



# **TC Study on the Request for the Reclassification of Impounding HEPP as Non-Scheduled Generating Unit**

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**April 2020**

This Report is prepared by the  
Technical Committee.

## **EXECUTIVE SUMMARY**

The TC submits this Report to the Department of Energy (DOE) in response to the latter's request to conduct a study on the feasibility of allowing impounding hydroelectric power plants (HEPP), specifically those with contracts to provide peaking requirements, to register as non-scheduled generating units in the Wholesale Electricity Spot Market (WESM).

To provide our recommendation to the said request, we reviewed the following areas:

### **A. Definition of a Non- Scheduled Generating Unit**

As defined in the Philippine Grid Code and WESM Rules, a generating unit can be classified as a non-scheduled generating unit if its nameplate rating is less than one tenth of one percent ( $<0.1\%$ ) of the peak load in a particular reserve region, or less than ten percent ( $<10\%$ ) of the size of the interconnection facilities, whichever is lower. In Luzon, a generating unit's capacity must be 11 MW or below to be 0.1% of Luzon's 11,344 MW peak demand in 2019.

Based on the registered capacity of the impounding HEPPs in the WESM, their installed capacity is more than 11 MW each. Thus, following the PGC and WESM Rules definition, these HEPPs do not qualify as non-scheduled generating plants; they fall under the category scheduled generating units.

### **B. Pivotal Supplier Index**

A generating plant is considered pivotal in a region when the sum of the remaining generating plants' capacities, after excluding its capacity, is less than the total demand (including reserve requirements) in that region for the relevant trading periods. In the WESM, pivotal suppliers are typically the large generating plants.

For this report, we reviewed data from 26 February 2019 to 25 May 2019, which was last year's dry season and observed that impounding HEPPs are pivotal suppliers. Hence, it is not recommended that these power plants be reclassified as non-scheduled generating units.

### **C. Offer Pattern**

The offer pattern of impounding HEPPs is generally similar during peak and off-peak hours, that is why some of them were dispatched even during off-peak hours. The dispatch of impounding HEPPs during peak and/or off-peak hours, even those with contracts to provide peaking requirements, would really depend on their bidding behavior.

In view of the foregoing, the TC respectfully recommends the retention of the classification of impounding HEPPs that are currently registered in the WESM as scheduled generating plants.

## Table of Contents

I. BACKGROUND .....	2
II. IMPOUNDING HYDROELECTRIC POWER PLANT .....	2
III. DEFINITION OF SCHEDULED AND NON-SCHEDULED GENERATING UNITS .....	3
IV. PIVOTAL SUPPLIER INDEX .....	5
V. OFFER PATTERN OF IMPOUNDING HEPPs IN THE WESM .....	7
VI. CONCLUSION .....	7

## **I. BACKGROUND**

On 10 December 2019, the Technical Committee received a letter from Assistant Secretary Redentor Delola of the Department of Energy (DOE) with a request to conduct a study on the feasibility of allowing impounding hydroelectric power plants (HEPP), specifically those with contracts to provide peaking requirements, to register as non-scheduled generating units in the Wholesale Electricity Spot Market (WESM).

During the TC Meeting held on 08 January 2020, the DOE observer in the TC explained that the foregoing request arose due to instances of impounding HEPPs being dispatched during off-peak hours, which affects the supply security during peak hours.

In response to the foregoing request, the TC respectfully submits this Report to Asec Delola, for consideration. The succeeding sections provide the TC's assessment and conclusion to the request.

## **II. IMPOUNDING HYDROELECTRIC POWER PLANT**

Impounding hydroelectric power plants store water in the reservoir behind a dam. Reservoir capacities can be small or very large, depending on the characteristics of the site and the economics of dam construction.<sup>1</sup> Hydroelectric power plants with impounding capacity offer flexibility to a power system. These plants can respond almost instantaneously to changes in the quantity of power in the grid. These power plants can effectively hold inflows in reservoirs and could then generate power when needed in the grid.<sup>2</sup>

It is noteworthy that the total registered capacity of impounding HEPPs at 1,581 MW accounts for about 8% of the total WESM registered capacity of 20,172 MW and 10% of the Luzon's total WESM registered capacity of 16,503 MW, as of 25 March 2020.

Table 1 lists the impounding HEPPs in Luzon with their capacity and purpose.

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<sup>1</sup> Renewable Energy Technologies: Cost Analysis Series, Volume 1: Power Sector, Issue 3/5, June 2012.

<sup>2</sup> Study on Luzon HEPP, Technical Committee, December 2013

Table 1. Impounding HEPPs in Luzon<sup>3</sup>

No.	Facility Name	WESM Registered Capacity (MW) <sup>4</sup>	Purpose	Ancillary Services Provider (Y/N)
1	Ambuklao	105	Flood Control, Power Generation	Yes, Contingency Reserve and Dispatchable Reserve
2	Angat Main	200	Domestic Supply, Irrigation, Flood Control, Power Generation	No
3	Binga	140	Flood Control, Power Generation	Yes, Contingency Reserve
4	Caliraya	28	Irrigation, Power Generation	No
5	Casacnan (NIA)	165	Irrigation, Power Generation	No
6	Magat	388	Irrigation, Flood Control, Power Generation	Yes, Regulating Reserve
7	Pantabangan	120	Irrigation, Power Generation	Yes, Regulating Reserve
8	San Roque	435	Irrigation, Water Quality Improvement, Flood Control, Power Generation	Yes, Contingency Reserve , Dispatchable Reserve
	Total Capacity	1,581		

### III. DEFINITION OF SCHEDULED AND NON-SCHEDULED GENERATING UNITS

Table 2 provides the relevant provisions in the Philippine Grid Code (PGC) and WESM Rules on the definition of scheduled and non-scheduled generating units.

<sup>3</sup> List of Existing Power Plants in Luzon as of 30 June 2019 [Online]. Available: <https://www.doe.gov.ph/list-existing-power-plants>

<sup>4</sup> WESM Registered Capacity List, PEMC, 25 March 2020

Table 2. Definition of Scheduled and Non-scheduled Generating Units

Term	REFERENCE	
	PGC	WESM Rules
Scheduled Generating Unit	A generating unit or a group of generating units connected at a common Connection Point with a nameplate rating of greater than or equal to one tenth of one percent ( $>0.1\%$ ) of the peak load in a particular reserve region	A generating unit or a group of generating units connected at a common connection point with a nameplate rating or a combined nameplate rating of greater than or equal to one tenth of one percent ( $> 0.1\%$ ) of the peak load in a particular reserve region shall be classified as a scheduled generating unit.
Non-Scheduled Generating Unit	A generating unit or a group of generating units connected at a common point with a nameplate rating and a combined nameplate rating of less than one tenth of one percent ( $<0.1\%$ ) of the peak load in a particular reserve region, or less than ten percent ( $<10\%$ ) of the size of the interconnection facilities, whichever is lower.	A generating unit or a group of generating units connected at a common connection point with a nameplate rating or a combined nameplate rating of less than one tenth of one percent ( $< 0.1\%$ ) of the peak load in a particular reserve region, or less than ten percent ( $< 10\%$ ) of the size of interconnection facilities, whichever is lower, shall be classified as a nonscheduled generating unit, but may at its option be classified as a scheduled generating unit.

In 2019, the peak load in Luzon was recorded on 21 June, 1352H, at 11,344 MW. Applying the above definitions, a generating unit in Luzon can only be classified as a non-scheduled generating unit if its installed capacity is 11 MW or below. However, all impounding HEPPs in Luzon have an installed capacity of more than 11 MW each. Except for Caliraya which is twice this limit, all other impounding HEPPs are around 10 to 40 times larger than this limit. Thus, strictly following the PGC and WESM Rules definition, these HEPPs do not qualify as non-scheduled generating plants and instead fall under the category scheduled generating units.

#### IV. PIVOTAL SUPPLIER INDEX

In this section, the TC assesses if the impounding HEPPs are critical in supplying the system demand vis-a-vis the effective supply at a given interval using the pivotal supplier index (PSI)<sup>5</sup> test.

A generating plant is considered pivotal in a region when the sum of the remaining generating plants' capacities, after excluding its capacity, is less than the total demand (including reserve requirements) in that region for the relevant trading periods. For this reason, a pivotal supplier can determine the spot price for energy in the affected region during the relevant trading periods and is said to have transient market power<sup>6</sup>. In the WESM, pivotal suppliers are typically the large generating plants. We further emphasize that pivotal suppliers must offer their capacity to the market.

To determine if any of the impounding HEPPs was classified as a pivotal supplier during the summer period or from 26 February to 25 May 2019, the following formulae<sup>7</sup> were used:

$$RDemi_i^h = GenTot^h + Res^h - (\Sigma GenCap^h - GenCap_i^h) - IntCap^h$$

$$PSI_i^h = 1, \text{ if } RDemi_i^h > 0$$

$$PSI_i^h = 0, \text{ if } RDemi_i^h \leq 0$$

Where:

- $RDemi_i^h$  residual demand of generator  $i$  in hour  $h$
- $PSI_i^h$  the pivotal supplier index for generator  $i$  in hour  $h$
- $GenTot^h$  total generation required in hour  $h$  to supply the load (energy withdrawn plus transmission losses)
- $Res^h$  the operating reserve in hour  $h$
- $\Sigma GenCap^h$  the sum of offered capacity of all generators in hour  $h$
- $GenCap_i^h$  offered capacity of generator  $i$  in hour  $h$
- $IntCap^h$  available import capacity from interconnection in hour  $h$

$$PSI_i^t = \frac{\Sigma PSI_i^h}{(\text{No. of hours in period } t)}$$

Where:  $PSI_i^t$  refers to the percentage of time that generator  $i$  is pivotal in period  $t$

<sup>5</sup> The PSI is a binary variable which measures for a generator in a particular period of time whether the demand can be supplied without that generator (Reference: WESM Catalogue of Market Monitoring Data and Indices, Issue 1., 17 May 2006)

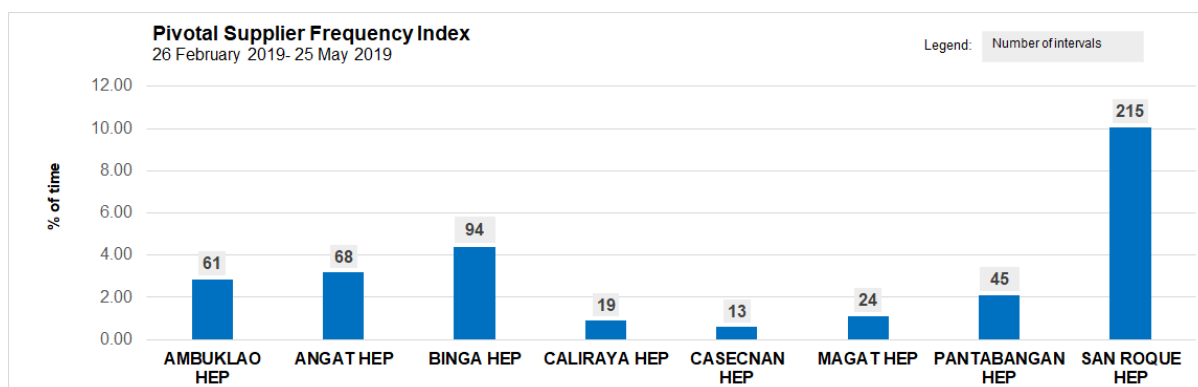
<sup>6</sup> Discussion Paper on Pricing in Pivotal Supplier Situations, Wholesale Advisory Group, 07 March 2013  
<https://www.ea.govt.nz/dmsdocument/15049-discussion-paper-pricing-in-pivotal-supplier-situations>

<sup>7</sup> Catalogue of Market Monitoring Data and Indices Issue 1.0, WESM, May 2006



Figure 1 shows the percent of time and number of intervals when the impounding HEPPs were tagged as pivotal suppliers during the said covered period.

Figure 1. Pivotal Supplier Frequency Index, System (26 February 2019 -25 May 2019)



Note: Total number of intervals: 2,136

During the said period, all impounding HEPPs were identified as pivotal suppliers, with San Roque HEPP recording the highest frequency at 12 percent of the time, or 215 intervals. In fact, San Roque HEPP was consistently part of the top 20 generating plants identified as pivotal suppliers during the said period.<sup>8</sup>

In the WESM, scheduled generating units are subject to the must-offer rule (MOR) or the requirement for all scheduled generation companies to offer their maximum available capacity of their respective plants. On the other hand, non-scheduled generating units are required to only submit the projected output for the next trading day.

It is important to note that as pivotal suppliers, the impounding HEPPs cannot be allowed to only submit their projected outputs instead of generation offers. Moreover, if impounding HEPPs are categorized as non-scheduled generating units, some scheduled generating plants will be constrained-off when the forecasted demand ends up to be less than the actual demand. Higher actual generation than the projected output of impounding HEPPs may pose significant impact to the grid particularly when there is excess generation and may also affect the scheduled generators equivalent to the capacity of the impounding HEPPs when trying to address such excess generation. Furthermore, the considerable capacity share of impounding HEPPs may cause significant imbalance in the ex-ante and ex-post market results, if they submit inaccurate projected output.

Given the foregoing results, impounding HEPPs should not be reclassified as non-scheduled generating units.

<sup>8</sup> Quarterly Market Assessment Report for 1<sup>st</sup> Quarter 2019 and 2<sup>nd</sup> Quarter 2019

## **V. OFFER PATTERN OF IMPOUNDING HEPPs IN THE WESM**

Regarding the concern that impounding HEPPs should be maximized during peak hours instead of off-peak hours, it should be noted that the bidding behavior of these plants determines their dispatch schedule every interval considering the merit order table in the WESM. As such, the TC reviewed the offer pattern of the impounding HEPPs during peak and off-peak periods from 26 February 2019 to 25 May 2019.

It is expected that impounding HEPPs should have offered their capacities at higher prices during off-peak hours so that they will not be dispatched during the said intervals and would be able to maintain the water level allotted for its power generation requirement during peak hours. Moreover, impounding HEPPs should have offered their capacities at lower prices during peak hours to be dispatched.

Based on the observations on the offer patterns of impounding HEPPs, these plants have a similar offer during peak and off-peak hours. The dispatch of impounding HEPPs, especially those with contracts to provide peaking requirements, during peak hours would really depend on their bidding behavior.

## **VI. CONCLUSION**

In summary, the TC emphasizes the following:

1. The impounding HEPPs registered in the market do not qualify as non-scheduled generating unit pursuant to the definitions provided in the PGC and WESM Rules based on the plant's capacity.
2. Allowing impounding HEPPs, which were identified as pivotal suppliers, to submit projected output instead of generation offers may compromise supply security, since they will no longer be required to comply with the must-offer rule.
3. The dispatch of impounding HEPPs during peak or off-peak hours, even those with contracts to provide peaking requirements, would depend on their bidding behavior.

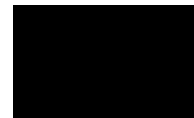
In view of the foregoing, the TC respectfully recommends the retention of the classification of impounding HEPPs as scheduled generating plants.

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