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TNG Energy from Waste Facility			

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# 1 Performance Tests and procedures

## 1.1 Introduction

Figure 1 in Schedule 13 provides an overview of all of the phases of testing required under this Contract. Schedule 13 describes the factory testing necessary for the various equipment supplied to the facility. Schedule 14 details the requirements for commissioning equipment and the Plant in order to receive the Construction Completion Certificate. Schedule 15 describes the procedures required to achieve Take Over. This Schedule describes the Reliability Test and Performance Guarantee Tests to be completed successfully in order to achieve the Performance Test Certificate and the Availability Test to be completed in order to achieve the Provisional Acceptance Certificate.

These are:

1. Reliability Test
2. Successful completion of the Performance Tests;
3. A final visual internal inspection of the Contractor's Works;
4. Successful completion of the Availability Test;
5. Acceptance Certificate Issue

For the purposes of these tests the entire Plant can be tested at once, or each half of the plant (two process steams and its corresponding power island) may be tested in term.

## 1.2 Responsibilities

### 1.2.1 Principal's responsibilities

The Principal will provide the operating and maintenance personnel required for normal operation of the Plant as set out in Schedule 3 (Responsibilities of Principal), who shall already have been adequately trained by the Contractor in compliance with Schedule 9 (Training by Contractor) and the Project Management Plan.

The Contractor shall plan and supervise all operational and testing activities in accordance with the Test Protocol and the Approved Programme.

No claim by the Contractor arising from incorrect operation of the Plant shall be allowed, unless there has been a clear failure by the Principal's personnel to carry out reasonable instructions laid down in the Contractor's Commissioning and Test Protocols or to comply with other written instructions from the Contractor.

The Principal will provide, at the Principal's expense, all Consumables after first fill including those used during the Reliability, Performance Guarantee and Availability Tests. Any steam, electricity or output products produced shall be the property of the Principal.

### 1.2.2 Contractor's responsibilities

The Contractor shall:

1. provide adequate personnel for the responsible supervision and attendance during the Reliability and Performance Guarantee Test Period on a 24-hour basis;
2. be responsible for its supervisory and commissioning staff and their expenses. The Contractor shall be responsible for the supervision and operation of the Plant during the Reliability and Performance Guarantee Test Period and any faults due to incorrect operation of the Plant during the Reliability and Performance Guarantee Test Period shall be the Contractor's responsibility;
3. provide all equipment, tools, materials, spare parts, additional labour, etc., for conducting the Reliability and Performance Guarantee Test; and

4. undertake the Reliability, Performance Guarantee and Availability Tests while the Plant is operated by the Principal.

During the Reliability and Performance Guarantee Tests the Contractor shall instruct the Principal's personnel in such a manner that on completion of the Performance Guarantee Tests they shall be familiar with all aspects of operation and maintenance of the Plant.

### 1.3 Reliability Test

The Reliability Test shall take place under the responsible supervision of the Contractor.

The purpose of the Reliability Test is to show that the Plant is capable of sustained operation at its Maximum Continuous Rating (refer 1.4.12), in full compliance with the Contract, and demonstrate the ability of the Plant to operate as a functional whole in a manner which meets all guaranteed capacity, residue, consumables and emissions criteria as defined in the Contract.

During the Reliability Test, the Plant shall at all times be run in compliance with all of the following:

- the Contract;
- the Planning Consent;
- the Environment Protection License; and
- all other applicable Legislation.

The Reliability Test shall continue until the Reliability Test ending criteria have been met, as defined in 1.3.1.

#### 1.3.1 Reliability Test criteria

The Contractor shall carry out the Reliability Test in accordance with the Contract. The Reliability Test shall include the Tests set out within this Schedule as well as those tests which the Contractor considers to be necessary to demonstrate that the Plant is achieving the ending criteria described in the table below. The Reliability Test shall start immediately upon the issue of the Take Over Certificate unless otherwise agreed by the Superintendent. A summary of the Reliability Test is included in the table below:

Starting criteria	The issuing of the Take Over Certificate.
Duration	The Reliability Test shall be carried out over a period of 30 days.
Ending criteria	To successfully complete the Reliability Test, the Contractor shall demonstrate that the Plant is "Available" (where Available is defined in paragraph 1.3.1.1 in this Schedule) for more than xxx hours in the 30-day Reliability Test period.
Result of completion	See Performance Guarantee Tests

##### 1.3.1.1 Conduct of the Test

The operation of the Plant shall be carried out by the Principal's staff and be supervised by the Contractor during the Reliability Test. The Contractor shall be permitted to make any minor adjustments which may be necessary, provided that such adjustments do not in any way interfere with the trial, or result in reducing the output or decreasing the efficiency.

Repair work of a lesser extent (considered to be interruptions causing Plant stoppages or reduced load due to the aforementioned faults and defects amounting to a total of less than 100 hours total equipment or Plant stoppages (per two waste streams and their corresponding power island) during the Reliability Test and no greater than 70 hours for any one stream) as agreed upon by the Superintendent may be carried out during the Reliability Test without affecting its duration. The duration of any stoppage within the allowed cumulative period of stoppages shall be added to the test duration. No failure of common services on which all Plant streams depend shall be allowed during the Reliability Test.

In the event of a fault which requires internal repair of the boiler and grate, the period for cooling down and warming up shall be added to the Reliability Test.

In the case that the Reliability Test is not passed, the Contractor shall complete any necessary repairs and/or modifications, and the test shall be repeated. The Contractor shall be liable for all additional costs incurred by the Principal arising from any such extension to the test period.

For the purposes of the Reliability Test, the Plant shall be considered "Available" if the turbine is operating and either:

- a) the hourly steam flow exceeds 90% of the guaranteed steam flow (as per the Guaranteed Performance Level specified in Schedule 17 (Performance Guarantees and damages for failure)); or
- b) the daily waste throughput exceeds 90% of the guaranteed Maximum Waste Throughput (as per the Guaranteed Performance Level specified in Schedule 17 (Performance Guarantees and damages for failure)).

Should the Reliability Test be considered void due to a Plant failure then the Contractor shall be liable for all additional costs incurred by the Principal and any third parties arising from repeat tests.

Should the Reliability Test be interrupted due to a breach by the Principal of his obligations under the Contract, the Principal shall have the choice of:

- a) accepting that the Reliability Test has been passed; or
- b) continuing the Reliability Test for the Plant until the Reliability Test has been passed up to a maximum period of xx days. In this case, the additional expenditure incurred by the Contractor as a direct consequence of the extended Reliability Test will be paid by the Principal, less the cost that would have been incurred by the Contractor to complete the Reliability Test if the breach had not occurred.

## 1.4 Performance Guarantee Tests

### 1.4.1 General

The purpose of the Performance Guarantee Tests is to demonstrate, under controlled and sustained conditions, that each system and component of the Plant meets the Guaranteed Performance Levels set out in Schedule 17 (Performance Guarantees and damages for failure).

The requirements for the conduct of the Performance Guarantee Tests are specified in this Schedule. The sequence of events for the Performance Guarantee Tests is summarised in the table below:

Starting criteria	After a minimum of 30 days of successful Reliability Test.
Duration	As required to demonstrate all guaranteed parameter, but typically around two weeks
Success criteria	For each Performance Indicator the Contractor shall demonstrate that the Plant is capable of achieving the relevant Guaranteed Performance Level.
Result of success	The issuing of the Performance Test Certificate

The Performance Guarantee Tests shall be undertaken following the period of the Reliability Test. The Performance Guarantee Tests shall be carried out with the Plant in its normal state and under normal operating conditions.

Tests shall include those necessary to demonstrate that an acceptable working environment is provided with respect to:

1. ambient temperatures and ventilation within plant areas;
2. noise levels;
3. control of fugitive emissions;
4. noise criteria (requires the Contractor to make noise surveys before and after plant is operating) including the criteria set down in the Planning Consent;
5. surface temperatures; and
6. health and safety requirements.

The Contractor may at his sole discretion carry out a trial run for each Performance Guarantee Test to confirm the methodology, instrumentation and test procedures prior to the actual Performance Guarantee Test.

The Principal shall engage at his own expense an independent approved sampling and analysis organisation to perform all emissions sampling and tests necessary to demonstrate to the Superintendent and EPA that the Plant is operating in compliance with the environmental criteria defined in the Contract and that the continuous monitoring equipment is correctly calibrated. The QAL2 test is to be undertaken prior to the Performance Guarantee Tests and shall be included by the Contractor. The DCS and CEMS are to be used to take the measurements for the performance testing, using the permanent instruments which must be calibrated. Temporary instruments or sampling may be used if permanent instruments are not available in the required location. Any sampling shall be carried out using an appropriately accredited tester.

The Contractor shall allow the necessary time in his programme for the sampling and analysis of complex organic compounds (including dioxins and furans) and heavy metals and for the preparation and submission by the sampling and analysis organisation of a full report of the results of the sampling and analysis. The Performance Guarantee Tests report prepared by the Contractor, once agreed, shall be signed by the Superintendent and the Contractor.

When the Reliability Test and Performance Guarantee Tests have been passed, the Plant shall be shut down and a visual internal inspection shall be made jointly by the Superintendent and the Contractor.

During the period of the Performance Guarantee Tests the Contractor shall provide an additional DCS terminal for the sole use of the Superintendent for monitoring the Tests.

#### **1.4.2 Methodology of measuring Performance Indicators**

During the Performance Guarantee Tests each of the Performance Indicators listed in Schedule 17 shall be evaluated in the following manner.

1. For Performance Indicators measured continuously (such as emissions limits, steam characteristics (temperatures, flow, pressure), instantaneous power output, etc.), the measurements for each Performance Indicator shall be evaluated over the duration of the Performance Guarantee Tests. Any single result falling outside of the Rejection Level, the Expected Performance Level or the Action Limit shall be treated as a failure of the Performance Indicator.
2. For Performance Indicators measuring the gross power output and parasitic power and for Performance Indicators measured discretely (such as waste throughput, crane capacity, residue production, Consumables consumption, etc.), the method of calculation shall be based on the total amount consumed or produced during the Performance Guarantee Test divided by the number of hours in the corresponding test period. Where the result falls outside of the Expected Performance Level or the Action Limit this shall be treated as a failure of the Performance Indicator.

#### **1.4.3 Timing of Performance Guarantee Tests**

The Performance Guarantee Tests shall not be carried out until the Plant has achieved the starting criteria shown in 1.4.1.

#### **1.4.4 Standards**

The acceptance and performance measurements shall be performed according to relevant Australian, EU or International Standards, as defined in and amended by subsequent sections. If such regulations do not cover certain measurements, the execution of such measurements shall be agreed upon with the Superintendent as part of the Test Protocol including any other provisions which have been made in the Contract.

#### **1.4.5 Data collection and analysis**

Test data shall, as far as reasonably practical, be recorded automatically using the DCS. The DCS shall record and store all raw data, make all necessary adjustments, including those necessary to adjust measured data to reference conditions, and store the adjusted data and derived performance figures. It shall be possible at any time for the Principal to repeat the full set of Performance Guarantee Tests using the DCS alone. All of the raw data collected shall be exported into a Microsoft Excel spreadsheet for

independent analysis. The procedure for logging and transfer of data shall be approved as part of the Test Protocol.

Check calculations shall be made whilst tests are in progress to identify any serious deficiencies as early as possible.

The complete data sets and analysis shall be copied as Excel spreadsheets and given to the Superintendent on a daily basis as a backup copy (preferably uncompressed) on write protected disks or memory sticks. These disks or memory sticks shall be stored safely by the Principal and will be used for security and clarification purposes.

During each test run the manually measured values shall be recorded jointly by the Contractor and the Superintendent.

#### **1.4.6 Data correction to reference conditions**

Where a Performance Indicator to be measured is influenced by variables which may, during test conditions, vary from the reference conditions on the basis of which performance guarantee values have been stated, the measured value of the performance parameter shall be corrected to the reference conditions.

For each such Performance Indicator, the Contractor shall, as part of the agreed Test Protocol, supply a correction formula or graph relating the performance parameter to the relevant variable.

The correction curve or formula shall be used to correct the measured value of the Performance Indicator to the reference conditions. The corrected value of the Performance Indicators shall then be compared with the Guaranteed Performance Levels.

#### **1.4.7 Failure to pass tests**

If the Performance Guarantee Tests have not been passed, the Contractor shall at his own expense undertake such adjustments and modifications as are necessary to correct the performance and then repeat the Performance Guarantee Tests. The Contractor shall reimburse the costs incurred by the Principal or third party as a consequence of repeating the Performance Guarantee Tests.

If the Guarantee Tests have not been passed due to the failure to achieve a discrete performance guarantee that does not adversely affect compliance with the Environment Protection License, waste throughput or power output the Contractor shall repeat the part of the Performance Guarantee Tests that has been failed.

#### **1.4.8 Performance Tests for Plant**

Throughout the period of the Performance Tests, the entire Plant including every relevant plant section and common services shall be tested simultaneously.

In order to receive the Performance Test Certificate, the Contractor shall, throughout the period of the Performance Guarantee Tests, demonstrate that all the Performance Indicators comply with the levels stated in Schedule 17.

#### **1.4.9 Test instrumentation**

The method of measuring all quantities and qualities and of assessing the measurement tolerances shall be in accordance with the appropriate Australian, EU and International Standards and approved by the Superintendent. Except as otherwise specified in the Contract, the Performance Guarantee Tests for the grate and boiler shall be carried out according to EN 12952-15: Water-tube boilers and auxiliary installations - Acceptance tests or FDBR – Guideline RL7 – Acceptance Testing of Waste Incineration Plants with Grate Firing Systems, Edition 03/2013, respectively.

The Contractor shall submit to the Superintendent a schedule of instrumentation necessary for conducting the Performance Guarantee Tests in order to demonstrate that the Plant has achieved the Guaranteed Performance Levels specified in Schedule 17 (Performance Guarantees and damages for failure) and that the Plant meets all of the requirements of the Specification. The instrumentation schedule shall quote an



appropriate test tolerance for each parameter and an overall test tolerance for each guarantee value. As a minimum, the Tests instrumentation shall be of sufficient accuracy to achieve the recommended measurement tolerances contained in the relevant standards.

All parameters required for establishing whether the Guaranteed Performance Levels are met shall be measured as far as possible by the permanently installed measuring equipment where supplied under the Contract with all parameters being acquired, stored and analysed by the DCS. Exceptions to this requirement are given in 1), 2) and 3) below. The Contractor shall ensure that the Plant instrumentation is adequate for this task, appropriately located and calibrated and that the accuracy of such equipment is adequate.

The Contractor shall provide calibration certificates for all instruments supplied as part of the Works and for any temporary instrumentation installed for the purposes of conducting the test. For standard instruments of known and repeatable accuracy, conformance certificates will suffice. Calibration records and, where appropriate, correction curves shall be available for inspection by the Superintendent.

All services required by the instruments, such as air and electricity supplies, shall be adjusted to the values required by the instrument manufacturer's specification prior to the commencement of the Performance Guarantee Tests and shall be kept at these values for the duration of the test.

All analysis, corrections and derivations shall be performed by the DCS which shall store the raw data, the corrected data, the derived data and the outputs. The sampling frequency, correction formulae and performance calculations shall be those agreed in the Test Protocol. Critical parameters such as steam flow shall be measured or assessed by two independent methods (e.g. steam measurement and feedwater measurement) to provide verification of the accuracy of the accuracy of the measurement. The exceptions to this arrangement are parameters which:

1. can only be assessed by sampling and analysis;
2. have to be assessed or verified by an independent testing sampling and analysis organisation in order to meet statutory requirements, the requirements of the Environment Protection License or where particularly specified within the Contract; and
3. may need to be measured for the purposes of performance testing of individual items of plant but which are not required for normal operation (for example, it might be desirable to install air temperature sensors around the inlet to the air-cooled condenser in order to accurately verify its performance rather than relying on the weather station which may not represent conditions at the air-cooled condenser air intake).

In cases where flow measurements are necessary for the Tests, the use of instruments which either recover the pressure loss or involve no pressure drop are preferred. Where flow measurement devices are critical to the assessment of plant performance, they shall be selected for their accuracy, and shall be supplied pre-calibrated as part of a complete pipe or duct length, including the necessary distances upstream and downstream of the meter for installation as an assembly into the Plant pipe or ductwork.

The Contractor shall provide the means of measurement of mass flow rate of solid materials and the means of calibration of the flow measurement device. The method of flow measurement and calibration shall be approved by the Superintendent but shall be by means of a purpose designed mass flow measurement device. Mass flow measurements shall not be inferred by reference to the speed of feeder devices.

Prior to commencement of the Performance Guarantee Tests, the Contractor shall demonstrate by means of a trial measurement period that the raw data is accurately collected and stored and that the corrections are properly applied. To the extent that manually collected data is used, the Contractor shall demonstrate how this data is to be entered and used within the calculations.

Sound level measurements shall be taken using equipment complying with EN 61672: Electro-acoustics - Sound level meters.

All manual logs shall be copied on a daily basis to the Superintendent.

### 1.4.10 Consumption of Consumables

The Contractor shall provide permanent facilities within the Plant for measuring the rate of consumption of reagents, water, power, fuel and other Consumables subject to the Guaranteed Performance Levels.

The consumption of Consumables shall be determined during the Performance Guarantee Tests over a continuous period of not less than xx weeks.

Performance Guarantee Tests which require operation at conditions other than at MCR for the consumption of Consumables shall be carried out either before the start or after the completion of the two week period.

With respect to Consumables, the Contractor shall demonstrate that the Guaranteed Performance Levels are not exceeded by determining the daily mean values of the respective Performance Indicator set out in Schedule 17 (Performance Guarantees and damages for failure). The values being determined shall be corrected to the guarantee conditions by considering the actual operational parameters and applying the adjustments set out in the Test Protocol pursuant to Schedule 15 (Take Over procedures).

### 1.4.11 Tests of control and monitoring equipment

Any time before or during the Performance Guarantee Tests, the Contractor shall test the main closed-loop control systems to demonstrate that each loop is properly tuned to give stable control and the degree of control is within the limits specified in the relevant sections of the Contract. The Contractor shall submit a comprehensive description of each test, which shall include the type and classification of all Tests equipment.

For each control loop, the Tests shall comprise, as a minimum:

- a demonstration that the process variable can be controlled to the set-point within the required overshoot at steady-state. This shall be demonstrated for at least three control levels; and
- a demonstration that within 1 minute of a change in setpoint of 10% or another agreed amount, a visible progression to the new set-point can be observed. This shall be demonstrated for at least three changes of set-point.

All significant parameters shall be logged and recorded using the DCS.

If these Tests indicate that any part of the control and monitoring equipment does not perform in a satisfactory manner or is not able to meet the figures specified in the Specification for overshoot or provide stable control, the Contractor shall improve the control equipment by suitable engineering measures, making full use of all theoretical and equipment engineering possibilities such as load-dependent parameter variation, feed forward of disturbance variable, improved optimisation and modification of characteristic curves for control valves and actuators.

The Tests shall also be carried out with a minimum of Plant alarms. Where the number of Plant alarms generated by the Works is considered by the Superintendent to be excessive, the Contractor shall remedy the cause of the alarms.

### 1.4.12 Maximum Continuous Rating (MCR)

The definition has to reflect the fact that the boiler will be controlled to a constant and stable steam flow rate with the waste feed through the Plant and other parameters varying to adjust for variations in waste characteristics and other influences.

The Maximum Continuous Rating (MCR) of the boiler is therefore the maximum mass flow rate of steam in tonnes per hour from the final superheater delivery connection, at the guaranteed delivery conditions of pressure and temperature, which the boiler is capable of maintaining for an indefinite period with minimal use of the auxiliary burners. The boiler shall be designed to operate safely, without incurring premature degradation of any of the boiler components or systems, at steam mass flow-rates of up to 110% MCR for short periods, provided that the average flow-rate over any period of 8 hours does not exceed the MCR by more than 2%.

### 1.4.13 Maximum waste feed throughput

The Maximum Waste Throughput is the maximum waste throughput in tonnes per hour that can be processed for an indefinite period. The Plant shall be tested to demonstrate that it operates safely, whilst achieving the maximum unburnt matter in combined bottom ash and boiler ash guarantee, at waste throughputs of up to 110% of the Maximum Waste Throughput, provided that the average over any period of 8 hours does not exceed the Maximum Grate Throughput by more than 2%.

### 1.4.14 Measurement of calorific value of waste

During all Tests, the calorific value of the waste, averaged over each test period, shall be measured using the waste crane and the Plant instrumentation to verify that the calorific value of the waste is within the range of permitted calorific values for the operation of the Plant at MCR and over the full design range shown in the Combustion Diagram.

The Contractor shall arrange and manage the verification of the waste crane feed rate by recording the weight of each grab and calibrating the grab weigh-scale with two calibrated weights corresponding to 80% and 50% of the nominal crane capacity immediately prior to and immediately following the Performance Guarantee Tests.

The Contractor shall provide all necessary permanent instrumentation, calibrated to the necessary degree of accuracy, to facilitate the measurement of calorific value for the tests in normal operation, and shall provide any temporary equipment necessary for the calibration of the crane weigh-scale. Subject to the submission by the Contractor of calculations confirming the thermal losses due to radiation, convection, heat losses in the ash, fly ash, flue gas and other losses, the net calorific value of the waste may be calculated using the Plant instrumentation.

In the event that, on the basis of the measurement procedure described above, the characteristics of the waste appear to lie outside the acceptable range of the Combustion Diagram at 100% MCR, the Superintendent reserves the right to insist on the sampling of waste and the measurement of the calorific value of the samples, both at the expense of the Principal. The purpose of such sampling will be to identify the sources of waste which might be causing the deviation so that they can be rejected.

### 1.4.15 Measurement accuracy and application of tolerances

The Contractor shall submit an assessment of the combined accuracy of each measurement procedure.

Measurement tolerances and uncertainty shall be applied to the correction of performance measurements in favour to the Contractor regardless of the treatment of such under the relevant test standard.

The Contractor shall ensure, at the Contractor's expense, that measuring equipment of a suitable standard is used so that the measurement uncertainty does not exceed the maximum permitted under the corresponding test standard (if any).

The tolerance level for the following measurements shall be:

- steam turbine generator electrical power : in accordance with the accuracy class requirements for tariff metering specified in Schedule 22C; and

Where the measurement tolerance is greater than that stated above, the Superintendent shall either reject the Test and require it to be repeated with more accurate measurements or apply the maximum tolerance in favour of the Contractor listed above in determining whether the measured value, including tolerance, meets the guaranteed value.

### 1.4.16 Test of boilers and associated equipment

Performance Guarantee Tests for the grate and boiler shall be carried out according to EN 12952-15: Water-tube boilers and auxiliary installations - Acceptance tests or FDBR – Guideline RL7 – Acceptance Testing of Waste Incineration Plants with Grate Firing Systems, Edition 03/2013, respectively. The system envelope will be in accordance with the 'normal envelope' defined in section 8.1.2 of the standard.

The performance test for the boiler shall have a minimum duration of 8 hours. Three full Tests may be carried out to demonstrate the performance of the boiler and associated plant to the satisfaction of the Superintendent. If operational parameters or measurement results from those three Tests show significant variations, the Superintendent may decide to carry out up to two additional Tests. The Superintendent shall select a single passed Test from these Tests as the valid Test for the determination of the guarantees.

A 24 hour performance Test shall be carried out to confirm the guaranteed continuous waste throughput shown on the Combustion Diagram.

The Contractor shall take sufficient measurements to demonstrate that the grate and boiler have achieved the relevant guarantees in Schedule 17 (Performance Guarantees and damages for failure).

The determination of the heat release from the boiler shall be calculated by the heat losses method (indirect method), as described in EN 12952-15. However, where it is considered that certain tests are not adequately covered by EN 12952-15 reference may be made to other guidelines e.g. FDBR – Guideline RL7 – Acceptance Testing of Waste Incineration Plants with Grate Firing Systems, Edition 03/2013. The Contractor should note that, if any heat is removed from the system for cooling, this heat shall be counted as a loss when calculating the boiler efficiency.

The thermal input from the waste shall be calculated from the calculated boiler efficiency and the heat input to the steam.

The Contractor shall demonstrate that the boiler and grate have achieved the relevant guarantees as detailed in the guarantee schedule.

Certain Guaranteed Performance Levels shall be assessed as described below:

#### **1.4.16.1 Thermal input from the combustion of waste**

If the calorific value of the waste is within the limits shown on the Combustion Diagram, the thermal input from waste shall meet the Guaranteed Performance Levels stated in Schedule 17 (Performance Guarantees and damages for failure). The thermal input shall be assessed using the loss assessment method by reference, among others, to:

1. ambient air temperature;
2. live steam flow, pressure and temperature;
3. boiler feedwater temperature and flow (as a check of the live steam flow measurement);
4. heat loss in the flue gases at the boiler exit;
5. heat loss by convection and radiation through the boiler and furnace walls (calculated value);
6. heat loss in the bottom ash;
7. heat provided as combustion air preheat and/or flue gas recirculation; and
8. evaporation heat loss of the SNCR ammonia solution.

#### **1.4.16.2 Waste throughput**

The Contractor shall demonstrate throughout the period of the Performance Guarantee Test that the guaranteed continuous waste throughput averaged over each 24 hour period of the test has been achieved, as defined in Schedule 17 (Performance Guarantees and damages for failure). The Principal reserves the right to select waste to adjust the calorific value in order to prove the maximum waste throughput at the 100% waste throughput condition on the Combustion Diagram can be sustained.

#### **1.4.16.3 Total organic carbon**

The ash shall be sampled from the ash conveyor in accordance with the indirect procedure (method A) defined in EN 13137: Characterisation of Waste Determination of total organic carbon (TOC) in waste, sludges and sediments. The total organic carbon shall be determined in accordance with a method approved by EPA. The Contractor shall demonstrate that the level of total organic carbon meets the Guaranteed Performance Level, for any waste within the range of the Combustion Diagram.

## 1.4.17 Flue gas treatment plant

### 1.4.17.1 Emission limits

The Contractor shall demonstrate that the flue gas treatment plant operates within the emission limits specified in the Environment Protection License over the entire range of input conditions set out in the Combustion Diagram, and that the Plant operates continuously and in a stable manner at the Guaranteed Performance Levels in Schedule 17 (Performance Guarantees and damages for failure). The Principal reserves the right to prepare selected higher CV wastes from the different waste streams delivered for the Tests. For example, the Principal may add materials with high chlorine content.

### 1.4.17.2 Continuous monitoring

During the Performance Guarantee Tests, the following pollutant concentrations in the raw and clean flue gases shall be measured continuously, and half-hourly and daily averages continuously calculated for:

- particulate matter;
- sulphur dioxide;
- hydrogen chloride;
- carbon monoxide;
- volatile organic matter excluding particulate (VOC as C);
- oxides of Nitrogen, expressed as NO<sub>2</sub>;

The monitoring of the clean and raw flue gases shall be checked at the beginning of the Performance Guarantee Tests and additionally once during each week of the Guarantee Tests by an independent laboratory. The checking shall be carried out by grid measurements in accordance with recognised national and international standards approved by EPA.

Instrumentation satisfying the requirements of the Environment Agency as stated in Technical Guidance Note M2 or other standard required by EPA shall be used to measure the emission pollutant concentrations. In particular, the system shall be certified to the MCERTS scheme with suitable certified ranges or similar, unless otherwise agreed. The system shall be further certified to EN 14181. The measured reference for continuously measured values shall not exceed the accuracy limits specified within the IEC Directive. If this condition is not met the instruments concerned shall be recalibrated, the recorded values since the previous successful check shall be deemed to be invalid and the Performance Guarantee Tests shall be extended by the time during which invalid readings were taken.

The Contractor shall provide evidence of the in-situ calibration of each of the continuous monitors. This will include calibration method and procedure together with regression lines of the measurements to demonstrate the accurate calibration of the monitors.

### 1.4.17.3 Sample measurements

The concentrations of the following pollutants shall be measured simultaneously in the raw and clean flue gases, also by an independent laboratory, at the beginning of the Performance Guarantee Test and additionally once during each week of the Performance Guarantee Tests. The measurements shall be carried out by grid measurements in accordance with recognised national and international standards approved by EPA, and include:

- mercury (total as Hg);
- cadmium and thallium (total as Cd + Tl);
- antimony, arsenic, chromium, cobalt, copper, lead, manganese, nickel, tin and vanadium (total as sum of elements); and
- dioxins and furans (TEQ according to Annex I of IEC Directive).

### 1.4.17.4 Additional measurements

In order to adjust the measurements to reference conditions of 273.15K, 11% oxygen and dry gas, raw and clean flue gas parameters recorded continuously shall include:

- flow;
- temperature;
- pressure;
- moisture content; and
- oxygen concentration.

#### 1.4.17.5 Consumption of lime, PAC and other reagents

The Contractor shall demonstrate that the guaranteed maximum consumption values of flue gas cleaning agents such as lime and PAC, as specified in Schedule 17 (Performance Guarantees and damages for failure), are not exceeded. This shall be demonstrated by the determination of the daily mean value of the respective parameter. No correction for consumption shall be made for flue gas moisture content or temperature.

The daily mean values shall be corrected if the plant operating conditions are different from the reference conditions on the basis of which performance guarantee values have been stated. The Contractor shall supply the following stoichiometric correction curves, to be used to correct the measured values.

1. Lime consumption variation against the inlet concentrations of:
  - a. HCl For the range 400 – 1,000 mg/Nm<sup>3</sup>; and
  - b. SO<sub>2</sub> For the range 40 – 1,000 mg/Nm<sup>3</sup>.
2. Lime consumption variation against flue gas flow for the range 60-120% of the flue gas flow at MCR, measured at the bag filter outlet.

#### 1.4.18 Steam Turbine Generator

The performance test shall be carried out for the specified loads in accordance with EN 60953-2 "Rules for steam turbine thermal acceptance tests, Part 2. Method B: Wide range of accuracy for various types and sizes of turbines". EN 61064 shall also apply. The purpose of the Test is to demonstrate that the net power production at the export transformer is greater than or equal to the relevant Guaranteed Performance Levels in Schedule 17.

For the purposes of the Test, the system shall comprise the turbine, the condensate and feed-water cycle and the air cooled condenser. Extraction steam to the air preheater, condensate reheaters and deaerator shall be operating at their design values for boiler operation at MCR. No additional steam shall be extracted for external process or district heating loads.

A full Test shall be carried out. The Test shall have a minimum duration of 2 hours.

The electrical power shall be measured by test standard calibrated kilowatt meters.

##### Assessment of Guarantees

The Contractor shall supply a final set of performance curves for the turbine to be approved by the Superintendent. These shall be such that the power output can be corrected for any variable outside the control of the Contractor. These shall include, but not be restricted to:

- Power output correction for ambient temperature.

Since the air cooled condenser is to be included within the system, the power output may not be corrected for the measured turbine exhaust pressure. The power output shall be corrected to the design dry bulb temperature by compensations for the air cooled condenser performance.

The Contractor shall demonstrate the swallowing capacity of steam turbine generator.

#### 1.4.19 Plant parasitic power

Measurements of Plant parasitic power shall be made during the Performance Guarantee Tests when the Plant is operating at 100% MCR.

Plant parasitic power shall be calculated by subtracting the power exported from the Site at the metering circuit breaker / tariff meter used for settlement purposes with the network operator from the power

measured at the terminals of the steam turbine generator. The Test shall be carried out with all consumers in normal operation excluding building services, civil scope and Company scope.

The electrical power shall be measured by test standard calibrated kilowatt meters.

#### 1.4.20 Noise

Measurement of the maximum noise emission shall be carried out during the Performance Guarantee Tests when the Plant is operating. All Plant areas shall be assessed to measure compliance with the Guaranteed Performance Levels. In particular, the Contractor shall prove that all Plant areas meet the Guaranteed Performance Levels defined in Schedule 17 (Performance guarantees and damages for failure

The assessment of any changes in external noise levels shall be carried out in accordance with the Interim Construction Noise Guideline (DECC, 2009), NSW Industrial Noise Policy (EPA, 2000) and Australian Standard AS 1055 – Acoustics – Description and measurement of environmental noise. Measurements shall be taken before and after the Plant is operational and the assessment calculations shall consider the characteristics of the noise (tonal, impulsive, etc.) and where applicable, apply modifying factors in accordance with Section 4 of the Industrial Noise Policy. The readings shall be adjusted using SoundPLAN noise prediction modelling software or similar methodology so that worst case meteorological conditions as specified in the Project Approval are considered when making the assessment.

For each sensitive receptor location the Plant shall comply with the conditions of the Planning Consent.

The Contractor shall be responsible for making any changes necessary to ensure that the noise levels comply with the requirements of the Environment Protection License and the Planning Consent.

#### 1.4.21 Equipment capacity

During the Performance Tests or at any time before, individual items of equipment shall be tested to demonstrate that it can achieve its nominal design capacity and is fit for its purpose. In particular, equipment designed for duty/standby shall be tested to ensure that under the normal design conditions only the duty item is required. These tests shall include:

1. duty/standby pumps such as feedwater pumps, condensate pumps, etc;
2. fan capacities;
3. flue gas cleaning reagents such as lime, PAC and FGT residue systems including metering equipment;
4. boiler water plant;
5. waste feed cranes;
6. waste handling equipment including dosing systems;
7. ash conveyors;
8. fire pumps;
9. turbine swallowing capacity and
10. the compressed air system

#### 1.4.22 Reporting of Tests

The Contractor shall provide a report on the Guarantee Tests shall containing all relevant information necessary to demonstrate that the Plant has met the specified Guaranteed Performance Levels. All manipulations or adjustments must be capable of independent verification. The content of the report shall include:

1. a description of the measuring points;
2. a description of the measuring methods;
3. the certificates of measuring equipment and auxiliaries;
4. a description of the Plant operation during the Performance Guarantee Tests;
5. a description of additional preparations/installations;
6. listings / chart records of measured raw data with time/date relation;
7. conversion and correction methods;

8. converted or corrected data with time/date relation;
9. a comparison of Plant data with requirements/guarantees;
10. the results of all laboratory sampling and testing;
11. a final conclusion; and
12. raw data from continuous monitoring issued as charts in any report. The data shall be issued as Windows compatible files on disk together with a file description.

Within one month of the completion of a Test, the Contractor shall supply the Superintendent with the Test report containing a complete evaluation of the results.

Where specified within a relevant standard, the Contractor shall supply test reports in accordance with the requirements of the standard.

### 1.5 Visual inspection

When the Performance Guarantee Tests have been successfully completed, the Plant shall be shut down and a visual internal inspection shall be made jointly by the Superintendent, the Principal and the Contractor of all works within the Contractor's scope of Works. The inspection will be passed if no corrosion, leaks, thermal stress, abnormal wear or damage are observed. No equipment will be dismantled without good cause, although the Superintendent shall be at liberty to open and inspect within all ports, doors, hoods and covers provided on the Plant. If the inspection is satisfactory, the Superintendent shall issue the Performance Test Certificate.

### 1.6 Availability Test

The Contractor shall conduct the Availability Test in accordance with the Contract. These Tests shall include the Tests set out within this Schedule as well as those Tests which the Contractor considers to be necessary to demonstrate that the Plant meets the requirements of the Availability Test. A summary of the Availability Test is included in the table below:

Starting criteria	Issuing of the Performance Test Certificate, following visual inspection.
Duration	365 days
Success criteria	The Plant has achieved the required Availability.
Result of success	The issuing of the Acceptance Certificate.

The one year Availability Test shall commence after the issue of the Performance Test Certificate followed by the visual inspection or at a time mutually agreed by the Contractor, Principal and Superintendent within 14 days of issue of the Performance Test Certificate. The Availability Test shall be carried out over a continuous period of 8760 hours in accordance with the requirements as defined in Schedule 17.

If, during the initial 12 months Availability Test period, it becomes apparent that the Contractor will fail the Availability Test, then the Parties shall discuss when the Contractor will be able to access the Plant to carry out rectification activities before the Availability Test is restarted. The Contract may request that the Principal reschedule the planned maintenance schedule so as to allow the Contractor this access at mutually convenient times and the Principal shall act reasonably in responding to any such request. If the duration of all rectification activities during the Availability Test cannot be completed within the 400 hours of planned outages as specified in item 7 below, the additional rectification activities beyond the 400 hours shall be deemed as unplanned shutdown and the Plant shall be considered as not Available.

The Availability Test shall be conducted in accordance with the following requirements.

1. The Plant is operated within the Combustion Diagram whenever sufficient fuel is available.
2. For periods when, for reasons not connected with the operation and maintenance of the Plant, the Principal schedules a lower steam flow within the limits of the Combustion Diagram or the stoppage



of one or more boiler streams, but the Plant is Available, the Plant shall be considered to be fully Available.

3. The Availability Test will be suspended if stopped due to:
  - a. a shortfall of Waste where the Plant has to be shutdown; or
  - b. a disruption to the grid connection which causes a shutdown of incineration; or
  - c. a one-off failure event to major equipment that does not reflect the long-term Availability of the Plant, i.e. significant boiler or steam turbine failure due to a manufacturing defect or a defect in material or erection;
  - d. a shutdown of the Plant due to a breach by the Principal of his obligations under the Contract, i.e. to supply reagents or remove residues.

In any of these events, the period of suspension will be added to the period of measurement so that the total period of the Availability Test is 8760 hours plus the period of suspension.

4. If the Plant stops due to lack of Waste, and the Contractor decides to proceed with rectification activities by agreement with the Principal, the Plant will only be considered to be Available during the period when sufficient Waste to operate the Plant at MCR is not available, not for any additional outage time caused by the Contractor's rectification activities.
5. Should the Availability not be reached by any circumstances which are the responsibility of the Principal, including the Operation Contractor, the Contractor shall not be held responsible. In this case, and except where this Schedule specifies otherwise, to the extent that the failure to meet the criteria for Availability is a consequence of such circumstances, the Plant shall be deemed to have been Available for the duration of the outage.
6. If the Plant or turbine is not Available, the Principal shall inform the Contractor without unnecessary delay, in writing, and within 4 hours about any relevant damage, faults or restrictions on performance during the Availability Test period together with the apparent reason for the fault. If the Principal exceeds the 4 hours to inform the Contractor, the non-Availability shall be calculated only from the moment of receipt of the Principal's respective written notice. The Principal shall be obligated to operate the Plant in accordance with the Operations and Maintenance Manuals and Good Industry Practice and shall take measures to rectify or minimise any outage or restriction on performance provided that the Principal shall always maintain the safe operation of the Plant and shall not be required to take any action that might jeopardise any warranty from the Contractor. The Principal shall maintain and make available to the Contractor all and complete Documentation of Plant outages or reduced load operation, including the reason for the outage or reduced load operation. To the extent that an outage is a consequence of a failure of the Principal pursuant to Schedule 3 (Principal Obligations):
  - a. to operate the Plant in accordance with the Operations and Maintenance Manuals and Good Industry Practice; or
  - b. to give the Contractor the opportunity to address the problem by means of a prompt notice of the problem,

the Plant shall be deemed to have been Available for the duration of the outage.

The data required for the verification of the guarantees in Schedule 17 and the format will be agreed by all Parties involved prior to commencement of the Availability Test. The Principal shall have the burden to prove that any outage is the responsibility of the Contractor.

7. The Contractor shall rectify the defects as soon as reasonably practical or, in case such defects do not require any decommissioning of the system before the next planned outage, specify the time at which defects will be rectified. Such defects will be rectified during the next planned outage and the Principal shall give to the Contractor all reasonable access during that period necessary for the rectification.
8. Throughout the Availability Test period, the Contractor acknowledges that the Principal shall undertake planned outages to carry out planned maintenance according to the Operation and Maintenance Manual requirements, including the annual boiler clean. The non-Availability due to planned outages shall not exceed 400 hours of operation per year. The variation to the planned outages period for the Availability Test shall be taken as:
  - a. If the total planned outage time is shorter than 400 hours the remaining time may be utilised as unplanned outage for the purpose of the Availability Test.

- b. If the total planned outage caused the Principal's activities is longer than 400 hours, the Contractor shall be credited for the lost time of the Plant being Available. This means that for the period of extended outage time the Plant shall be deemed to have been Available.
- c. If and to the extent that the extended outage is a result only of the Contractor's work including rectification activities, it shall not be credited as the Plant being Available.

The Contractor shall be entitled to make full use if any planned or unplanned system outages for the purpose of inspection, cleaning or improvement provided this does not interfere with the Operator's activities during the system outage, who shall act reasonably.

9. Any planned outage of an incineration line or turbine group shall be announced by the Principal to the Contractor 8 weeks prior to the commencement of the outage.
10. The Plant shall be operated and maintained by suitably qualified and fully trained operating and maintenance personnel in accordance with the requirements and recommendations of the Operating and Maintenance Manuals supplied by the Contractor in accordance with this Contract and with Good Industry Practice. Should an outage be caused and / or lengthened or the performance of the Plant be reduced by the Principal's or Operation Contractor's staff, the Plant shall be considered Available where reasonable written instructions provided by the Contractor have not been adhered to or where the actions or omissions of the Principal's or Operation Contractor's staff are not in accordance with Good Industry Practice. For these purposes, "Available" means that to the extent that a lack of Availability is a consequence of such outage or lengthening, the Plant shall be deemed to have been Available for this period.

The Contractor shall not be entitled to any relief on the basis that the Plant has not been correctly operated or maintained except to the extent that such incorrect operation or maintenance is the responsibility of the Principal including but not limited to the events mentioned in item 5 and 6 of this section. The Principal's or Operation Contractor's personnel shall be capable of repairing small defects and restarting the Plant after a shutdown in accordance with the training provided by the Contractor.

11. If the Plant is not Available due to force majeure which, for the purpose of this paragraph, shall include protestor actions, the Availability Test shall be suspended. The period of suspension will be added to the period of measurement so that the total period of the Availability Test is extended by the length of the suspension. For the avoidance of doubt, this paragraph 11 is without prejudice to Clause [] (Protestor Action) and Clause [] (Termination on Force Majeure) of the EPC Contract.
12. The stock of spare and wear parts supplied by the Contractor for Plant shall be maintained and made available by the Principal. Spare Parts taken from stock for the purposes of the Availability Test shall be re-ordered by the Contractor, at the Contractor's expense, within 1 week after Principal notified the Contractor.
13. The operating hours of the boilers and steam turbines shall be continuously measured, by the methodology outlined in Schedule 17, within the DCS which shall provide instantaneous and accumulated values for each parameter and cumulative Availability. Corrections for misperformance due to the Principal's defaults e.g. lack of waste, and notification times shall be added manually and mutually agreed.

Prior to commencement of the Availability Test all calculations within the DCS shall be verified by the Principal. Other instruments may be used by the Contractor, subject to agreement with the Principal, to gather information to support the calculations.

### 1.6.1 Availability Test Report

The Contractor shall issue at the end of the Availability Test a report summarising the performance of the Plant during the Availability Test based on the records from the DCS of the Plant and other instruments as agreed with the Principal who shall act reasonably. The Operator Contractor of the Plant shall maintain documentation of all Plant outages, including reasons for the outages, and of all data necessary for the calculation of the Availability. The report shall be issued within 2 weeks of completion of the Availability Test. The Principal shall approve or reject the report within 2 weeks. Approval shall not be unreasonably withheld or delayed.

## 1.6.1.1 Availability Test Certificate

Once the Availability Test Report has been approved by the Principal and the Availability Test criteria have been achieved, the Principal shall issue the Availability Test Certificate to the Contractor.

The Availability Test Certificate shall state either that:

1. The Availability Test shows that the Availability guarantee has been satisfied; or
2. The Availability Test shows that the Availability guarantee has not been satisfied in which case the Availability Test Certificate shall set out the amount of Availability Damages due and owing from the Contractor to the Principal in accordance with the EPC Contract.

Following receipt of the Availability Test Certificate for the first test, should Damages be due, the Contractor shall within 2 weeks advise the Principal whether he will pay the Damages or request evaluation of Availability for the second period.