Appendix L2: Calculating Combined Cycle and Co-Generation Block Data Using the Fleet-type Roll-up Method

Overview

This document will explain the fleet-type roll-up method for collecting combined-cycle data on a unit level basis and creating combined-cycle block statistics from the unit level event and performance information.

This document applies only to reporters who wish to report event and performance data for each generating unit individually. This document does not apply to reporters wishing to continue reporting combined-cycle data to GADS as a 'single unit' (or traditional method). GADS will still accept the traditional method, but this is not favored over the reporting of each generating unit within the block.

Please Note: *The majority of this document is the same as the synthesis method. The basic data gathering process on a unit level basis is* ***identical*** *in all respects. The differences will be in creating block statistics from the unit level data.*

IEEE 762 does not address reporting separate units and bringing the components together to create combined-cycle block statistics. Therefore, we are establishing a NERC methodology based on the generally accepted industry practice of fleet-type roll-up calculations for a group of units – in this case, the group of units consists of the individual generating units that make up the combined-cycle block.

Terms

To insure proper documentation some terms must be agreed on to eliminate some of the ambiguity concerning combined-cycle blocks in general.

- **Combined-cycle Block (also known in the industry as a "Block")** –By definition, a combined cycle is a process for generating energy (either electricity or steam) constituted by the marriage of a Brayton Cycle (expand hot gas to turn a gas turbine) with a Rankine Cycle (use heat to boil water to make steam to turn a steam turbine). A combined-cycle block employs electric generating technology in which electricity and process steam are produced from otherwise lost waste heat exiting from one or more combustion turbines. In most situations, the exiting waste heat is routed to a conventional boiler or to a heat recovery steam generator (HRSG) for use by a steam turbine in the production of electricity. Therefore, the combined-cycle block consists of one or more gas turbines/jet engines, one or more steam turbines, and balance of plant equipment supporting the production of electricity or steam energy.

There may be more than one combined-cycle block at a plant site. Our discussion relates to each individual combined-cycle block reporting, not the process of reporting several combined-cycle blocks as one plant site.

- **Units** – Each generator set is considered a "unit." Typically in combined cycle, each gas turbine or jet engine and each steam turbine are considered a "unit." Each unit contributes to the total electric generation of the combined-cycle block, and each unit has one or more of its own generators for providing electric power.
- **Heat Recovery Steam Generator (HRSG)** – There may be one or more HRSG or waste-heat boilers in a combined-cycle block. Some units may have a single HRSG per GT/jet engine; others may have several GT/jet engine feeding a single HRSG. The HRSG does not contribute electricity to the output of the combined-cycle block, so is considered a component rather than a unit.
- **Other Balance of Plant Equipment** – These are the other pieces of equipment in the combined-cycle block used to support the production of electricity. They are not related to any specific part of the block and are also considered as components.

Combined-Cycle block/Unit Numbering

The combined-cycle block and unit numbering system should be straightforward and follow the usual guidelines. The combined-cycle block is identified by the range 800-899 and is used to relate the individual units to the block level. The GT/jet engine units are numbered in the range 300-399 or 700-799. The steam turbine units are numbered in the range of 100-199.

Impact on Design Data

It will be necessary for each generating company to provide new and/or additional design data for the combined-cycle blocks that is submitting GADS data to NERC. This new design data will allow NERC to identify the specific units that make up each combined-cycle block for the purposes of creating fleet-type calculations of the unit level data that is submitted to NERC.

- **Units** - The design data is reported as though each unit were a separate generator, this meaning that each unit would have its own unit number and design data as described in the NERC guidelines for each unit type. In addition to this, the unit should be marked as being part of a combined-cycle block by a field that would hold the identifying 800 series unit code of the combined-cycle block.
- **Combined-Cycle block** – Balance of plant and other equipment not directly related to each unit should be coded as described for the combined-cycle block.

Cause Codes

Since each unit of the combined-cycle block can affect the generation of the other units, it is possible to have a situation where a derate in a gas turbine or jet engine may have a steam turbine cause code. (See Example 2 below). In other words, the cause codes for all units will be open to all task-force-approved cause codes for all units within the combined-cycle blocks.

Reporting Event Records

Report events on the unit level only. NO COMBINED-CYCLE BLOCK EVENTS ARE REPORTED TO NERC! Since the design data links the units together with the combined-cycle block, NERC will use the unit level to perform block-level roll-up statistics using the fleet-type (sum of hours) method to calculate traditional industry statistics. All the normal methods/rules would apply with the exception of cause codes crossing over between dissimilar unit types.

Reporting Performance Records

Report performance records on a unit basis only. YOU SHOULD NOT REPORT COMBINED-CYCLE BLOCK PERFORMANCE RECORDS TO NERC! Since the design data links the units together to the combined-cycle block, NERC will use the performance records of the individual units to calculate traditional industry statistics using the fleet-type roll-up method.

Therefore, if you operate a combined-cycle block with two gas turbines and one steam turbine, you will report 36 performance records annually – one set of 12 performance records for each gas turbine unit and one set of 12 performance records for the steam turbine unit.

Effects on pc-GAR Peer Groups

Exposing the data on the units of combined-cycle block allows those units to become part of other peer groups. In pc-GAR, the following options are given when the peer group is created.

- Include units of combined-cycle blocks – create a gas turbine peer group that includes gas turbines in simple cycle operation with those in combined-cycle blocks.

- Include units of combined-cycle blocks only – i.e. view gas turbine units in combined-cycle blocks operation only.
- Combined-cycle blocks are available for each of the three groups shown below or groups 1 and 2 **or** 1 and 3:
  - **Group 1:** Not rolled up (neither syntheses nor fleet) but used only reported block data as supplied by the reporter (traditional data reporting).
  - **Group 2:** Creating block data using the synthesis event and performance method shown in this document.
  - **Group 3:** Creating block data using the fleet-type roll-up method described in a separate document "Calculating Combined-cycle block Data Using a Fleet-type Roll-up Method When Reporting Each Gas Turbine/Steam Turbine Unit."

Not everyone will wish to use some of these options. However, GADS is committed to providing options to all since the individual needs of GADS data users also vary.

Calculating Fleet-type Combined-Cycle Block Statistics from the Unit Event & Performance Records

Do not report combined-cycle block event and performance records to NERC. NERC only needs the individual unit event and performance records.

Illustrated below are examples of how to create a block performance record using the fleet-type roll-up calculation. Please note that there is no double counting of penalties on the combined-cycle block; we are actually maintaining the impact of the problem of one unit on another unit. The addition of the two units affects the overall electric production of the block.

There will be times when the cause code of one unit (GT#1 for example) will also be shown on a second unit (the steam turbine for example). That is because the resultant outage of the GT affected the steam production on the steam turbine, resulting in the steam turbine's inability to provide full capacity. This may look as if it were "double" counting (see Example #2); however, the steam turbine itself is not in need of repairs and the cause of the reduction in steam-turbine production to the steam turbine points to a GT (doesn't say which GT, just "a" GT). Therefore, the GT gets two penalties against it: one for the outage (to the GT#1 itself) and another for the derate (to the steam turbine.) which may appear as a "double counting," but is not. This is because the GT actually caused the entire shortage. This type of event is called a concurrent derate.

Please note two things:

- When GT#1 is on outage, the outage time and cause is related to GT#1 via the event record (only the outage is related to GT#1), and
- The derate to the steam turbine is NOT related to GT#1 "directly" because the derate is shown to be caused by a GT cause code but not identifying which GT (assuming there is more than one GT unit). Therefore, when the computer calculates the statistics of GT#1, it only sees the outage, not the derate. When the computer calculates the statistics on the steam turbine, it sees the derate caused by a GT. Therefore, GT#1 is not penalized twice, but only the one time.

In the NERC performance statistics, you would see the following:

GT#1 EAF=…, EFOR=…., etc.
GT#2 EAF=…., EFOR = …., etc.

Steam Turbine EAF= …., EFOR = …., etc.

These values are calculated based only on the performance and event records directly attributed to each of the individual units. However, when you report on cause code based values, the entire effect of the outage will be taken into account. With the effect of the outage being attributed to the cause code and not the unit, the unit is not penalized.

Equivalent Fleet Roll-up Calculations

The equivalent-fleet-type roll-up of combine-cycle units is based on the energy generated or lost as a result of the time that the unit is available or unavailable. By weighting the hours of the time-based calculations by the capacity of each unit, you are able to add the energy of each unit to create the rolled-up statistics needed for the block. You can then use the roll-up of unit hours to determine the rates and factors of the block.

You do need to keep in mind that, when using the equivalent fleet roll-up method, you are working with energy in MWh and not capacity and hours as separate entities. In all calculations, we can substitute the energy based number for a particular statistic by multiplying the hours by the unit's maximum capacity (Net Maximum Capacity). So, for instance, service hours become service MWh.

As an example of this, consider this simple relationship:

Service Hours = Period Hours – Outage Hours – Reserve Shutdown Hours

This works for a single unit, but, if period hours are used for the block, the following relationship doesn't work –

$(SH_{unit1} + SH_{unit2}) = PH – (OH_{unit1} + OH_{unit2}) – (RSH_{unit1} + RSH_{unit2})$

The relationship of service hours to period and outage hours needs to remain constant for the individual unit and for the block when all units are added together. By multiplying each element by the capacity of the related unit, we keep the relationship stable.

So, for each unit in the block we have:

SMWh = SH x Capacity

PMWh = PH x Capacity

OHMWh = OH x Capacity

RSHMWh = RSH x Capacity

Now you can sum the MWh for all units to create the values for the block

$\Sigma(SMWh) = \Sigma(PMWh) - \Sigma(OHMWh) - \Sigma(RSHMWh)$

Special Rules Used in Calculating Combined-Cycle Block and Units Using Fleet-type Roll-up Method

There is a need to establish some rules for fleet-type combined-cycle blocks. The rules will insure uniformity in creating fleet-type statistics from the unit level data.

- The number of attempted and actual starts for the combined-cycle block is determined by the sum of all attempted and actual starts of the units. Due to this, all unit events transfer directly to the block without interpretation to the cumulative status of the block. In other words, if a unit is on forced outage, the forced outage event is also posted to the block even though the other units in the block may be producing power. In this way, a total count of all events that occur within the block can be maintained.

- A unit is on reserve shutdown when it is removed from service for economic reasons or the electricity is not needed on the system (standard RS definition.) The reserve shutdown may affect other units (for example a GT out on reserve shutdown will reduce the steam to the steam turbine). In such cases where the steam turbine is still in operation, there would be no concurrent event reported because of the reduction in steam flow because the steam turbine is operating as if in load-following and can return to full capacity as soon as the GT unit is returned to service.
- As reported for other unit types, coast down to outages is not reported to GADS. Therefore, the orderly removing of units towards an outage (standard outage procedure) is considered a coast down and is not reported as a penalty against the combined-cycle block. (See Example #7).

Examples in Fleet-Type Block Outages and Deratings from Reported Unit level Data

In each example, the status of each unit is discussed. Some units are not impacted at all by the outages or derates. The only reason they are listed is to show they are not impacted and have no impact on available electricity production. In actual reporting, the unaffected units would not be reported or even mentioned.

Please Note: *These examples are created simply to illustrate specific cause-and-effect relationships for discussion purposes only, and may or may not be real world equipment designs, installations, configurations or actual outage occurrences. The purpose of these examples is to illustrate how the outage of one unit affects other units and the entire combined-cycle block.*

Our example Combined-Cycle block – Big Jumbo, the combined-cycle block, consists of two gas turbines, each with its own generator. Each GT has its own HRSG. The two GT/HRSG trains are connected through a manifold to a single steam turbine that also has its own generator. The total electrical combined capacity of this fictitious combination is 710 MW.

- Units – The units which make up the example combined-cycle block are as follows –
  - Two 225 MW Gas Turbines numbered 301 & 302
  - One 260 MW Steam Turbine numbered 101
- Combined-cycle block – The combined-cycle block is a 710 MW combined cycle numbered 801

Example 1 – Three Reserve Shutdowns (RS) on Different Units.

Unit Event Report

- GT #2 placed on RS from January 1 at 0000 until January 7 at 0315. GT #2 was capable of providing 225 MW during this period.
- ST #1 placed on RS from January 3 at 0010 to January 6 at 0230. The steam turbine was capable of providing 260 MW during this period.
- GT #1 placed on RS from January 3 at 0015 to January 6 at 0215. GT #1 was capable of providing 225 MW during this period.

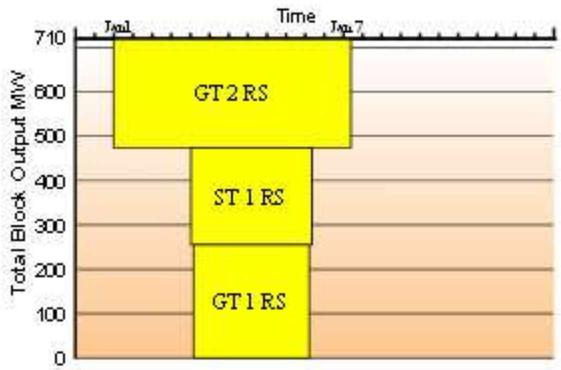

Figure L2-1: Concurrent RS

Summary of Example #1:

- GT #1 on Reserve Shutdown for 74.00 hrs x 225MW = 16,650 MWh.
- GT #2 on Reserve Shutdown for 147.25 hrs x 225 MW = 33,131.25 MWh.
- ST #1 on Reserve Shutdown for 74.33 hrs x 260 MW = 19.326.67 MWh.
- Combined-cycle block records 3 events:
  - RS of 16,650 MWh
  - RS of 33,131.25 MWh
  - RS of 19,326.67 MWh

Please note that only three events were reported: one for each unit. The block impact is the sum of each RS event by each of the three units. The equivalent block hours (69,107.92 MWh / 710MWh) are 97.34 hours.

Example 2 – Single Cause of Derates on All Units.

Unit Event Report

- GT #1 on D1 derate from January 7 at 1000 until January 7 at 1400. GT #1 was capable of providing 180 MW during this period. Cause code 3620 – Main Transformer.
- GT #2 on D1 derate from January 7 at 1000 to January 7 at 1400. GT #2 was capable of providing 180 MW during this period. Cause code 3620 – Main Transformer.
- ST #1 on D1 derate from January 7 at 1000 to January 7 at 1400. The steam turbine was capable of providing 208 MW during this period. Cause code 3620 – Main Transformer.

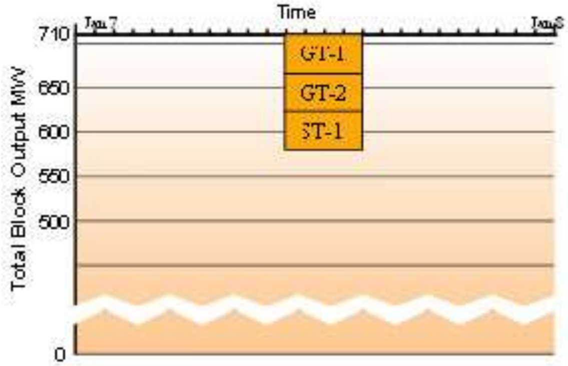

Figure L2-2: Single Cause of Derates

Summary of Example #2:

- GT #1 reports forced derate for 4Hrs x 45MW = 180 MWh.
- GT #2 reports forced derate for 4Hrs x 45MW = 180 MWh.
- ST #1 reports forced derate for 4Hrs x 52MW = 208 MWh.
- Combined-cycle block reports 3 overlapping derates:
  - Forced derate of 4hrs x 45MW = 180MWh
  - Forced derate of 4hrs x 45MW = 180MWh
  - Forced derate of 4hrs x 52MW = 208MWh

Total Block derated 568MWh (568 / 710 =0.80 Equivalent Hours)

Example 3 – Single Unit on Reserve Shutdown.

Unit Event Report

- GT #1 placed on RS from January 7 at 2115 to January 8 at 0500. GT #1 was capable of providing 225 MW during this period.

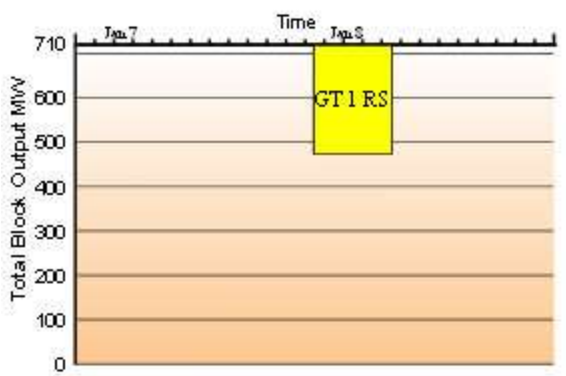

Figure L2-3: Single Unit on RS

Summary of Example #3:

- GT #1 on reserve shutdown 7.75 hours x 225MW = 1,743.75 MWh.
- Combined-cycle block reports reserve shutdown for 1,743.75 MWh (1,743.75 / 710 = 2.46 Equiv. Hours)

Example 4 - Single Unit on Outage, Affecting Other Units and Then Changing Event Types.

Unit Event Report

- GT #2 on Forced Outage (U1) from January 11 at 0700 to January 11 at 14:45 (cause code 5030 – supercharging fans). No supplemental firing of HRSG. GT #2 was capable of providing no MW during this period.
- As a result, ST #1 on forced derate (D1) from January 11 at 0700 to January 11 at 14:45 (cause code 5030 – supercharging fans). The steam turbine unit was capable of providing 130 MW during this period.
- GT #2 was placed on RS from January 11 at 1445 to January 14 at 0330. GT #2 was capable of providing 225 MW during this period.
- ST #1 was placed on reserve shutdown from January 12 at 0000 to January 12 at 11:20. The steam turbine unit was capable of providing 260 MW during this period.
- GT #1 was placed on RS from January 12 at 0015 to January 12 at 0930. GT #1 was capable of providing 225 MW during this period.

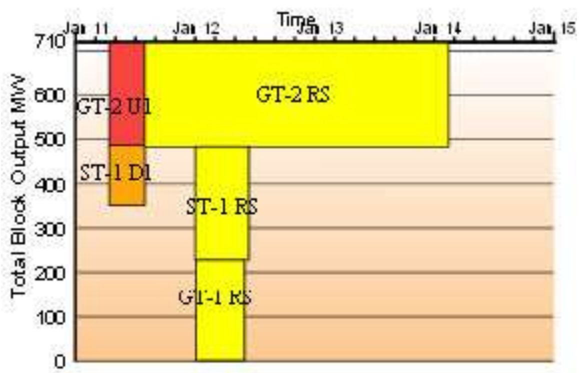

Figure L2-4: Single Unit Outage, Other Events

Summary of Example #4:

- GT #1 on Reserve Shutdown for 9.25 hrs x 225 MW = 2,081.25 MWh.
- GT #2 on forced outage for 7.75 hrs x 225 MW = 1,743.75 MWh.
- GT #2 on Reserve Shutdown for 60.75 hrs x 225 MW = 13,668.75 MWh.
- ST #1 on forced derate for 7.75 hrs x 130 MW = 1,007.50 MWh.
- ST #1 on Reserve Shutdown for 11.33 hrs x 260MW = 2,946.67 MWh.
- Combined-cycle block reports 5 events:
  - RS of 2,081.25 MWh
  - FO of 1,743.75 MWh
  - RS of 13,668.75 MWh
  - FO of 1,007.50 MWh
  - RS of 2,946.67 MWh

Example 5 – Reserve Shutdowns of unit followed by a startup failure of one unit.

Unit Event Report

- GT #1 was placed on RS from January 14 at 2215 to January 16 at 0445. GT #1 was capable of providing 225 MW during this period.
- ST #1 was placed on reserve shutdown from January 15 at 2300 to January16 at 0600. The steam turbine unit was capable of providing 260 MW during this period.
- GT #2 was placed on RS from January 15 at 2310 to January 16 at 0545. GT #2 was capable of providing 225 MW during this period.
- GT #1 on Startup Failure outage (SF) from January 16 at 0445 to January 6 at 0600 (cause code 5030 – supercharging fans). No supplemental firing of HRSG. GT #1 was capable of providing no MW during this period.
- As a result of the GT#1 SF, ST #1 on forced derate (D1) from January 16 at 0445 to January 16 at 0600 (cause code 5030 – supercharging fans). ST #1 was capable of providing 130 MW during this period. (Note: ST #1 was on RS but it is treated as if it were in service.)

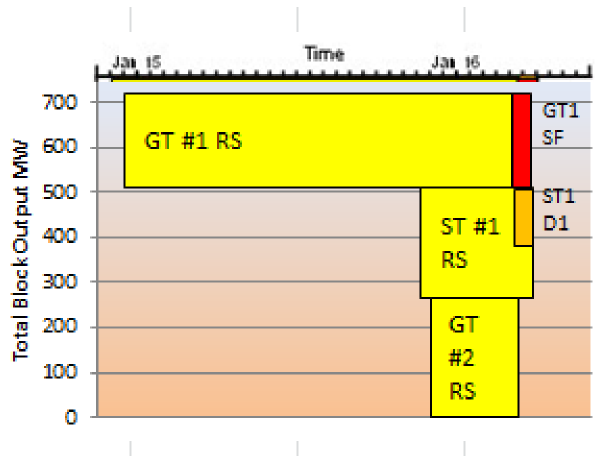

Figure L2-5: RS Followed by SF

Summary of Example #5:

- GT #1 on reserve shutdown for 30.50 hrs x 225 MW = 6,862.50 MWh.
- GT #1 on Forced Outage for 1.25 hrs x 225 MW = 281.25 MWh.
- GT #2 on reserve shutdown for 6.58 hrs x 225 MW = 1,481.25 MWh.
- ST #1 on reserve shutdown for 7.00 hrs x 260 MW = 1,820 MWh.
- ST #1 on forced derate for 1.25 hours with a loss of capacity of 130MW or 1.25 hrs x 130 MW = 162.50 MWh.
- Combined-cycle block reports the 5 events:
  - RS of 6,862.50 MWh
  - FO of 281.25 MWh
  - RS of 1,481.25 MWh
  - RS of 1,820.00 MWh

- D1 of 162.50 MWh

Example 6 – Unit outage to unit outage affecting other units.

Unit Event Report

- GT #2 on Forced Outage (U1) from January 22 at 0440 to January 22 at 0450 (cause code 5250 – Other Controls and instrumentation Problems).

Note: Because the FO on GT#2 was so short, there was no loss of steam flow to ST #1. Therefore, the steam turbine unit was capable of providing 260 MW during this period.

- GT #2 on Forced Outage (U1) from January 22 at 0455 to January 22 at 0545 (cause code 5250 – Other Controls and instrumentation Problems).
- As a result of GT #2 not providing steam service, ST #1 on forced derate (D1) from January 22 at 0455 to January 22 at 0545 (cause code 5250 – Other Controls and Instrumentation Problems). ST #1 was capable of providing 130 MW during this period.

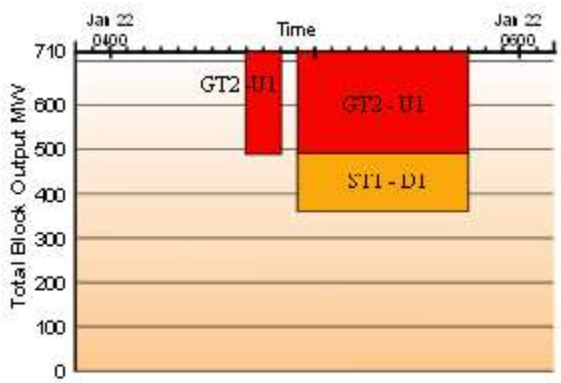

Figure L2-6: Multiple Unit Outages

Summary of Example #6:

- GT #2 reports 2 forced outages for 0.17 hrs x 225MW = 37.50 MWh. and 0.83 hrs x 225 MW = 187.50 MWh.
- ST #1 on forced derate for 0.83 hours (or 0.42 Equivalent Forced Derated Hours) or 0.83 hr x 130 MW = 108.33 MWh.
- Combined-cycle block reports the 3 events:
  - FO of 37.50 MWh
  - FO of 187.50 MWh
  - D1 of 108.33 MWh

Example 7 – Combined-Cycle Block Annual Planned Outage.

Unit Event Report

- GT #2 placed on Planned Outage from January 24 at 0000 until January 31 at 1000 (cause code 5260 – Major Gas Turbine Overhaul). GT #2 was not capable of providing power during this period.

- As a result of GT #2 not providing steam service, ST #1 was placed on Planned derate (PD) from January 24 at 0000 to January 24 at 0515 (cause code 5260 – Major Gas Turbine Overhaul). ST #1 was capable of providing 130 MW during this period.
- ST #1 placed on Planned Overhaul from January 24 at 0515 to January 31 at 1130 (cause code 4240 – low-pressure steam-turbine bearings). ST #1 was not capable of providing power during this period.
- GT #1 placed on Planned Outage January 24 at 0530 to January 31 at 1015 (cause code 5272 - Borescope inspection). GT #1 was not capable of providing power during this period.

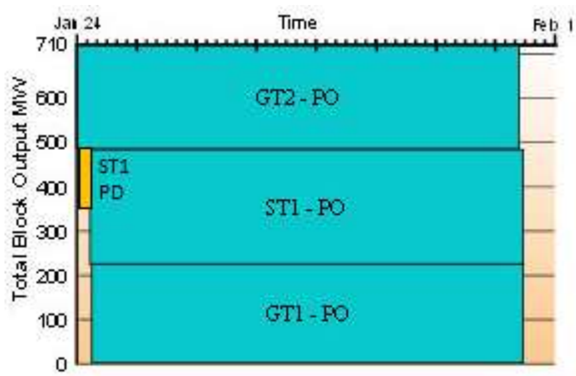

Figure L2-7: CC Block Annual PO

Summary of Example #7:

- GT #1 on Planned Outage for 172.75 hrs x 225 MW = 38,868.75 MWh.
- GT #2 on Planned Outage for 178.00 hrs x 225 MW = 40,050 MWh.
- ST #1 on Planned Derate for 5.25 hours with a loss of capacity of 130MW or 5.25 hrs x 130 MW = 682.50 MWh.
- ST #1 on Planned Outage for 174.25 hrs x 260 MW = 45,305 MWh.
- Combined-cycle block reports 4 events:
  - PO of 38,868.75 MWh
  - PO of 40,050 MWh
  - D1 of 682.50 MWh
  - PO of 45,305 MWh

Statistics from Unit Event and Performance Reports

There will be other outages, deratings, and reserve shutdown periods at a real combined-cycle block. We could list more, but they would just be repeats of the seven earlier examples. So to test the data collection methodology, we will calculate statistics for each unit and the combined-cycle block using the data from the seven examples.

The time period will be January 1 at 0000 to January 31 at 2400. This is a total of 744 hours during the month of January.

Net Actual Generation would be taken from the meters. Values stated here are for demonstration purposes only.

Table 1: Statistics from Unit Event and Performance Reports				
Statistic	**GT #1**	**GT #2**	**ST #1**	**CC Block**
Net Maximum Capacity	225	225	260	710
Period MWh	167,400	167,400	193,440	528,240.00
Forced Outage MWh	281.25	1,968.75	0	2,250.00
Planned Outage MWh	38,868.75	40,050.00	45,305.00	124,223.75
Maintenance Outage MWh	0	0	0	0.00
Reserve Shutdown MWh	27,337.50	48,281.25	24,093.33	99,712.08
Service MWh	100,912.50	77,100.00	124,041.67	302,054.17
Equiv. Forced Derated MWh	180.00	180.00	1486.33	1846.33
EFDH During RS MWh	0	0	162.50	162.50
Equiv. Plan. Derated MWh	0	0	682.50	682.50
Net Actual Generation	100,000	77,000	124,000	301,000.00
Attempted Starts	6	7	4	17.00
Actual Starts	5	7	4	16.00
Equiv. Availability Factor	76.51%	74.79%	75.46%	75.58%
Equiv. Forced Outage Rate	0.46%	2.72%	1.20%	1.36%
Forced Outage Factor	0.17%	1.18%	0.00%	0.43%
Forced Outage Rate	0.28%	2.49%	0.00%	0.74%
Scheduled Outage Factor	23.22%	23.92%	23.42%	23.52%
Net Capacity Factor	59.74%	46.00%	64.10%	56.98%
Starting Reliability	83.33%	100.00%	100.00%	94.12%

Table 2: Sample Data Summary									
Event #	**Unit**	**Event Type**	**Start Date**	**End Date**	**Duration**	**Loss MW**	**Loss MWh**	**Equiv. Blk Hrs**	**Example**
1	GT #2	RS	01/01/0000	01/07/0315	147:15:00	225	33,131.25	46.66	1
2	ST #1	RS	01/03/0010	01/06/0230	74:20:00	260	19326.67	27.22	
3	GT #1	RS	01/03/0015	01/06/0215	74:00:00	225	16,650.00	23.45	
4	GT #1	D1	01/07/1000	01/07/1400	4:00:00	45	180.00	0.25	2
5	GT #2	D1	01/07/1000	01/07/1400	4:00:00	45	180.00	0.25	
6	ST #1	D1	01/07/1000	01/07/1400	4:00:00	52	208.00	0.29	
7	GT #1	RS	01/07/2115	01/08/0500	7:45:00	225	1,743.75	2.46	3
8	GT #2	U1	01/11/0700	01/11/1445	7:45:00	225	1,743.75	2.46	4
9	ST #1	D1	01/11/0700	01/11/1445	7:45:00	130	1,007.50	1.42	
10	GT #2	RS	01/11/1445	01/14/0330	60:45:00	225	13,668.75	19.25	
11	ST #1	RS	01/12/0000	01/12/1120	11:20:00	260	2946.67	4.15	
12	GT #1	RS	01/12/0015	01/12/0930	9:15:00	225	2,081.25	2.93	
13	GT #1	RS	01/14/2215	01/16/0445	30:30:00	225	6,862.50	9.67	5
14	ST #1	RS	01/15/2300	01/16/0600	7:00:00	260	1,820.00	2.56	
15	GT #2	RS	01/15/2310	01/16/0545	6:35:00	225	1,481.25	2.09	
16	GT #1	SF	01/16/0445	01/16/0600	1:15:00	225	281.25	0.40	
17	ST #1	D1	01/16/0445	01/16/0600	1:15:00	130	162.50	0.23	
18	GT #2	U1	01/22/0440	01/22/0450	0:10:00	225	37.50	0.05	6
19	GT #2	U1	01/22/0455	01/22/0545	0:50:00	225	187.50	0.26	
20	ST #1	D1	01/22/0455	01/22/0545	0:50:00	130	108.33	0.15	

Table 2: Sample Data Summary									
Event #	Unit	Event Type	Start Date	End Date	Duration	Loss MW	Loss MWh	Equiv. Blk Hrs	Example
21	GT #2	PO	01/24/0000	01/31/1000	178:00:00	225	40,050.00	56.41	7
22	ST #1	PD	01/24/0000	01/24/0515	5:15:00	130	682.50	0.96	
23	ST #1	PO	01/24/0515	01/31/1130	174:15:00	260	45,305.00	63.81	
24	GT #1	PO	01/24/0530	01/31/1015	172:45:00	225	38,868.75	54.74	