Office of Utilities Regulation

DECLARATION OF GENERATION AVOIDED COSTS

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Estimation of Generation Avoided Costs
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1. DOCUMENT TITLE:

Office of Utilities Regulation Declaration of Generation Avoided Costs

2. **PURPOSE OF DOCUMENT**

This document sets out the initial declaration of Generation Avoided costs which is intended to be used to compute the costs of alternative sources of electricity and to define the market values of electricity generated by various sources.

3. RECORD OF REVISION

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APPROVAL

This document is approved by the Office of Utilities Regulation and becomes effective as of September 1, 2007.

On behalf of the Office:

J. Paul Morgan
Director General
Date

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Office Utilities Regulation

Generation Avoided Costs Declaration

Background

Consistent with its mandate to ensure the provision of a reliable supply of electricity to consumers at least cost, the Office of Utilities Regulation (OUR/the Office) has undertaken a review of the generation options available to determine the best strategy to address the capacity requirements for the public grid going forward. The review is largely based on recent assessments carried out by the OUR but takes into consideration information from LCEP reports submitted by Jamaica Public Service Company Limited (JPS) and the Acres Management Consultants (AMC) Study dated October 2006 and March 2007 respectively.

The Office's Regulatory Policy for the addition of generating capacity (Ele 2005/08.1) requires the OUR to provide sufficient data concerning avoided costs to allow the owner or operator of a qualifying facility (QF), to estimate with reasonable accuracy, the payment it could receive from JPS if the qualifying facility went into operation under any of the purchase agreements provided for in the policy. This draft paper sets out the methodology used to derive the generation avoided costs estimates based on the various possible conventional generation options over the long run. The actual estimates of avoided costs, using the methodology described herein are provided.

Qualifying Facilities (QF) are alternative resources that are:

- non conventional producers, including cogeneration, renewable sources such as wind, solar, geothermal, biomass etc.,

The calculation of avoided costs is used to compute the costs of alternative sources of electricity and to define the market values of electricity generated by various sources.

Where policy dictates that a particular generation option should be used, rather than competitive bidding, the payment to the operator will be based on the avoided cost plus any premium stipulated.

Additionally, cogeneration by virtue of its design should result in prices that are lower than the avoided cost published from time to time by the Office.

While the planning tools will provide a good guide for the estimation of the avoided costs, a more precise estimate can be achieved when the required capacity is subjected to competitive bids.

1. Definition of Avoided Costs

The definition of avoided cost applicable to our analysis is adopted from the United States Public Utility Regulatory Policy Act (PURPA). According to the definition of PURPA, avoided cost is the fixed and running costs of an electric utility system which can be avoided by obtaining energy or capacity from qualifying facilities. Following this definition avoided cost is the incremental cost of generating and delivering electric power that will not occur if an alternative source(s), is added to the system. Therefore avoided cost is the net savings that result when additional demand is covered by a more effective source over the period of the contract. The calculation of net savings depends on whether only direct/internal costs are taken into account, or whether indirect/external costs are included as well.

Avoided costs for the JPS electric grid, company can be defined as the incremental costs to the electric utility of energy or capacity or both which, but for the purchase from the qualifying facility or qualifying facilities, the utility would generate itself or purchase from other source. Avoided costs, therefore, incorporate projections of future year-by-year JPS system incremental costs.

2. Avoided cost calculation for various types of contracts

2.1. Long Term contracts with guaranteed capacity Components of generation avoided costs

The pertinent costs considered for the avoided costs calculation are:

(i) generation fixed costs (capacity costs),

(ii) generation variable costs (energy costs).

Generation fixed costs (capacity) include capital costs for new generation capacity to be installed over the planning period, depreciation of the investment and fixed maintenance costs for these facilities. All these costs are dependent on the characteristic of the generation plants. Variable (energy) costs include fuel

costs and variable operation and maintenance cost. The energy cost is also dependent on time of day (e.g. peak or off-peak) and prices of the fuel used.

Calculations of generation avoided costs for JPS must be consistent with the Least Cost Expansion Planning (LCEP) Methodologies, in order to identify the most cost-efficient resources and to minimize the cost of providing energy to consumers. To this end the Wien Automatic System Planning software, WASP, was employed to simulate the various generation options based on potentially new technology fuel type, fuel prices and projected demand growth for the twenty year period to 2027. One of the important outputs of the WASP programme is the incremental or marginal costs of generation over the long run (LRMC). This cost represents the incremental cost of providing electrical power to the system over a 20 year period in the most cost-efficient manner. The LRMC is the incremental capital, operating and maintenance and fuel costs for the twenty years planning horizon discounted to present value by the opportunity cost of capital (12%) attributable to new plants to be added over the 20 year planning horizon divided by the expected energy (or capacity) to be supplied by these plants. The incremental energy produced by these plants is also discounted to present value at the same rate and the unit fixed and variable costs are then calculated.

Since the addition of new capacity to the system should be done to satisfy the least cost criteria, then the cost avoided when this capacity is installed by another supplier would be the same as the LRMC. ***The avoided cost therefore approximates to the LRMC.***

2.2. Long term contracts without guaranteed capacity (Energy only)

Energy only pricing contracts are applicable in situation in which the capacity provided by Qualifying Facilities cannot be guaranteed. Pricing for these contracts will take the long run avoided variable cost into consideration. This is particularly relevant in cases of renewable energy supplies in which the availability of capacity is not certain (e.g. hydro, wind, and solar sources). Calculations of the variable avoided costs for JPS must be consistent with the Least Cost Expansion Planning (LCEP) Methodologies, in order to identify the most cost-efficiency resources and to minimize the cost of providing energy to consumers. WASP was employed to simulate the various generation options based on potentially new technology fuel type, fuel prices and projected demand growth for the twenty year period ending 2007. The least cost output of fuel

prices and variable Operating and Maintenance costs for all plants were discounted to present value by the opportunity cost of capital (12%) and divided by the discounted energy supplied by the least cost plants. The calculated values derived from this method is the long run variable (energy) avoided cost, applicable to long term contract without guaranteed capacity.

2.3. Short term Contracts

While most contracts will take the long run avoided variable cost into consideration, there will be scope for pricing based on the short term avoided cost. Under such arrangements the price per kWh will change from month to month depending on the cost of fuel to the system. The avoided cost applicable for the pricing of these qualifying facilities will be equal to JPS system cost of fuel for the month the energy is supplied

3. Range of generation avoided costs

The OUR estimation of the generation avoided costs is done in the context of the evaluation of generation options arising from an assessment of the LCEP report submitted by JPS and Acres Management Consultants (AMC) dated October 2006 and March 2007 respectively. Additionally, there have been significant developments regarding some of the key assumptions made in both studies, especially in relation to the availability of natural gas as an alternative fuel. The evaluation of a range of generation options has necessitated the need to estimate a range of generation avoided costs. The range of options includes the evaluation of the availability of LNG at US$4.50/Mbtu as one extreme to LNG not being available at the other extreme.
Consequently:

1. ***The range of generation avoided cost estimated for capacity and energy is 6.1 US cents/kWh to 6.9 US cents/kWh for contracts with guaranteed capacity.***

2. ***The range of generation avoided cost estimated for energy only qualifying facilities is 4.6 US cents/kWh to 5.0 US cents/kWh for contracts without guaranteed capacity.***

Table 1 provides an outline of the generation avoided cost estimates

Table 1

Plant Type	Range of Avoided cost
Conventional Technologies (capacity and energy)	6.1 – 6.9 US cents/kWh
Energy only	4.6 – 5.0 US cents/kWh

4. Variations on the Avoided Cost

The estimation of avoided costs gives the additional capabilities of cost comparison and advantage comparison of various projects of alternatives sources It is a useful tool for decision making, especially if the avoided cost is determined through a competitive bidding process. The calculation of avoided cost is done in order to estimate the value and to define the prices of electricity generated by various alternative sources and the indicative prices to be applied in the contracts between the market participants, i.e. JPS and IPPs. Three applicable variations are:

1. Renewable Technologies: In order to encourage the development of more environmentally friendly generation sources and to reduce Jamaica's reliance on imported fuels, the government has established, by policy, that Independent Power Producers (IPPs) may develop facilities employing renewable technologies (wind, solar, biomass, etc) and sell power to the grid (refer to OUR Document Ele 2005/08.1 "*Guidelines for the Addition of Generating Capacity to the Public Electricity Supply System*.") at a price up to ***15% above the avoided costs***.

2. Cogeneration Plants: The process of cogeneration enables the production of process heat and electricity to occur simultaneously thus allowing the combustion of fuel to take place at higher efficiency levels than is the case for conventional technologies. As a matter of policy the savings derived

from the process should be shared between the IPP and the end-users of electricity on the grid. The price at which power is bought from these plants is ***less than the avoided cost***. The precise price is determined by the OUR on a case by case basis after a technical evaluation of the system.

3. Short-term Arrangements: There are some small IPPs who are not in a position to commit to the long term provision of firm capacity but are capable of supplying the grid energy whenever it is available. The appropriate purchase price for operations of this type is the fuel cost avoided by other generators by virtue of the fact that energy is supplied from this source. The price of energy provided under this arrangement will be equal to JPS system cost of fuel for the month the energy is supplied.

Table 2 provides the purchase price per KWh for the alternatives discussed.

Table 2

Plant Type	Purchase Price per KWh
Renewable Technologies with guaranteed capacity	6.1 to 6.9 US cents plus premium
Cogeneration Plants	Less than 6.1US cents
Short Term Arrangement	JPS monthly cost of fuel

Changes in Avoided costs

The avoided cost will change over time because of updates to the demand forecast, changes in fuel prices and capital cost as well as improvements in technology. As a result of these factors the avoided cost will have to be updated to reflect these realities. The OUR will update the avoided cost on an annual basis or as the needs dictate.

APPENDIX – Tables showing derivation of guaranteed capacity avoided cost and non-guaranteed (energy only) avoided cost based on a range of generation options.

Guaranteed Capacity Avoided Cost - Base Case LNG Available									
Year	**Present Value Factor**	**Capital Cost (US k$)**	**O&M Cost (US k$)**	**Fuel Cost (US k$)**	**Energy (GwH)**	**Capital Cost (US k$), PV in 2007 at 12%**	**O&M Cost (US k$), PV in 2007 at 12%**	**Fuel Cost (US k$), PV in 2007 at 12%**	**Energy (GwH), PV in 2007 at 12%**
2007	1.0000	_	_	_	_	_	_	_	_
2008	0.8929	_	_	_	_	_	_	_	_
2009	0.7972	_	_	_	_	_	_	_	_
2010	0.7118	_	_	_	_	_	_	_	_
2011	0.6355	_	_	_	_	_	_	_	_
2012	0.5674	284600	8946.7	76616.5	2152.7	161489.7	5076.6	43474.3	1221.5
2013	0.5066		8946.7	76616.5	2152.7	0.0	4532.7	38816.3	1090.6
2014	0.4523	129300	13104.1	107769.9	3075.5	58488.8	5927.6	48749.6	1391.2
2015	0.4039	129300	17232.4	138487.7	3985.5	52222.1	6959.9	55932.9	1609.7
2016	0.3606		17244.5	138654.8	3990.7	0.0	6218.5	50000.3	1439.1
2017	0.3220	129300	21301.4	168443.9	4870.9	41631.1	6858.5	54234.4	1568.3
2018	0.2875		21346.1	169122.6	4891.3	0.0	6136.5	48618.7	1406.1
2019	0.2567		21373.2	169432.8	4901.6	0.0	5486.0	43489.2	1258.1
2020	0.2292	129300	25366.2	198361.9	5755.2	29632.2	5813.3	45459.4	1318.9
2021	0.2046		25451.8	199618.3	5793.3	0.0	5207.9	40845.9	1185.4
2022	0.1827	129300	29252.7	226045.4	6567.4	23622.6	5344.4	41297.6	1199.8
2023	0.1631		29464.7	228841.1	6655.6	0.0	4806.3	37328.9	1085.7
2024	0.1456	129300	33043.4	253454.8	7359.3	18831.8	4812.6	36914.3	1071.8
2025	0.1300	26000	33820.1	267090.8	7675.3	3381.0	4398.0	34732.4	998.1
2026	0.1161	129300	37222.1	289874.2	8315.6	15012.6	4321.7	33656.4	965.5
		TOTALS				**404311.98**	**81900.45**	**653550.55**	**18809.91**
		LRMC		**0.061**	**US$/KWH**				

Guaranteed Capacity Avoided Cost - Base Case LNG Available									
Year	**Present Value Factor**	**Capital Cost (US k$)**	**O&M Cost (US k$)**	**Fuel Cost (US k$)**	**Energy (GWh)**	**Capital Cost (US k$), PV in 2007 at 12%**	**O&M Cost (US k$), PV in 2007 at 12%**	**Fuel Cost (US k$), PV in 2007 at 12%**	**Energy (Gwh), PV in 2007 at 12%**
2007	1.0000	_	_	_	_	_	_	_	_
2008	0.8929	_	_	_	_	_	_	_	_
2009	0.7972	_	_	_	_	_	_	_	_
2010	0.7118	_	_	_	_	_	_	_	_
2011	0.6355	_	_	_	_	_	_	_	_
2012	0.5674	615560	32181.9	55107.9	2678.9	349285.3	18260.9	31269.7	1520.1
2013	0.5066	210500	41554.2	73370.9	3541.3	106645.9	21052.7	37172.0	1794.1
2014	0.4523		41565.7	73420.4	3543.1	0.0	18802.2	33211.7	1602.7
2015	0.4039	421000	59029.2	105536.3	5078.6	170034.8	23840.9	42624.3	2051.2
2016	0.3606		59505.4	107163.5	5148.9	0.0	21458.2	38644.2	1856.8
2017	0.3220	210500	67170.6	120190.1	5763.3	67775.4	21627.1	38698.0	1855.6
2018	0.2875		67911.9	122453.3	5870.9	0.0	19523.0	35202.4	1687.8
2019	0.2567		68553.1	124352.8	5963.7	0.0	17595.9	31918.3	1530.7
2020	0.2292	210500	76194.0	137562.0	6576.2	48241.2	17461.7	31525.7	1507.1
2021	0.2046	210500	29026.3	148415.5	7072.0	43072.5	5939.4	30368.8	1447.1
2022	0.1827		84398.5	152455.6	7270.5	0.0	15419.3	27853.1	1328.3
2023	0.1631	44900	85530.1	155863.8	7545.1	7324.2	13951.8	25424.8	1230.8
2024	0.1456	210500	92751.7	167792.1	8057.1	30658.1	13508.8	24438.0	1173.5
2025	0.1300		94145.1	171911.9	8288.5	0.0	12242.6	22355.4	1077.8
2026	0.1161	210500	101373.4	183977.5	8805.5	24440.5	11770.1	21361.0	1022.4
		TOTALS				**847477.74**	**252454.59**	**472067.18**	**22685.81**
		LRMC		**0.069**	**US$/KWH**				

Avoided Cost - Base Case LNG Available (Energy Only)									
Year	**Present Value Factor**	**Capital Cost (US k$)**	**O&M Cost (US k$)**	**Fuel Cost (US k$)**	**Energy (GWh)**	**Capital Cost (US k$), PV in 2007 at 12%**	**O&M Cost (US k$), PV in 2007 at 12%**	**Fuel Cost (US k$), PV in 2007 at 12%**	**Energy (Gwh), PV in 2007 at 12%**
2007	1.0000	_	95154.9	309145.1	3578.6	_	95154.90	309145.10	3578.56
2008	0.8929	_	96485.7	333830.6	4306.7	_	86147.95	298063.04	3845.30
2009	0.7972	_	97533.8	355798.8	4484.7	_	77753.35	283640.63	3575.21
2010	0.7118	_	98539.5	379834.6	4663.1	_	70138.47	270358.77	3319.10
2011	0.6355	_	99569.1	405983.8	4844.5	_	63277.96	258010.04	3078.77
2012	0.5674	_	89856.2	218109.8	5067.1	_	50986.82	123761.36	2875.19
2013	0.5066	_	91156.4	231786.7	5277.7	_	46182.67	117430.36	2673.86
2014	0.4523	_	90572.4	219727.2	5494.6	_	40970.35	99393.43	2485.49
2015	0.4039	_	63432.0	216153.2	5727.3	_	25619.12	87300.65	2313.14
2016	0.3606	_	65428.3	229246.9	5974.3	_	23594.10	82668.73	2154.39
2017	0.3220	_	63751.6	228155.0	6232.8	_	20526.31	73459.80	2006.81
2018	0.2875	_	66035.2	240988.6	6497.8	_	18983.54	69278.46	1867.95
2019	0.2567	_	68426.0	255471.6	6777.8	_	17563.25	65573.20	1739.69
2020	0.2292	_	66783.3	256922.5	7073.9	_	15305.01	58880.01	1621.15
2021	0.2046	_	69260.0	271770.0	7377.0	_	14171.97	55609.53	1509.48
2022	0.1827	_	68469.2	276327.2	7696.9	_	12509.07	50483.95	1406.19
2023	0.1631	_	70858.8	291640.1	8024.1	_	11558.61	47572.82	1308.91
2024	0.1456	_	70713.8	299562.6	8369.7	_	10299.06	43629.60	1219.00
2025	0.1300	_	71949.3	315920.4	8733.5	_	9356.26	41082.16	1135.70
2026	0.1161	_	72175.6	327776.7	9113.2	_	8380.08	38057.10	1058.11
		TOTALS					**326006.21**	**1054181.14**	**27375.05**
		LRMC		**0.050**	**US$/KWH**				

Non-Guaranteed Capacity (Energy only) Avoided Cost - No LNG Case									
Year	**Present Value Factor**	**Capital Cost (US k$)**	**O&M Cost (US k$)**	**Fuel Cost (US k$)**	**Energy (GWh)**	**Capital Cost (US k$), PV in 2007 at 12%**	**O&M Cost (US k$), PV in 2007 at 12%**	**Fuel Cost (US k$), PV in 2007 at 12%**	**Energy (Gwh), PV in 2007 at 12%**
2007	1.0000	_	95154.9	309235	4087.8	_	95154.9	309234.6	4087.76
2008	0.8929	_	96485.7	333920	4306.7	_	86147.9	298142.9	3845.30
2009	0.7972	_	97533.8	355888	4484.8	_	77753.3	283711.9	3575.28
2010	0.7118	_	98559.5	375924	4663.1	_	70152.7	267575.3	3319.10
2011	0.6355	_	99569.1	406073	4844.5	_	63278.0	258066.9	3078.79
2012	0.5674	_	113555.2	212047	5066.2	_	64434.3	120321.2	2874.71
2013	0.5066	_	115379.8	180271	5277.8	_	58455.0	91330.7	2673.87
2014	0.4523	_	117895.8	196677	5494.3	_	53330.1	88966.7	2485.32
2015	0.4039	_	96437.1	142728	5726.8	_	38949.3	57645.3	2312.94
2016	0.3606	_	99258.7	157681	5973.1	_	35793.7	56861.2	2153.95
2017	0.3220	_	102124.9	144916	6232.5	_	32881.5	46659.1	2006.69
2018	0.2875	_	104947.2	158686	6467.0	_	30169.8	45618.5	1859.11
2019	0.2567	_	108057.2	174966	6775.9	_	27735.6	44909.3	1739.21
2020	0.2292	_	111819.7	166003	7072.8	_	25626.2	38043.7	1620.90
2021	0.2046	_	115868.5	162525	7376.9	_	23709.0	33255.8	1509.45
2022	0.1827	_	118953.3	175872	7696.0	_	21732.3	32131.2	1406.02
2023	0.1631	_	122538.1	189653	8023.1	_	19988.6	30936.4	1308.75
2024	0.1456	_	127088.2	186725	8369.8	_	18509.7	27195.4	1219.01
2025	0.1300	_	130537.7	202943	8732.5	_	16975.1	26390.7	1135.58
2026	0.1161	_	135555.7	202458	9113.7	_	15738.9	23506.7	1058.16
		TOTALS					**484029.0**	**763771.9**	**27363.67**
		LRMC		**0.046**	**US$/KWH**				