

SCHEDULE 4**Inspection and testing****1. Introduction**

- 1.1. Clauses 5.3 (*Independent Engineer Inspection and Testing*) and 5.4 (*Facility Contracted Capacity*) of this Agreement provide for the Facility to be inspected and tested prior to the issue by the Independent Engineer of a Notice of Contracted Capacity Form.
- 1.2. Such inspections and tests shall be carried out for the Facility unless stated otherwise, in accordance with the provisions of this Agreement and the requirements set out in this Schedule 4 (*Inspection and Testing*).
- 1.3. The tests detailed in this Schedule 4 (*Inspection and Testing*) are the tests agreed between the Seller and the Buyer as being the tests which the Buyer requires to be carried out for the purposes of the Independent Engineer issuing a Notice of Contracted Capacity Form.
- 1.4. The obligations on the Seller to carry out the tests detailed in this Schedule 4 (*Inspection and Testing*) are obligations which are independent of the Seller's other obligations in this Agreement, including the Seller's undertakings in clause 17 (*General Seller Undertakings*) to Operate the Facility in compliance with the requirements of the standards of a Reasonable and Prudent Operator, and accordingly the carrying out of tests detailed in this Schedule 4 (*Inspection and Testing*) to the reasonable satisfaction of the Independent Engineer shall not be a defence to an averment that the Seller has failed to comply with any such other obligations in this Agreement.
- 1.5. The detailed procedure for the inspection and testing will be agreed or determined in accordance with the provisions of clause 5.3 (*Independent Engineer Inspection and Testing*) of this Agreement.

- 1.6. The Seller shall coordinate the timing for all tests that export Energy to the System with the Buyer.

2. Definitions

- 2.1. For the purpose of this Schedule 4 (*Inspection and Testing*), the following capitalised terms shall have the meanings given to them below:
 - 2.1.1. **"Excusing Cause"** means, in relation to an Interruption, an act or omission of the Buyer which, in the reasonable opinion of the Independent Engineer, is not caused or contributed to by the Seller, the Contractors or the Suppliers (or any of its or their subcontractors or agents of any tier);
 - 2.1.2. **"Interruption"** means an event which results in an NDC Test being interrupted or rendered ineffective, including any Outage or unplanned component failure or other condition that requires the capacity of a Facility or a Project to be reduced;
 - 2.1.3. **"Net Dependable Capacity Test"** or **"NDC Test"** means the tests conducted by the Seller to determine the Facility Net Dependable Capacity in accordance with clauses 1 (*Introduction*), and 5.4 (*Facility Contracted Capacity*) of this Schedule 4 (*Inspection and Testing*), as applicable;

3. General

3.1. Facility Compliance prior to Back Energisation (where relevant)

- 3.1.1. The Seller shall, prior to Back Energisation, demonstrate to the reasonable satisfaction of the Independent Engineer that the Facility and key equipment have been designed, manufactured and installed in accordance with South African Standards and or the relevant equivalent standards published by the relevant authorities.
- 3.1.2. Documentation to demonstrate such compliance shall be submitted to the Independent Engineer by the Seller and shall consist of the certifications evidencing that (a) the design of the Facility and key equipment complies with

South African Standards and the Codes and or for the key equipment equivalent standards published by the equivalent relevant authorities that such have been installed in accordance with their designs.

3.2. **Testing Program Principles**

The overall testing program shall consist of the Net Dependable Capacity Tests of the Dispatchable Facility.

3.3. **Test procedures**

- 3.3.1. Development and implementation of test procedures for the Connection Works (where relevant) and the Delivery Point in accordance with clause [5.3] (*Independent Engineer Inspection and Testing*) of this Agreement will be the responsibility of the Seller.
- 3.3.2. The testing procedures which are required to be submitted by the Seller to the Independent Engineer in accordance with the provisions of clause [5.3] (*Independent Engineer Inspection and Testing*) of this Agreement shall include:
 - 3.3.2.1. a test program;
 - 3.3.2.2. the test standards;
 - 3.3.2.3. the type of inspection and the type of tests;
 - 3.3.2.4. the methodology of the tests;
 - 3.3.2.5. the check lists that are required to be completed, including the list of the process data to be recorded;
 - 3.3.2.6. the equations and correction curves for the process data;
 - 3.3.2.7. the description of instrumentation to be used, including calibration test results;
 - 3.3.2.8. the location of measurements;
 - 3.3.2.9. the list of tests which are to be witnessed by third parties;

- 3.3.2.10. the quality control procedures and tests;
- 3.3.2.11. the manpower and deployment schedule of the Seller for performing the tests;
- 3.3.2.12. duration of the tests;
- 3.3.2.13. performance standards (where applicable); and
- 3.3.2.14. the forms of test records and of the report.

3.4. **Witness of Tests by Independent Engineer**

- 3.4.1. All testing on the Site in respect of the tests referred to in clause 4.2 (*Functional Testing*) and 5 (*Tests for Reliability and Initial Net Dependable Capacity*) of this Schedule 4 (*Inspection and Testing*) shall be witnessed by the Independent Engineer, the Buyer (in its sole discretion) and a Responsible Authority if such witnessing by a Responsible Authority is required by Law.
- 3.4.2. All other testing on the Site may be witnessed by the Independent Engineer and the Buyer (in its sole discretion) and shall be witnessed by a Responsible Authority if such witnessing by a Responsible Authority is required by Law.
- 3.4.3. The Seller shall notify the Independent Engineer and the Buyer in writing of the date and time on which all tests are to be performed. Unless otherwise specified in this Schedule 4 (*Inspection and Testing*) twenty-four (24) hours' written notice shall be given by the Seller to the Independent Engineer and the Buyer for any re- test of the Facility.

4. **Testing of Equipment and Systems**

4.1. **Tests during manufacture, construction and commissioning**

The Seller shall, on written request of the Buyer or the Independent Engineer, provide the Buyer with all requested and relevant test reports in relation to all tests conducted during the manufacture, construction and commissioning of the Facility, as the Buyer may in its sole discretion deem necessary. The Buyer may, on written notice, request

that the Seller re-performs any such tests which the Buyer or the Independent Engineer deems were not initially conducted to its satisfaction.

4.2. **Functional Testing**

4.2.1. All tests shall be conducted in accordance with the codes and standards set out in Schedule 1 (*Details of the Facility*) or as otherwise required in accordance with the standards of a Reasonable and Prudent Operator.

4.2.2. No tests shall commence until all interlocks which prevent Start Ups under dangerous conditions, and where applicable, the operation of pressure relief devices, over temperature devices, and over current devices are in place. It's a requirement that safety circuits and devices are tested and verified to be functional prior to commissioning.

4.2.3. For the Dispatchable Facility, the Seller shall ensure that the following tests shall be carried out to demonstrate that key features of the design operate satisfactorily:

4.2.3.1. Test and Start-up of Auxiliaries

4.2.3.1.1. All auxiliaries shall be tested to verify that they can be operated safely, that their performance satisfies the design specifications, and that all protective devices, mechanical as well as electrical, are functioning effectively at their correct settings.

4.2.3.1.2. Automatic start-up of stand-by auxiliaries upon the loss of running auxiliaries shall also be tested.

4.2.3.2. Control System

Automatic control systems shall be tested for correct functioning and controls tuning shall be carried out.

4.2.3.3. Synchronising Checks

Before each part of the Facility is permitted to Operate synchronised in parallel with other machines, tests shall be performed to ensure that it is safe to do so and that all the instruments associated with the synchronising operation are functioning correctly and in accordance with the Codes.

4.2.3.4. Protective Devices

4.2.3.4.1. All electrical and mechanical protective systems, circuits, devices, equipment and instruments associated with the interconnection of the Facility and Connection Works with the System shall be tested on site to prove Operation and stability, as well as compliance of the actual relays and current transformers with the equipment Supplier's published information.

4.2.3.4.2. Generator protection and tripping settings shall be tested for proper Operation.

4.2.3.5. Stability

4.2.3.5.1. Each generator shall have an automatic voltage regulator ("**AVR**") and the AVR shall, in compliance with the Codes, be tested for proper and stable Operation over zero to maximum load.

4.2.3.5.2. The tests must demonstrate the ability to Operate at the range of voltages, frequencies and power factors specified in the Connection Agreements and in compliance with the Codes.

4.2.3.5.3. Tests shall also be conducted to test the ability of the Facility to control the system and respond appropriately in compliance with the Codes.

4.2.3.5.4. Each Facility shall be tested for stable Operation at the Minimum Stable Load without supplemental or support fuel firing.

4.2.3.6. Response times

The automatic Start Up times and raise and lower ramp rates from various initial conditions shall be tested to demonstrate that the performance in Schedule 6 (*Performance Requirements*) of this Agreement has been achieved.

4.2.3.7. Load Rejection Test and Step-Load Change Rejection Test

4.2.3.7.1. The Seller shall:

4.2.3.7.1.1. carry out load rejection tests relevant to the technology and applicable Codes;

4.2.3.7.1.2. simulate tests of load rejection relevant to the technology and applicable Codes; and

4.2.3.7.1.3. verify & check Operating Stability with load variations relevant to technology and applicable Codes.

4.2.3.7.2. Full load rejection testing shall be carried out relevant to the technology and applicable Codes.

4.2.3.7.3. The Seller shall carry out step load changes relevant to the technology to maintain operation and recovery applicable in the Codes.

4.2.3.8. Metering Installations

The Metering Installations shall be inspected and tested in accordance with the Codes and clause 12 (*Metering*) of this Agreement.

4.2.3.9. Grid Compliance

Any other tests required to demonstrate compliance with the System and the Connection Works requirements and the Codes shall be carried out.

4.2.3.10. Environmental Compliance

Environmental compliance tests (including noise level tests) to demonstrate compliance with all Consents under Environmental Laws shall be carried out.

4.3. **Test Reports**

- 4.3.1. As soon as possible after each of the tests specified in clauses 4.1 (*Tests during manufacture*) to 4.2 (*Functional Testing*), but in no case later than seven (7) days from the end of a test, the Seller shall prepare and submit to the Independent Engineer a draft test report and required test certificates.
- 4.3.2. All draft test reports shall include:
 - 4.3.2.1. a brief description of the Facility (as the case may be) tested;
 - 4.3.2.2. procedure for testing and calculations;
 - 4.3.2.3. calculations;
 - 4.3.2.4. results (corrected and uncorrected);
 - 4.3.2.5. correction curves;
 - 4.3.2.6. copy of log sheets; and
 - 4.3.2.7. calibration certificates of all instruments used in the tests.
- 4.3.3. Six (6) hard copies of the final test report shall be submitted to the Independent Engineer, in addition to an electronic copy.
- 4.3.4. One (1) hard copy and one (1) electronic copy of a full set of documentation of the tests referred to in clause 4.3 of this Schedule 4 (*Inspection and Testing*) shall be submitted to the Independent Engineer and submission to, and acceptance by, the Independent Engineer of such documentation for electrical protection devices shall be required prior to the issue by the Independent Engineer of Notice of Contracted Capacity Form.

5. **Tests for Net Dependable Capacity of the Dispatchable Facility**

5.1. **General**

- 5.1.1. After the Effective Date the Seller shall be entitled to prepare the Facility for the NDC Tests.
- 5.1.2. The NDC Tests shall be undertaken in accordance with the requirements of the ASME Performance Test Codes and the procedures agreed or determined in accordance with the provisions of clause [5.3] (*Independent Engineer Inspection and Testing*) of this Agreement.
- 5.1.3. The NDC Tests shall be carried out while the Facility (as the case may be) is Operating in compliance with all the Consents under Environmental Laws.

5.2. **Scheduling**

- 5.2.1. The Seller shall determine and give the Independent Engineer sixty (60) days prior written notice of the date and time scheduled for commencement of a NDC Test in respect of a Facility.
- 5.2.2. Any rescheduling of a NDC Test to a date other than the date set forth in the written notice to the Independent Engineer pursuant to the preceding clause shall require two (2) weeks' advance written notice from the Seller. If any unforeseen delays arise to the start of the NDC Test within the latter period, the Seller shall provide daily confirmations of the expected date by no later than 15:00 hours on each day.

5.3. **NDC Test**

- 5.3.1. If the Facility comprises multiple units then, in order to procure the Facility Completion Form separate NDC Tests shall not be conducted on each Facility for which a Facility Completion Form has already been issued.
- 5.3.2. The NDC Test shall form the basis of the Net Dependable Capacity of the Facility (as the case may be) from the Commercial Operation Date of the Facility:
 - 5.3.2.1. one NDC Test shall be performed for the Facility;

- 5.3.2.2. the NDC Test in clause 5.3.2.1 shall be used to determine the Net Dependable Capacity of the Facility Auxiliary Consumption shall be determined while the entire facility is in Operation so that all Auxiliary Consumption is accounted for and then proportionately allocated in the facility.
- 5.3.3. The duration of a NDC Test shall be no less than eight (8) hours, during which time the Facility (as the case may be) shall Operate at testing full load while supplying the Auxiliary Consumption to establish Net Dependable Capacity.
- 5.3.4. The NDC Test shall be conducted without Interruption unless there is an Excusing Cause.
- 5.3.5. In the event of an Interruption due to an Excusing Cause:
 - 5.3.5.1. the NDC Test shall be resumed after such Interruption once stable operations have been achieved, as the Seller may reasonably determine; and
 - 5.3.5.2. all continuous hours of testing prior to an Interruption due to an Excusing Cause shall be taken into account in calculating whether the tests have been carried out for the duration required in this clause 5.3 (NDC Test).

5.4. **Test Instrumentation**

- 5.4.1. The NDC Test instrumentation shall include precision wattmeter, ambient air and cooling water conditions (temperature, pressure and humidity) devices. Information shall be recorded regarding internal values via the Distributed Control System ("**DCS**"), including the trend of electrical output in order to prove the plant reached proper stabilisation and worked in stable conditions during the test. All special test instrumentation shall be calibrated, installed and working prior to start of the NDC Test.
- 5.4.2. No tolerances in calculating performance test results will be permitted for measurement uncertainty.

5.5. **Procedures**

- 5.5.1. During testing, both the Seller and the Buyer shall make all reasonable efforts to maintain the frequency, load, power factor and Facility voltage steady.
- 5.5.2. The power factor and voltage during the test shall be set to demonstrate that the NDC is able to be achieved within the range of power factors and voltages specified in the Codes. The power factor and voltage levels shall be included in the test procedure required by clause 5.3 (*Independent Engineer Inspection and Testing*) of this Agreement.
- 5.5.3. Energy Output shall be measured at the Metering Installation in accordance with clause 12 (*Metering*) of this Agreement. All special instruments used at the Facility for testing shall be calibrated and installed prior to the commencement of the NDC Test.

5.6. **Correction of Performance**

- 5.6.1. Performance shall, in accordance with the provisions and formulae in this clause 5.6 (*Correction of Performance*), only be corrected to Reference Site Conditions and grid frequency.
- 5.6.2. The corrected Net Dependable Capacity calculation formula is:

$$\text{NDC} = \text{Naumann Construction} / (C1 * C2 * C3 * C4 * C5 * C6)$$

where:

- NC = Net Capacity measured at the Main Metering Installation
- NDC = Net output corrected to contract conditions and with the following correction factors:
- C1 = Correction factor taking into account for effect of ambient air dry bulb temperature (Table 7.1)

- C2 = Correction factor taking into account effect of ambient air wet bulb temperature (Table 7.2)
- C3 = Correction factor taking into account effect of condenser cooling water inlet temperature (Table 7.3)
- C4 = Correction factor taking into account barometric pressure (Table 7.4)
- C5 = Correction factor taking into account relative humidity (Table 7.5)
- C6 = Correction factor taking into account variations in grid frequency (corrected to 50 Hz) (Curves referred to in Table 7.6)

5.6.3. The correction curves in Tables 7.1 to 7.6 are to be used for corrections to Reference Site Conditions.

5.6.3.1. Table 7.1 - Air Temperature Correction Curve

Ambient Air Dry Bulb Temperature	Net Dependable Capacity Correction Factor, C1
(Max. Temperature)	
Site Reference Dry Bulb Temperature	1.0
(Min. Temperature)	

5.6.3.2. **Table 7.2 Wet Bulb Temperature Correction Curve**

Ambient Air Wet Bulb Temperature	Net Dependable Capacity Correction Factor, C2
(Max. Temperature)	
Site Reference Wet Bulb Temperature	1.0

Ambient Air Wet Bulb Temperature	Net Dependable Capacity Correction Factor, C2
(Min. Temperature)	

5.6.3.3. **Table 7.3 Condenser Cooling Water Inlet Temperature Correction Curve**

Condenser Cooling Water Inlet Temperature	Net Dependable Capacity Correction Factor, C3
(Max. Temperature)	
Site Reference Condenser Cooling Water Inlet Temperature	1.0
(Min. Temperature)	

5.6.3.4. **Table 7.4 - Barometric Pressure Correction Curve**

Barometric Pressure (mbar)	Net Dependable Capacity Correction Factor, C4
(Max. mbar)	

Barometric Pressure (mbar)	Net Dependable Capacity Correction Factor, C4
Site Reference Barometric Pressure	1.0
(Min. mbar)	

5.6.3.5. **Table 7.5 Humidity Correction Curve**

Relative Humidity (%)	Capacity Correction Factor, C5
100% (Max. Relative Humidity)	
99	
98	
97	
96	
95	
94	
93	
92	
91	

Relative Humidity (%)	Capacity Correction Factor, C5
90	
89	
88	
87	
86	
85	
84	
83	
82	
81	
80	
75	
70	
65	
60	
55	
50	

5.6.3.6. **Table 7.6 Grid Frequency Correction Curve (C6)**

[Note to Bidders: correction factors for variations from Reference Site Conditions during testing and for grid frequency (C6) will be applied in accordance with the curves provided by the Seller and included in this Schedule 4 (Inspection and Testing).]

[Note to Bidders: if the Facility has 2 or more different types or sizes of plant equipment, there will need to be correction factors and tables for each type or size of Plant].

5.7. Test Readings

The following readings should be taken at indicated minimum intervals. The frequency of readings may be modified on site for practical reasons only after mutual agreement with the Independent Engineer. The final intervals between readings shall not exceed fifteen (15) minutes.

5.7.1.	Electrical power, power factor:	1 Minute
5.7.2.	Atmospheric temperature, pressure and humidity:	5 Minutes
5.7.3.	Auxiliaries power consumption:	5 Minutes
5.7.4.	Cooling water temperature:	5 Minutes
5.7.5.	Others including line frequency and voltage:	10 Minutes

6. Dispatchable Facility Net Dependable Capacity Test During Operation

6.1. NDC Test Date

- 6.1.1. The Seller shall carry out an eight (8) hour NDC Test of the Facility, for the purpose of demonstrating Net Dependable Capacity, every twelve (12) months after the Commercial Operation Date, unless the requirement to carry out any such test is waived by the Buyer.
- 6.1.2. The Seller shall give the Buyer not less than thirty (30) days prior written notification of its intention to perform such tests.

- 6.1.3. The exact date and time of the testing shall be finally determined by the Buyer, subject to the limitations set forth below.
- 6.1.4. If as a result of Scheduled Outages or an Unscheduled Outage or other reasons that may arise, the scheduled test date is not appropriate for testing, then the Buyer and the Seller shall reschedule the test.
- 6.1.5. The rescheduled date of testing shall not be more than two (2) months later than the original test date.
- 6.1.6. The Net Dependable Capacity established by the most recent NDC Test shall continue in effect until the next twelve (12) month NDC Test is completed and the results accepted by the Buyer or determined by the Independent Expert in the case of a dispute, in either case in accordance with the procedures set forth below.

6.2. **Conditions**

The NDC Test shall be performed by the Seller and may be witnessed by the Buyer or its representative. The NDC Test shall be conducted for eight (8) hours without Interruption, during which time the Facility shall Operate at Testing Full Load while supplying the Auxiliary Consumption to establish Net Dependable Capacity.

6.3. **Procedure**

- 6.3.1. During the NDC Test both the Seller and the Buyer shall make all reasonable efforts to maintain the frequency, load, power factor and stator voltage steady and in accordance with this Agreement, the Codes and the standards of a Reasonable and Prudent Operator.
- 6.3.2. The Energy Output shall be measured at the Metering Installation.
- 6.3.3. To the extent that the conditions in existence during the NDC Test differ from the Reference Site Conditions set forth in Schedule 1 (Details of the Facility) the Seller may correct the results obtained in the NDC Test according to the design correction curves to be provided by the Seller to the Buyer, including 50 Hz

system frequency. However, the NDC test result shall not be corrected for variations in fuel characteristics.

- 6.3.4. Subject to acceptance by the Buyer, the Seller shall determine the subsystem set points for determining the electrical and thermal conditions for the NDC Test.

6.4. **Test Results**

The NDC of the Facility shall be determined by dividing the Energy Output (as determined in accordance with the metering provisions in clause 12 (Metering) of this Agreement during the test and corrected to Reference Site Conditions) by the test duration period in hours.

6.5. **Retest**

- 6.5.1. If the Facility fails to Operate continuously for eight (8) hours or the test results are unacceptable to the Seller, then the Seller may elect to void the test and to implement corrective action and either immediately retest the Facility, in accordance with the above procedures or reschedule a test to occur as soon as reasonably practicable upon forty eight (48) hours notification to the Buyer.
- 6.5.2. The Seller may conduct one (1) retest per Week, provided, however, that if the Seller has elected to void the most recent NDC Test and has not accepted an NDC Test within forty five (45) days after the date agreed in clause 6.1 (NDC Test Date), then the Net Dependable Capacity of the Facility, shall be that achieved during the most recent voided NDC Test.

6.6. **Buyer Acceptance**

If the test results are acceptable to the Seller, the Seller shall submit such results in writing to the Buyer. The Buyer shall indicate in writing whether they accept or dispute such test results within ten (10) Business Days after receiving from the Seller the information reasonably necessary to evaluate such results in accordance with this Schedule 4 (Inspection and Testing). If the Buyer fails to respond in writing within such

ten (10) Business Day period, they shall be deemed to have accepted the test results submitted by the Seller.

6.7. Dispute of Test Results

If the Buyer disputes the results submitted by the Seller, such dispute shall first be discussed by senior members of the Buyer and the Seller for resolution. If a satisfactory resolution of the dispute cannot be reached within ten (10) Business Days, such dispute shall be submitted for resolution in accordance with the provisions of clause 23 (Fast Track Dispute Resolution) of this Agreement, provided, however, that the NDC Test submitted by the Seller shall be deemed accepted until the final decision of the Independent Expert, upon which any excess amounts paid by the Buyer during the period of such dispute may be taken as credit by the Buyer against amounts invoiced pursuant to clause 9 (Invoicing) of this Agreement.

6.8. Test Report Form

The result of the NDC Test shall be documented by the Seller in the Net Dependable Capacity Test Result Form in Table A.1 (Updated Contracted Capacity) in Schedule 5 (Calculation of Payments). The Seller shall, within two (2) Business Days, deliver a copy of the completed Net Dependable Capacity Test Result Form and the updated Schedule 5 (Calculation of Payments) to the Buyer ("Delivery Date"). The updated Net Dependable Capacity shall become effective at 00:00 hours on the first Business Day following the Delivery Date.