets; (v) pressure testing the air cooler assembly; (vi) painting and preserving the air cooler for shipping.
3. Standard overhaul services of turbochargers shall include: (i) evaluation of rotor components, bearings, and nozzle ring, (ii) cleaning of parts, (iii) dynamic balancing, (iv) optical fine tuning, (v) preserve for shipment, and (vi) provide measurement form records for turbocharger balancing. Standard overhaul services of turbochargers shall be performed during each 12,000 Hour Interval as detailed in Appendix 20.

#### Responsibility matrix for Workshop Services Matrix W20V34LPG

WORKSHOP SERVICES W20V34LPG		
	Operator Responsibility Standard overhaul	Owner Responsibility Additional work
Cylinder head overhaul	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Charge air cooler overhaul	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Turbocharger cartridge overhaul	<input checked="" type="checkbox"/>	<input type="checkbox"/>



## APPENDIX 20. PLANNED MAINTENANCE PROCEDURES

Shared Operation and Maintenance Agreement by and between

Owner and Operator

### Maintenance procedures

#### System

3xW34LPG-20V34LPG (PAAE327456)

#### Running hour based jobs

<u>Job duty</u>	<u>Interval</u>
Check the draining of air cooler(s)	50
Check the operating values	50
Check water level in the expansion tank(s)	50
Check pressure drop indicators	50
Check oil level in the sump	50
Water cleaning of the compressor	50
Wash the filter mat on the turbocharger silencer (if equipped)	500
Take oil Sample	500
Check the water quality	500
Clean the centrifugal filter(s)	500
Check the function of the safety system and automatic stop devices	2,000
Regrease the drive shaft of the turning device	2,000
Check the valve clearances	2,000
Check the differential pressure over the charge air cooler	2,000
Perform the leak test with compressed air or nitrogen	2,000
Clean and check the condition of the ignition coil	2,000

Replace the spark plugs	2,000
Check the crankshaft alignment	4,000
Check the thrust bearing clearance	4,000
Inspect the contact faces of camshaft	4,000
Check the function of the valve and calibrate the I/P converter	4,000
Check the connectors and connector holders	4,000
Clean and check the prechamber valve	4,000
Check the lubricating oil temperature	8,000
Overhaul the wastegate valve and actuator	8,000
Replace the lubricating oil filter candles	8,000
General control and monitoring system inspection	8,000
Replace the turbocharger bearings	12,000
Recalibrate the I/P converters and replace the built-in filters in the I/P converter	12,000
Check the exhaust manifold for leaks and loose or broken supports	12,000
Check the tightness of the counterweight fastening nut(s) after an overhaul	16,000
Change the oil in the turning device	16,000
Check the tightening of the engine fastening bolts	16,000
Check the valve mechanism parts	16,000
Clean charge air cooler(s)	16,000
Clean the lubricating oil cooler	16,000
Replace the big end bearing	16,000
Inspect the camshaft bearings, one per bank	16,000
Inspect the intermediate gears	16,000
Inspect the cylinder liners	16,000
Inspect the HT water pump and the driving gear	16,000
Inspect the LT water pump and the driving gear	16,000

Inspect one main bearing	16,000
Inspect the lubricating oil pump and driving gear	16,000
Clean and inspect oil thermostatic valve	16,000
Inspect the pistons and replace the piston rings	16,000
Overhaul the cylinder head	16,000
Overhaul the starting valves in the cylinder heads	16,000
Overhaul the main starting valve	16,000
Check the functioning of one hydraulic jack. Change the O-rings in all hydraulic jacks at every second overhaul interval.	16,000
Replace crankcase relief valve o-ring (ins.dep.)	16,000
Inspect the pre-lubricating oil pump	16,000
Change the lubricating oil in connection with every piston overhaul	16,000
Overhaul the ignition coil	16,000
Replace the prechamber lower part	16,000
Inspect the HT water spaces.	16,000
Replace the main gas admission valves	16,000
Clean the main gas admission valve filter insert	16,000
Inspect the de-gassing valves	16,000
Inspect the pilot de-gassing valve	16,000
Inspect the small end bearings	16,000
Replace the control system vibration dampers	24,000
Overhaul the starting air distributor	24,000
Replace the I/P converters, if equipped	24,000
Check and clean the solenoid valves with a neutral cleaning agent	24,000
Check the expansion bellows	24,000
Replace the turbocharger nozzle ring, shroud ring and turbine inlet casing	24,000
Replace the drive electronics such as cylinder control module, coil drivers, fuel injection controls & power distribution modules	24,000

Replace the cylinder pressure sensors	24,000
Dismantle and check the vibration damper	32,000
Inspect the camshaft bearings, one per bank (ins.dep.)	32,000
Check the functioning of one hydraulic jack. Change the O-rings in all hydraulic jacks at every second overhaul interval. (ins.dep.)	32,000
Replace the air cooler(s)	32,000
Replace the main bearings and thrust bearings	32,000
Replace the connecting rod screws	32,000
Replace the connecting rod shims	32,000
Replace the turbine outlet casing	36,000
Inspect the crankshaft	48,000
Check the flexible elements of engine foundation	48,000
Replace the turbocharger rotor and rotating parts	48,000
Inspect the intermediate gear bearings	48,000
Replace the measuring electronics	48,000
Replace the turbocharger bearings (48k)	48,000

### **Calendar based jobs**

<b><u>Job duty</u></b>	<b><u>Interval</u></b>
Look for leaks and other defects	2 day
Inspect the pre-lubricating oil pump	2 day
Check the static pressure in the engine cooling circuits	1 week
Test start (if the engine is on standby)	1 week
Inspect the gas system for leakage by using a handheld gas detector	2 week

Auxiliary System Planned Maintenance

**[Place Holder for Auxiliary System Planned Maintenance]**

	2023	2024	2025	2026
Percentage Planned	100%	100%	100%	100%

Over the Agreement Term Period June 01, 2023 to May 31, 2026

Maintenance Schedule Generator	2023	2024	2025	2026	Total
L1	1	0	3	0	4
L2	0	0	0	0	0
L3	0	3	0	0	3
L4	0	0	0	0	0
Total	1	3	3	0	7

Maintenance Schedule Oil Mist Separator	2023	2024	2025	2026	Total
L1	3	0	3	0	6
Total	3	0	3	0	6

Maintenance Schedule Air Compressor	2023	2024	2025	2026	Total
2K	1	2	2	1	6
4K	1	1	1	0	3
8K	1	1	1	1	4
Total	3	4	4	2	13

Maintenance Schedule Start Air Compressor	2023	2024	2025	2026	Total
750h	0	0	1	1	2
1.5K	0	2	0	0	2
3K	0	0	0	0	0
6K	0	0	0	0	0
Total	0	2	1	1	4

## Annual Maintenance Plan

Installation: WAPA New Power Generation Project

Equipment: Auxiliaries – Maintenance by time

Planned Maintenance					
3 Fuel gas system					
3.3 Compact gas ramp					
3.3.1 Gas filter	Manufacturer	Type	Task	Interval	Type of job
ZAC011-B001	Boll & Kirch	1.58.1.160.500 DN80	Maintaining the simplex gas filter	1 Months	Inspection
ZAC021-B001	Boll & Kirch	1.58.1.160.500 DN80	Maintaining the simplex gas filter	1 Months	Inspection
ZAC031-B001	Boll & Kirch	1.58.1.160.500 DN80	Maintaining the simplex gas filter	1 Months	Inspection
3.3.2 Gas shut-off valve (Pekos)	Manufacturer	Type	Task	Interval	Type of job
ZAC011-V001	Pekos	Fig. Z26 TTG	Maintaining the ball valve	24 Months	Planned maintenance
ZAC021-V001	Pekos	Fig. Z26 TTG	Maintaining the ball valve	24 Months	Planned maintenance
ZAC031-V001	Pekos	Fig. Z26 TTG	Maintaining the ball valve	24 Months	Planned maintenance
ZAC011-V001	Pekos	Fig. Z26 TTG	Overhauling the ball valve	60 Months	Planned maintenance
ZAC021-V001	Pekos	Fig. Z26 TTG	Overhauling the ball valve	60 Months	Planned maintenance
ZAC031-V001	Pekos	Fig. Z26 TTG	Overhauling the ball valve	60 Months	Planned maintenance
3.3.3 Quick closing valve	Manufacturer	Type	Task	Interval	Type of job
ZAC011-V003	Kühme	L-SEV-1/4-VA	Inspecting the valve for external leaks	1 Months	Inspection
ZAC021-V003	Kühme	L-SEV-1/4-VA	Inspecting the valve for external leaks	1 Months	Inspection
ZAC031-V003	Kühme	L-SEV-1/4-VA	Inspecting the valve for external leaks	1 Months	Inspection
ZAC011-V004	Kühme	L-SEV-1/4-VA	Inspecting the valve for external leaks	1 Months	Inspection
ZAC021-V004	Kühme	L-SEV-1/4-VA	Inspecting the valve for external leaks	1 Months	Inspection
ZAC031-V004	Kühme	L-SEV-1/4-VA	Inspecting the valve for external leaks	1 Months	Inspection
ZAC011-V003	Kühme	L-SEV-1/4-VA	Testing and inspecting the safety shut-off valve	12 Months	Inspection
ZAC021-V003	Kühme	L-SEV-1/4-VA	Testing and inspecting the safety shut-off valve	12 Months	Inspection
ZAC031-V003	Kühme	L-SEV-1/4-VA	Testing and inspecting the safety shut-off valve	12 Months	Inspection
ZAC011-V004	Kühme	L-SEV-1/4-VA	Testing and inspecting the safety shut-off valve	12 Months	Inspection
ZAC021-V004	Kühme	L-SEV-1/4-VA	Testing and inspecting the safety shut-off valve	12 Months	Inspection
ZAC031-V004	Kühme	L-SEV-1/4-VA	Testing and inspecting the safety shut-off valve	12 Months	Inspection
ZAC011-V003	Kühme	L-SEV-1/4-VA	Maintaining the safety shut-off valve	36 Months	Planned maintenance
ZAC021-V003	Kühme	L-SEV-1/4-VA	Maintaining the safety shut-off valve	36 Months	Planned maintenance
ZAC031-V003	Kühme	L-SEV-1/4-VA	Maintaining the safety shut-off valve	36 Months	Planned maintenance
ZAC011-V004	Kühme	L-SEV-1/4-VA	Maintaining the safety shut-off valve	36 Months	Planned maintenance
ZAC021-V004	Kühme	L-SEV-1/4-VA	Maintaining the safety shut-off valve	36 Months	Planned maintenance
ZAC031-V004	Kühme	L-SEV-1/4-VA	Maintaining the safety shut-off valve	36 Months	Planned maintenance
ZAC011-V003	Kühme	L-SEV-1/4-VA	Revising the safety shut-off valve	108 Months	Planned maintenance
ZAC021-V003	Kühme	L-SEV-1/4-VA	Revising the safety shut-off valve	108 Months	Planned maintenance
ZAC031-V003	Kühme	L-SEV-1/4-VA	Revising the safety shut-off valve	108 Months	Planned maintenance
ZAC011-V004	Kühme	L-SEV-1/4-VA	Revising the safety shut-off valve	108 Months	Planned maintenance
ZAC021-V004	Kühme	L-SEV-1/4-VA	Revising the safety shut-off valve	108 Months	Planned maintenance
ZAC031-V004	Kühme	L-SEV-1/4-VA	Revising the safety shut-off valve	108 Months	Planned maintenance
3.3.4 Gas pressure regulating valve	Manufacturer	Type	Task	Interval	Type of job
ZAC011-V005	Fisher	GX	Calibrating the gas regulator	12 Months	Planned maintenance
ZAC021-V005	Fisher	GX	Calibrating the gas regulator	12 Months	Planned maintenance
ZAC031-V005	Fisher	GX	Calibrating the gas regulator	12 Months	Planned maintenance
ZAC011-V006	Fisher	GX	Calibrating the gas regulator	12 Months	Planned maintenance
ZAC021-V006	Fisher	GX	Calibrating the gas regulator	12 Months	Planned maintenance
ZAC031-V006	Fisher	GX	Calibrating the gas regulator	12 Months	Planned maintenance
ZAC011-V005	Fisher	GX	Replacing the packing and gaskets	24 Months	Planned maintenance
ZAC021-V005	Fisher	GX	Replacing the packing and gaskets	24 Months	Planned maintenance
ZAC031-V005	Fisher	GX	Replacing the packing and gaskets	24 Months	Planned maintenance
ZAC011-V006	Fisher	GX	Replacing the packing and gaskets	24 Months	Planned maintenance
ZAC021-V006	Fisher	GX	Replacing the packing and gaskets	24 Months	Planned maintenance
ZAC031-V006	Fisher	GX	Replacing the packing and gaskets	24 Months	Planned maintenance
3.4 Gas pressure reduction system					
3.4.1 Gas cooler	Manufacturer	Type	Task	Interval	Type of job
ZAB901-10-ACE-000-001	Alfa Laval Olmi Spa	Olmi	Checking the air cooled heat exchanger	3 Months	Check job
ZAB901-10-ACE-000-001	Alfa Laval Olmi Spa	Olmi	Lubricating the bearings	6 Months	Lubrication
ZAB901-10-ACE-000-001	Alfa Laval Olmi Spa	Olmi	Cleaning the air cooled heat exchanger	24 Months	Wash/Clean

ZAB901-10-ACE-000-001	Alfa Laval Olmi Spa	Olmi	Replacing the fan shaft bearings	144 Months	Planned maintenance
3.5 Gas shut-off and vent valves (Starline)					
3.5.1 Shut-off and vent valve 236SGS-G/BW	Manufacturer	Type	Task	Interval	Type of job
ZAA900-V004	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB010-V005	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB010-V006	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB020-V005	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB020-V006	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB030-V005	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB030-V006	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB900-V021	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB900-V022	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB900-V023	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB900-V025	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
ZAA900-V004	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB010-V005	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB010-V006	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB020-V005	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB020-V006	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB030-V005	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB030-V006	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB900-V021	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB900-V022	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB900-V023	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB900-V025	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
3.5.2 Vent valve 216SGS-G/BW	Manufacturer	Type	Task	Interval	Type of job
ZEB010-V007	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB020-V007	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB030-V007	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB010-V007	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB020-V007	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB030-V007	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
3.5.3 Shut-off valve 176SGS-G	Manufacturer	Type	Task	Interval	Type of job
ZAA900-V040	Starline	Split Star	Maintaining the ball valve	24 Months	Planned maintenance
ZEB900-V001	Starline	Split Star	Maintaining the ball valve	24 Months	Planned maintenance
ZAA900-V040	Starline	Split Star	Overhauling the ball valve	60 Months	Planned maintenance
ZEB900-V001	Starline	Split Star	Overhauling the ball valve	60 Months	Planned maintenance
4 Lubricating oil system					
4.2 Lubricating oil unloading pump unit					
4.2.1 Unloading pump	Manufacturer	Type	Task	Interval	Type of job
QAA901-D001	IMO	ACE 038N3 NVBP	Inspecting and lubricating the pump	6 Months	Inspection
QAA901-D001	IMO	ACE 038N3 NVBP	Overhauling the screw pump	36 Months	Overhaul
4.2.2 Unloading pump motor	Manufacturer	Type	Task	Interval	Type of job
QAA901-M001	Brook Crompton	WP-DA184TD-S 2P	Inspecting the motor	3 Months	Inspection
QAA901-M001	Brook Crompton	WP-DA184TD-S 2P	Maintaining the motor	24 Months	Planned maintenance
4.3 Lubricating oil transfer pump unit					
4.3.1 Transfer pump	Manufacturer	Type	Task	Interval	Type of job
QAE901-D001	IMO	ACE 038N3 NVBP	Inspecting and lubricating the pump	6 Months	Inspection
QAE901-D002	IMO	ACE 038N3 NVBP	Inspecting and lubricating the pump	6 Months	Inspection
QAE901-D001	IMO	ACE 038N3 NVBP	Overhauling the screw pump	36 Months	Overhaul
QAE901-D002	IMO	ACE 038N3 NVBP	Overhauling the screw pump	36 Months	Overhaul
4.3.2 Transfer pump motor	Manufacturer	Type	Task	Interval	Type of job
QAE901-M001	Brook Crompton	WP-DA184TD-S 2P	Inspecting the motor	3 Months	Inspection
QAE901-M002	Brook Crompton	WP-DA184TD-S 2P	Inspecting the motor	3 Months	Inspection
QAE901-M001	Brook Crompton	WP-DA184TD-S 2P	Maintaining the motor	24 Months	Planned maintenance
QAE901-M002	Brook Crompton	WP-DA184TD-S 2P	Maintaining the motor	24 Months	Planned maintenance
4.3.3 Flow meter	Manufacturer	Type	Task	Interval	Type of job
QAE901-F001	Aquametro	VZO 50 FL 130/25	Replacing the flow meter filter	4 Months	Replacement
QAE901-F001	Aquametro	VZO 50 FL 130/25	Maintaining the flow meter	12 Months	Check job
4.4 Oil mist separator unit					
4.4.2 Variable frequency drive	Manufacturer	Type	Task	Interval	Type of job
QBF011-B001	Vacon	0100-3L-0008-4X+A1133	Maintaining the VFD	6 Months	Planned maintenance
QBF021-B001	Vacon	0100-3L-0008-4X+A1133	Maintaining the VFD	6 Months	Planned maintenance
QBF031-B001	Vacon	0100-3L-0008-4X+A1133	Maintaining the VFD	6 Months	Planned maintenance



QBF011-B001	Vacon	0100-3L-0008-4X+A1133	Replacing the VFD main fan	72 Months	Planned maintenance
QBF021-B001	Vacon	0100-3L-0008-4X+A1133	Replacing the VFD main fan	72 Months	Planned maintenance
QBF031-B001	Vacon	0100-3L-0008-4X+A1133	Replacing the VFD main fan	72 Months	Planned maintenance
QBF011-B001	Vacon	0100-3L-0008-4X+A1133	Replacing the VFD real time clock battery	120 Months	Planned maintenance
QBF021-B001	Vacon	0100-3L-0008-4X+A1133	Replacing the VFD real time clock battery	120 Months	Planned maintenance
QBF031-B001	Vacon	0100-3L-0008-4X+A1133	Replacing the VFD real time clock battery	120 Months	Planned maintenance
4.5 Lubricating oil transfer pump (mobile)					
4.5.1 Transfer pump	Manufacturer	Type	Task	Interval	Type of job
QLC901-D001	IMO	ACE 038N3 NVBP	Inspecting and lubricating the pump	6 Months	Inspection
QLC901-D001	IMO	ACE 038N3 NVBP	Overhauling the screw pump	36 Months	Overhaul
4.5.2 Transfer pump motor	Manufacturer	Type	Task	Interval	Type of job
QLC901-M001	Brook Crompton	WP-DA184TD-S 2P	Inspecting the motor	3 Months	Inspection
QLC901-M001	Brook Crompton	WP-DA184TD-S 2P	Maintaining the motor	24 Months	Planned maintenance
4.6 Lubricating oil tanks					
4.6.1 Tanks	Manufacturer	Type	Task	Interval	Type of job
QAC901	Wartsila	20m3	Draining water from the oil tank	1 Months	Planned maintenance
QAM901	Wartsila	20m3	Draining water from the oil tank	1 Months	Planned maintenance
QAC901	Wartsila	20m3	Inspecting tanks and surroundings	6 Months	Inspection
QAM901	Wartsila	20m3	Inspecting tanks and surroundings	6 Months	Inspection
QAC901	Wartsila	20m3	Maintaining tank concrete foundations	12 Months	Inspection
QAM901	Wartsila	20m3	Maintaining tank concrete foundations	12 Months	Inspection
QAC901	Wartsila	20m3	Inspecting tanks (five year in-service)	60 Months	Inspection
QAM901	Wartsila	20m3	Inspecting tanks (five year in-service)	60 Months	Inspection
QAC901	Wartsila	20m3	10 year out-of service inspection	120 Months	Inspection
QAM901	Wartsila	20m3	10 year out-of service inspection	120 Months	Inspection
4.6.2 Level switch	Manufacturer	Type	Task	Interval	Type of job
QAC901-L001	Besta	B15 4" A4/D1"	Maintaining the level switch	12 Months	Inspection
QAM901-L001	Besta	B15 4" A4/D1"	Maintaining the level switch	12 Months	Inspection
4.7 Shut-off valves (Starline)					
4.7.1 Shut-off valve 116SGS	Manufacturer	Type	Task	Interval	Type of job
QAA900-V001	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
QAA900-V002	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
QAA900-V003	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
QAE900-V001	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
QAE900-V002	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
QAF900-V003	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
QAM900-V001	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
QAM900-V003	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
QAA900-V001	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
QAA900-V002	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
QAA900-V003	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
QAE900-V001	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
QAE900-V002	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
QAF900-V003	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
QAM900-V001	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
QAM900-V003	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
4.7.2 Shut-off valve 235SGS	Manufacturer	Type	Task	Interval	Type of job
QAB900-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
QAB900-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
4.7.3 Shut-off valve 236SGS	Manufacturer	Type	Task	Interval	Type of job
QAC900-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
QAC900-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
QAE010-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
QAE020-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
QAE030-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
QAM900-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
QAM900-V004	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
QAC900-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
QAC900-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
QAE010-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
QAE020-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
QAE030-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
QAM900-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
QAM900-V004	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
5 Compressed air system					
5.2 Instrument air unit					

5.2.2 Dryer	Manufacturer	Type	Task	Interval	Type of job
TCA901-D002	Atlas Copco	FD120	Cleaning the manual drain	1 Months	Wash/Clean
TCA901-D002	Atlas Copco	FD120	Maintaining the dryer	3 Months	Planned maintenance
TCA901-D002	Atlas Copco	FD120	Checking the filters and separator (optional equipment)	6 Months	Check job
TCA901-D002	Atlas Copco	FD120	Replacing the oil/condensate OSD separator (optional equipment)	12 Months	Planned maintenance
TCA901-D002	Atlas Copco	FD120	Replacing the DD and PD filters (optional filters)	12 Months	Planned maintenance
TCA901-D002	Atlas Copco	FD120	Replacing the electronic water drain wearing parts	12 Months	Planned maintenance
5.4 Shut-off valves (Starline)	Manufacturer	Type	Task	Interval	Type of job
5.4.1 Shut-off valve 216SGS	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
TSB900-V002	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
5.4.2 Shut-off valve 236SGS	Manufacturer	Type	Task	Interval	Type of job
TCC010-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC020-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC030-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC900-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC900-V017	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC900-V019	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC900-V026	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC900-V027	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC900-V028	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC900-V029	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC900-V030	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC900-V031	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TSA900-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TSA900-V003	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
TCC010-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC020-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC030-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC900-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC900-V017	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC900-V019	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC900-V026	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC900-V027	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC900-V028	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC900-V029	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC900-V030	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TCC900-V031	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TSA900-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
TSA900-V003	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
6 Cooling water system	Manufacturer	Type	Task	Interval	Type of job
6.2 Maintenance water tank	Ebara	CDXH/I 120/206 + TEFC	Maintaining the Water pump	24 Months	Planned maintenance
6.2.0 Centrifugal Pump	Manufacturer	Type	Task	Interval	Type of job
VBA901-D001	Ebara	CDXH/I 120/206 + TEFC	Maintaining the Water pump	24 Months	Planned maintenance
6.2.1 Pump motor	Manufacturer	Type	Task	Interval	Type of job
VBA901-M001	Brook Crompton	WP-DA184TD-S2 B35	Inspecting the motor	3 Months	Inspection
VBA901-M001	Brook Crompton	WP-DA184TD-S2 B35	Maintaining the motor	24 Months	Planned maintenance
6.3 Radiators	Manufacturer	Type	Task	Interval	Type of job
6.3.1 Radiator	Alfa Laval	FBLGS-1155-12-7B8-144DN80S8-Cu3	Maintaining the radiator	1 Months	Planned maintenance
VCA011	Alfa Laval	FBLGS-1155-12-7B8-144DN80S8-Cu3	Maintaining the radiator	1 Months	Planned maintenance
VCA012	Alfa Laval	FBLGS-1155-12-7B8-144DN80S8-Cu3	Maintaining the radiator	1 Months	Planned maintenance
VCA021	Alfa Laval	FBLGS-1155-12-7B8-144DN80S8-Cu3	Maintaining the radiator	1 Months	Planned maintenance
VCA022	Alfa Laval	FBLGS-1155-12-7B8-144DN80S8-Cu3	Maintaining the radiator	1 Months	Planned maintenance
VCA031	Alfa Laval	FBLGS-1155-12-7B8-144DN80S8-Cu3	Maintaining the radiator	1 Months	Planned maintenance
VCA032	Alfa Laval	FBLGS-1155-12-7B8-144DN80S8-Cu3	Maintaining the radiator	1 Months	Planned maintenance
6.3.2 Frequency converter	Manufacturer	Type	Task	Interval	Type of job
VCA011-F001	Vacon	R\$ 100.00	Checking the frequency converter	12 Months	Inspection
VCA012-F001	Vacon	R\$ 100.00	Checking the frequency converter	12 Months	Inspection
VCA021-F001	Vacon	R\$ 100.00	Checking the frequency converter	12 Months	Inspection
VCA022-F001	Vacon	R\$ 100.00	Checking the frequency converter	12 Months	Inspection
VCA031-F001	Vacon	R\$ 100.00	Checking the frequency converter	12 Months	Inspection
VCA032-F001	Vacon	R\$ 100.00	Checking the frequency converter	12 Months	Inspection
VCA011-F001	Vacon	R\$ 100.00	Replacing the cooling fan	72 Months	Replacement
VCA012-F001	Vacon	R\$ 100.00	Replacing the cooling fan	72 Months	Replacement
VCA021-F001	Vacon	R\$ 100.00	Replacing the cooling fan	72 Months	Replacement
VCA022-F001	Vacon	R\$ 100.00	Replacing the cooling fan	72 Months	Replacement
VCA031-F001	Vacon	R\$ 100.00	Replacing the cooling fan	72 Months	Replacement
VCA032-F001	Vacon	R\$ 100.00	Replacing the cooling fan	72 Months	Replacement
6.4 Electric preheating unit	Manufacturer	Type	Task	Interval	Type of job
6.4.1 Electric heater	Loval	R\$ 78 467.00	Inspecting the immersion heater	12 Months	Inspection
VDA011-B001	Loval	R\$ 78 467.00	Inspecting the immersion heater	12 Months	Inspection

VDA031-B001	Loval	R\$ 78 467.00	Inspecting the immersion heater	12 Months	Inspection
6.4.2 Circulation pump	Manufacturer	Type	Task	Interval	Type of job
VDA011-D001	Ebara	CDU 120/315 T3H + TEFC	Inspecting the pump	12 Months	Inspection
VDA021-D001	Ebara	CDU 120/315 T3H + TEFC	Inspecting the pump	12 Months	Inspection
VDA031-D001	Ebara	CDU 120/315 T3H + TEFC	Inspecting the pump	12 Months	Inspection
6.4.3 Pressure relief valve	Manufacturer	Type	Task	Interval	Type of job
VDA011-V004	Götze	618tGFO	Testing the safety valve	12 Months	Test
VDA021-V004	Götze	618tGFO	Testing the safety valve	12 Months	Test
VDA031-V004	Götze	618tGFO	Testing the safety valve	12 Months	Test
6.4.4 Automatic air venting valve	Manufacturer	Type	Task	Interval	Type of job
VDA011-V005	Spirotech	AB050	Replacing the automatic air vent valve	24 Months	Replacement
VDA021-V005	Spirotech	AB050	Replacing the automatic air vent valve	24 Months	Replacement
VDA031-V005	Spirotech	AB050	Replacing the automatic air vent valve	24 Months	Replacement
6.5 Shut-off valves (Starline)					
6.5.1 Shut-off valve 235SGS/INI	Manufacturer	Type	Task	Interval	Type of job
VBA010-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
VBA010-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
VBA020-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
VBA020-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
VBA030-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
VBA030-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
VBA900-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
VBA010-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
VBA010-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
VBA020-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
VBA020-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
VBA030-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
VBA030-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
VBA900-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
6.5.2 Shut-off valve 215SGSG/BW	Manufacturer	Type	Task	Interval	Type of job
VEA900-V001	Starline	Super Star	Maintaining the ball valve	24 Months	Planned maintenance
VEA900-V001	Starline	Super Star	Overhauling the ball valve	60 Months	Planned maintenance
7 Charge air and exhaust gas system					
7.3 Charge air filter					
7.3.1 Oil bath filter	Manufacturer	Type	Task	Interval	Type of job
NGA010-B001	AAF	MultiDuty Size 8-110 + M5 H4W4	Removing sludge from the filter	1 Months	Planned maintenance
NGA020-B001	AAF	MultiDuty Size 8-110 + M5 H4W4	Removing sludge from the filter	1 Months	Planned maintenance
NGA030-B001	AAF	MultiDuty Size 8-110 + M5 H4W4	Removing sludge from the filter	1 Months	Planned maintenance
NGA010-B001	AAF	MultiDuty Size 8-110 + M5 H4W4	Inspecting the MultiDuty filter	6 Months	Inspection
NGA020-B001	AAF	MultiDuty Size 8-110 + M5 H4W4	Inspecting the MultiDuty filter	6 Months	Inspection
NGA030-B001	AAF	MultiDuty Size 8-110 + M5 H4W4	Inspecting the MultiDuty filter	6 Months	Inspection
NGA010-B001	AAF	MultiDuty Size 8-110 + M5 H4W4	Replacing the Viscosine	12 Months	Planned maintenance
NGA020-B001	AAF	MultiDuty Size 8-110 + M5 H4W4	Replacing the Viscosine	12 Months	Planned maintenance
NGA030-B001	AAF	MultiDuty Size 8-110 + M5 H4W4	Replacing the Viscosine	12 Months	Planned maintenance
7.3.2 Fine filter	Manufacturer	Type	Task	Interval	Type of job
NGA010	AAF	Chevronet	Cleaning or replacing the fine filter	12 Months	Wash/Clean
NGA020	AAF	Chevronet	Cleaning or replacing the fine filter	12 Months	Wash/Clean
NGA030	AAF	Chevronet	Cleaning or replacing the fine filter	12 Months	Wash/Clean
7.4 Oil shut-off valves for filters					
7.4.1 Oil shut-off valve	Manufacturer	Type	Task	Interval	Type of job
NGD010-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD010-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD020-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD020-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD030-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD030-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD900-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD900-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD900-V003	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD900-V004	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
NGD010-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
NGD010-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
NGD020-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
NGD020-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
NGD030-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
NGD030-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
NGD900-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
NGD900-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
NGD900-V003	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
NGD900-V004	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
7.5 Dew point control for charge air cooler					
7.5.1 Dew point control	Manufacturer	Type	Task	Interval	Type of job

NGA	Vaisala	HMT337	Checking the dew point control	3 Months	Check job
NGA	Vaisala	HMT337	Calibrating the ambient air humidity sensor	12 Months	Planned maintenance
7.6 Charge air silencer					
7.6.1 Charge air silencer	Manufacturer	Type	Task	Interval	Type of job
NGB010-B001	JTK-Power	SCAS NS 600 / 35 dB(A)	Inspecting the charge air silencer	3 Months	Inspection
NGB020-B001	JTK-Power	SCAS NS 600 / 35 dB(A)	Inspecting the charge air silencer	3 Months	Inspection
NGB030-B001	JTK-Power	SCAS NS 600 / 35 dB(A)	Inspecting the charge air silencer	3 Months	Inspection
NGB010-B002	JTK-Power	SCAS NS 600 / 35 dB(A)	Inspecting the charge air silencer	3 Months	Inspection
NGB020-B002	JTK-Power	SCAS NS 600 / 35 dB(A)	Inspecting the charge air silencer	3 Months	Inspection
NGB030-B002	JTK-Power	SCAS NS 600 / 35 dB(A)	Inspecting the charge air silencer	3 Months	Inspection
NGB010-B001	JTK-Power	SCAS NS 600 / 35 dB(A)	Maintaining the charge air silencer	12 Months	Planned maintenance
NGB020-B001	JTK-Power	SCAS NS 600 / 35 dB(A)	Maintaining the charge air silencer	12 Months	Planned maintenance
NGB030-B001	JTK-Power	SCAS NS 600 / 35 dB(A)	Maintaining the charge air silencer	12 Months	Planned maintenance
NGB010-B002	JTK-Power	SCAS NS 600 / 35 dB(A)	Maintaining the charge air silencer	12 Months	Planned maintenance
NGB020-B002	JTK-Power	SCAS NS 600 / 35 dB(A)	Maintaining the charge air silencer	12 Months	Planned maintenance
NGB030-B002	JTK-Power	SCAS NS 600 / 35 dB(A)	Maintaining the charge air silencer	12 Months	Planned maintenance
7.7 Exhaust gas system					
7.7.1 Rupture disc	Manufacturer	Type	Task	Interval	Type of job
NHA010-B004	FIKE	CV-S-I-LW DN 1200	Inspecting the explosion vent	12 Months	Inspection
NHA010-B005	FIKE	CV-S-I-LW DN 1200	Inspecting the explosion vent	12 Months	Inspection
NHA020-B004	FIKE	CV-S-I-LW DN 1200	Inspecting the explosion vent	12 Months	Inspection
NHA020-B005	FIKE	CV-S-I-LW DN 1200	Inspecting the explosion vent	12 Months	Inspection
NHA030-B004	FIKE	CV-S-I-LW DN 1200	Inspecting the explosion vent	12 Months	Inspection
NHA030-B005	FIKE	CV-S-I-LW DN 1200	Inspecting the explosion vent	12 Months	Inspection
8 Emission control system					
8.1 Continuous emission measurement system					
8.1.1 NO/NO2/NOX analyzer	Manufacturer	Type	Task	Interval	Type of job
YMB011	Teledyne	T200	Maintaining the analyzer	1 Weeks	Planned maintenance
YMB021	Teledyne	T200	Maintaining the analyzer	1 Weeks	Planned maintenance
YMB031	Teledyne	T200	Maintaining the analyzer	1 Weeks	Planned maintenance
YMB011	Teledyne	T200	Maintaining the analyzer	3 Months	Planned maintenance
YMB021	Teledyne	T200	Maintaining the analyzer	3 Months	Planned maintenance
YMB031	Teledyne	T200	Maintaining the analyzer	3 Months	Planned maintenance
YMB011	Teledyne	T200	Maintaining the analyzer	12 Months	Maintenance
YMB021	Teledyne	T200	Maintaining the analyzer	12 Months	Maintenance
YMB031	Teledyne	T200	Maintaining the analyzer	12 Months	Maintenance
YMB011	Teledyne	T200	Rebuilding the pump head	12 Months	Maintenance
YMB021	Teledyne	T200	Rebuilding the pump head	12 Months	Maintenance
YMB031	Teledyne	T200	Rebuilding the pump head	12 Months	Maintenance
YMB011	Teledyne	T200	Maintaining the analyzer	12 Months	Planned maintenance
YMB021	Teledyne	T200	Maintaining the analyzer	12 Months	Planned maintenance
YMB031	Teledyne	T200	Maintaining the analyzer	12 Months	Planned maintenance
YMB011	Teledyne	T200	Replacing the NO2 converter	36 Months	Planned maintenance
YMB021	Teledyne	T200	Replacing the NO2 converter	36 Months	Planned maintenance
YMB031	Teledyne	T200	Replacing the NO2 converter	36 Months	Planned maintenance
8.1.2 Carbon monoxide analyzer	Manufacturer	Type	Task	Interval	Type of job
YMB011	Teledyne	T300	Maintaining the carbon monoxide analyzer	1 Weeks	Planned maintenance
YMB021	Teledyne	T300	Maintaining the carbon monoxide analyzer	1 Weeks	Planned maintenance
YMB031	Teledyne	T300	Maintaining the carbon monoxide analyzer	1 Weeks	Planned maintenance
YMB011	Teledyne	T300	Inspecting and cleaning the carbon monoxide analyzer	12 Months	Maintenance
YMB021	Teledyne	T300	Inspecting and cleaning the carbon monoxide analyzer	12 Months	Maintenance
YMB031	Teledyne	T300	Inspecting and cleaning the carbon monoxide analyzer	12 Months	Maintenance
YMB011	Teledyne	T300	Maintaining the carbon monoxide analyzer	12 Months	Planned maintenance
YMB021	Teledyne	T300	Maintaining the carbon monoxide analyzer	12 Months	Planned maintenance
YMB031	Teledyne	T300	Maintaining the carbon monoxide analyzer	12 Months	Planned maintenance
8.2 Vocidizer					
8.2.1 Vocidizer	Manufacturer	Type	Task	Interval	Type of job
	Babcock & Wilcox MEG	Electric heated 3015	Checking the VOCISIDIZER system	1 Weeks	Check job
	Babcock & Wilcox MEG	Electric heated 3015	Maintaining the VOCISIDIZER system	12 Months	Planned maintenance
	Babcock & Wilcox MEG	Electric heated 3015	Lubricating the fan bearings	4 Months	Lubrication
	Babcock & Wilcox MEG	Electric heated 3015	Replacing the motor bearings	36 Months	Planned maintenance
9 Oily water system					
9.2 Oily water/sludge transfer pump unit					
9.2.1 Transfer pump	Manufacturer	Type	Task	Interval	Type of job
DAD901-D001	Depa	DH40-FA-NNN + A1MF4030/10	Maintaining the sludge pump	1 Months	Planned maintenance
DAD903-D001	Depa	DH40-FA-NNN + A1MF4030/10	Maintaining the sludge pump	1 Months	Planned maintenance
DDD901-D001	Depa	DH40-FA-NNN + A1MF4030/10	Maintaining the sludge pump	1 Months	Planned maintenance
9.3 Sludge tank					
9.3.1 Tank	Manufacturer	Type	Task	Interval	Type of job
DDB901	Wartsila	20m3	Draining water from the oil tank	1 Months	Planned maintenance
DDB901	Wartsila	20m3	Inspecting tanks and surroundings	6 Months	Inspection
DDB901	Wartsila	20m3	Maintaining tank concrete foundations	12 Months	Inspection

DDB901	Wartsila	20m3	Inspecting tanks (five year in-service)	60 Months	Inspection
DDB901	Wartsila	20m3	10 year out-of service inspection	120 Months	Inspection
9.3.2 Level switch	Manufacturer	Type	Task	Interval	Type of job
DDB901-L001	Besta	B15 4" A4/D1"	Maintaining the level switch	12 Months	Inspection
9.4 Shut-off valves (Starline)					
9.4.1 Shut-off valve 235SGS/INI	Manufacturer	Type	Task	Interval	Type of job
DAA900-V006	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
DAA900-V007	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
DAD900-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
DDD900-V001	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
DDD900-V002	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
DAA900-V006	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
DAA900-V007	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
DAD900-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
DDD900-V001	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
DDD900-V002	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
9.4.2 Shut-off valve 216SGSG/BW	Manufacturer	Type	Task	Interval	Type of job
DAD900-V007	Starline	Master Star	Maintaining the ball valve	24 Months	Planned maintenance
DAD900-V007	Starline	Master Star	Overhauling the ball valve	60 Months	Planned maintenance
10 Combined system modules					
10.2 Cube auxiliary module					
10.2.1 Instrument air filter	Manufacturer	Type	Task	Interval	Type of job
MOD011-B001	Zander	G5 XP4-D	Checking the condensate trap	1 Weeks	Check job
MOD021-B001	Zander	G5 XP4-D	Checking the condensate trap	1 Weeks	Check job
MOD031-B001	Zander	G5 XP4-D	Checking the condensate trap	1 Weeks	Check job
MOD011-B001	Zander	G5 XP4-D	Replacing the filter element	12 Months	Planned maintenance
MOD021-B001	Zander	G5 XP4-D	Replacing the filter element	12 Months	Planned maintenance
MOD031-B001	Zander	G5 XP4-D	Replacing the filter element	12 Months	Planned maintenance
10.2.2 Water temperature control Valve	Manufacturer	Type	Task	Interval	Type of job
MOD011-V001	Ari Armaturen	FIG 22.450 + DP34 + EPS 16.2	Maintaining the 3-way control valve	12 Months	Planned maintenance
MOD011-V002	Ari Armaturen	FIG 22.450 + DP34 + EPS 16.2	Maintaining the 3-way control valve	12 Months	Planned maintenance
MOD021-V001	Ari Armaturen	FIG 22.450 + DP34 + EPS 16.2	Maintaining the 3-way control valve	12 Months	Planned maintenance
MOD021-V002	Ari Armaturen	FIG 22.450 + DP34 + EPS 16.2	Maintaining the 3-way control valve	12 Months	Planned maintenance
MOD031-V001	Ari Armaturen	FIG 22.450 + DP34 + EPS 16.2	Maintaining the 3-way control valve	12 Months	Planned maintenance
MOD031-V002	Ari Armaturen	FIG 22.450 + DP34 + EPS 16.2	Maintaining the 3-way control valve	12 Months	Planned maintenance
10.2.3 Starting air valve	Manufacturer	Type	Task	Interval	Type of job
MOD011-V022	Starline	Standard	Maintaining the ball valve	24 Months	Planned maintenance
MOD021-V022	Starline	Standard	Maintaining the ball valve	24 Months	Planned maintenance
MOD031-V022	Starline	Standard	Maintaining the ball valve	24 Months	Planned maintenance
MOD011-V022	Starline	Standard	Overhauling the ball valve	60 Months	Planned maintenance
MOD021-V022	Starline	Standard	Overhauling the ball valve	60 Months	Planned maintenance
MOD031-V022	Starline	Standard	Overhauling the ball valve	60 Months	Planned maintenance
11 Fire protection system					
11.1 Fire protection system general instructions					
11.1.1 Standpipe and hose system	Manufacturer	Type	Task	Interval	Type of job
NFPA			Inspecting the control valves	1 Weeks	Inspection
NFPA			Inspecting the gauges	1 Months	Inspection
NFPA			Inspecting the standpipe and hose system	12 Months	Planned maintenance
NFPA			Conducting a main drain test	12 Months	Test
NFPA			Testing the mechanical waterflow devices	3 Months	Test
NFPA			Testing the vane and pressure switch waterflow devices	6 Months	Test
NFPA			Testing the standpipe and hose system	60 Months	Test
11.1.2 Engine hall sprinkler system	Manufacturer	Type	Task	Interval	Type of job
NFPA			Inspecting the valves	1 Weeks	Inspection
NFPA			Inspecting the control valves	1 Weeks	Inspection
NFPA			Inspecting the gauges	1 Weeks	Inspection
NFPA			Inspecting the wet pipe gauges	1 Months	Inspection
NFPA			Inspecting the sprinkler system	3 Months	Inspection
NFPA			Inspecting the sprinkler system	12 Months	Inspection
NFPA			Testing the sprinkler system	3 Months	Test
NFPA			Testing the sprinkler system	6 Months	Test
NFPA			Inspecting the piping internally	60 Months	Inspection
NFPA			Conducting a main drain test	12 Months	Test
NFPA			Maintaining the sprinkler system	12 Months	Planned maintenance
NFPA			Maintaining the sprinkler system	60 Months	Planned maintenance
NFPA			Replacing or testing the dry sprinklers	120 Months	Planned maintenance
NFPA			Replacing or testing the fast response sprinklers	240 Months	Replacement
NFPA			Replacing or testing the sprinklers	600 Months	Replacement
NFPA			Replacing or testing the sprinklers	864 Months	Replacement
11.1.3 Private fire system	Manufacturer	Type	Task	Interval	Type of job
NFPA			Inspecting the hose houses	3 Months	Check job
NFPA			Inspecting the monitor nozzles	6 Months	Planned maintenance

NFPA			Inspecting the hydrants and piping	12 Months	Planned maintenance
NFPA			Testing the monitors and hydrants GUID	12 Months	Test
NFPA			Testing the private fire service piping	60 Months	Test
NFPA			Maintaining the hydrants and monitor nozzles	12 Months	Planned maintenance
12 Electrical systems					
12.2 LV switchgear					
12.2.1 Switchgear	Manufacturer	Type	Task	Interval	Type of job
BFA011	Arnon	OVO Ultra	Maintaining the switchboard	12 Months	Planned maintenance
BFA021	Arnon	OVO Ultra	Maintaining the switchboard	12 Months	Planned maintenance
BFA031	Arnon	OVO Ultra	Maintaining the switchboard	12 Months	Planned maintenance
BFA901	Arnon	OVO Ultra	Maintaining the switchboard	12 Months	Planned maintenance
BFA902	Arnon	OVO Ultra	Maintaining the switchboard	12 Months	Planned maintenance
BFA903	Arnon	OVO Ultra	Maintaining the switchboard	12 Months	Planned maintenance
BFA011	Arnon	OVO Ultra	Checking the switchboard equipment	24 Months	Check job
BFA021	Arnon	OVO Ultra	Checking the switchboard equipment	24 Months	Check job
BFA031	Arnon	OVO Ultra	Checking the switchboard equipment	24 Months	Check job
BFA901	Arnon	OVO Ultra	Checking the switchboard equipment	24 Months	Check job
BFA902	Arnon	OVO Ultra	Checking the switchboard equipment	24 Months	Check job
BFA903	Arnon	OVO Ultra	Checking the switchboard equipment	24 Months	Check job
12.3 System grounding					
12.3.1 Neutral grounding resistor	Manufacturer	Type	Task	Interval	Type of job
Neutral grounding resistor	Powerohm Resistor	Neutral grounding resistor	Inspecting the neutral grounding resistor	12 Months	Inspection
12.4 Station transformer					
12.4.1 Transformer	Manufacturer	Type	Task	Interval	Type of job
BFB901	ABB	Secondary unit substation transformer	Inspecting the transformer	12 Months	Inspection
12.5 DC system					
12.5.1 Battery charger	Manufacturer	Type	Task	Interval	Type of job
	Benning	Hdi 125VDC and 24VDC	Maintaining the battery charger	12 Months	Maintenance
12.6 Gas detection					
12.6.1 Gas detector	Manufacturer	Type	Task	Interval	Type of job
	Crowcon	Xgard IR	Maintaining the Xgard IR detector	6 Months	Planned maintenance
13 Civil systems					
13.1 Cranes and hoists					
13.1.1 Overhead crane and hoist	Manufacturer	Type	Task	Interval	Type of job
	Konecranes	CXT/QQSM	Maintaining the overhead crane and hoist	12 Months	Planned maintenance
	Konecranes	CXT/QQSM	Maintaining the overhead crane and hoist	48 Months	Planned maintenance
13.1.2 Light crane	Manufacturer	Type	Task	Interval	Type of job
	Konecranes	UKA	Maintaining the crane	12 Months	Planned maintenance
13.1.3 Trolley and hoist	Manufacturer	Type	Task	Interval	Type of job
	Konecranes	KMII	Inspecting the chain block	1 Months	Inspection
	Konecranes	KMII	Inspecting the chain block	12 Months	Inspection
13.1.4 Bridge crane	Manufacturer	Type	Task	Interval	Type of job
	Konecranes	XMSL/XMSA K16409	Inspecting the bridge crane	12 Months	Inspection
13.1.5 Crane	Manufacturer	Type	Task	Interval	Type of job
	Konecranes	PS-suspension	Inspecting the crane	12 Months	Inspection
13.2 Engine hall inlet ventilation unit (generator side)					
13.2.1 Ventilation unit	Manufacturer	Type	Task	Interval	Type of job
EAA011	Miraco	18m3/s	Maintaining the ventilation unit	12 Months	Planned maintenance
EAA021	Miraco	18m3/s	Maintaining the ventilation unit	12 Months	Planned maintenance
EAA031	Miraco	18m3/s	Maintaining the ventilation unit	12 Months	Planned maintenance
13.2.2 Fan	Manufacturer	Type	Task	Interval	Type of job
EAA011	Siemens	100 ID1 268T 25.9A 460V 60Hz 1180rpm	Inspecting the fan	12 Months	Check job
EAA021	Siemens	100 ID1 268T 25.9A 460V 60Hz 1180rpm	Inspecting the fan	12 Months	Check job
EAA031	Siemens	100 ID1 268T 25.9A 460V 60Hz 1180rpm	Inspecting the fan	12 Months	Check job
EAA011	Siemens	100 ID1 268T 25.9A 460V 60Hz 1180rpm	Maintaining the fan motor bearings	12 Months	Planned maintenance
EAA021	Siemens	100 ID1 268T 25.9A 460V 60Hz 1180rpm	Maintaining the fan motor bearings	12 Months	Planned maintenance
EAA031	Siemens	100 ID1 268T 25.9A 460V 60Hz 1180rpm	Maintaining the fan motor bearings	12 Months	Planned maintenance
13.2.3 Frequency converter	Manufacturer	Type	Task	Interval	Type of job
EAA011-F001	Vacon	R\$ 100.00	Maintaining the VFD	6 Months	Planned maintenance
EAA021-F001	Vacon	R\$ 100.00	Maintaining the VFD	6 Months	Planned maintenance
EAA031-F001	Vacon	R\$ 100.00	Maintaining the VFD	6 Months	Planned maintenance
EAA011-F001	Vacon	R\$ 100.00	Replacing the VFD main fan	72 Months	Planned maintenance
EAA021-F001	Vacon	R\$ 100.00	Replacing the VFD main fan	72 Months	Planned maintenance
EAA031-F001	Vacon	R\$ 100.00	Replacing the VFD main fan	72 Months	Planned maintenance
EAA011-F001	Vacon	R\$ 100.00	Replacing the VFD real time clock battery	120 Months	Planned maintenance
EAA021-F001	Vacon	R\$ 100.00	Replacing the VFD real time clock battery	120 Months	Planned maintenance
EAA031-F001	Vacon	R\$ 100.00	Replacing the VFD real time clock battery	120 Months	Planned maintenance
13.2.4 Air filters	Manufacturer	Type	Task	Interval	Type of job
EAA011-B002	Camfill	F4 592-592-330-6 G4	Maintaining the air filters	1 Months	Planned maintenance
EAA021-B002	Camfill	F4 592-592-330-6 G4	Maintaining the air filters	1 Months	Planned maintenance
EAA031-B002	Camfill	F4 592-592-330-6 G4	Maintaining the air filters	1 Months	Planned maintenance
13.3 Engine hall inlet ventilation unit (auxiliary side)					



13.3.1 Ventilation unit	Manufacturer	Type	Task	Interval	Type of job
EAA012-V001	Miraco	12m3/s	Maintaining the ventilation unit	12 Months	Planned maintenance
EAA022-V001	Miraco	12m3/s	Maintaining the ventilation unit	12 Months	Planned maintenance
EAA032-V001	Miraco	12m3/s	Maintaining the ventilation unit	12 Months	Planned maintenance
13.3.2 Fan	Manufacturer	Type	Task	Interval	Type of job
EAA012-D001	Siemens	75hp 9.3A 460V 60Hz 1760 rpm	Inspecting the fan	12 Months	Check job
EAA022-D001	Siemens	75hp 9.3A 460V 60Hz 1760 rpm	Inspecting the fan	12 Months	Check job
EAA032-D001	Siemens	75hp 9.3A 460V 60Hz 1760 rpm	Inspecting the fan	12 Months	Check job
EAA012-D001	Siemens	75hp 9.3A 460V 60Hz 1760 rpm	Maintaining the fan motor bearings	12 Months	Planned maintenance
EAA022-D001	Siemens	75hp 9.3A 460V 60Hz 1760 rpm	Maintaining the fan motor bearings	12 Months	Planned maintenance
EAA032-D001	Siemens	75hp 9.3A 460V 60Hz 1760 rpm	Maintaining the fan motor bearings	12 Months	Planned maintenance
13.3.3 Frequency converter	Manufacturer	Type	Task	Interval	Type of job
EAA012-F001	Vacon	R\$ 100.00	Maintaining the VFD	6 Months	Planned maintenance
EAA022-F001	Vacon	R\$ 100.00	Maintaining the VFD	6 Months	Planned maintenance
EAA032-F001	Vacon	R\$ 100.00	Maintaining the VFD	6 Months	Planned maintenance
EAA012-F001	Vacon	R\$ 100.00	Replacing the VFD main fan	72 Months	Planned maintenance
EAA022-F001	Vacon	R\$ 100.00	Replacing the VFD main fan	72 Months	Planned maintenance
EAA032-F001	Vacon	R\$ 100.00	Replacing the VFD main fan	72 Months	Planned maintenance
EAA012-F001	Vacon	R\$ 100.00	Replacing the VFD real time clock battery	120 Months	Planned maintenance
EAA022-F001	Vacon	R\$ 100.00	Replacing the VFD real time clock battery	120 Months	Planned maintenance
EAA032-F001	Vacon	R\$ 100.00	Replacing the VFD real time clock battery	120 Months	Planned maintenance
13.3.4 Air filters	Manufacturer	Type	Task	Interval	Type of job
EAA012-B001	Camfill	XLS4 HCSX G4- 592-592-370-6-25	Maintaining the air filters	1 Months	Planned maintenance
EAA022-B001	Camfill	XLS4 HCSX G4- 592-592-370-6-25	Maintaining the air filters	1 Months	Planned maintenance
EAA032-B001	Camfill	XLS4 HCSX G4- 592-592-370-6-25	Maintaining the air filters	1 Months	Planned maintenance
13.4 Exhaust air duct	Manufacturer	Type	Task	Interval	Type of job
13.4.1 Exhaust air duct	Wartsila		Cleaning the exhaust air ducts	3 Months	Planned maintenance
13.5 Compressor room ventilation	Manufacturer	Type	Task	Interval	Type of job
13.5.1 Fan	Manufacturer	Type	Task	Interval	Type of job
EEB901-D001	Miraco	3.5m3/s	Inspecting the fan	12 Months	Check job
EBB902-D001	Miraco	3.5m3/s	Inspecting the fan	12 Months	Check job
EBB903-D001	Miraco	3.5m3/s	Inspecting the fan	12 Months	Check job
EEB901-D001	Miraco	3.5m3/s	Maintaining the fan motor bearings	12 Months	Planned maintenance
EBB902-D001	Miraco	3.5m3/s	Maintaining the fan motor bearings	12 Months	Planned maintenance
EBB903-D001	Miraco	3.5m3/s	Maintaining the fan motor bearings	12 Months	Planned maintenance

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