Ministry of Energy and Mineral Resources
The Republic of Indonesia

THE STUDY ON OPTIMAL ELECTRIC POWER DEVELOPMENT
IN JAVA-MADURA-BALI IN THE REPUBLIC OF INDONESIA

JUSTIFICATION OF JICA STUDY REPORT AGAINST RUKN 2008-2027

DECEMBER 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

NEWJEC INC.
THE KANSAI ELECTRIC POWER CO., INC.

Table of Contents

Justification of JICA Study Report against RUKN 2008-2027

1. INTRODUCTION

The Study on optimal electric power development in Java-Madura-Bali was executed from January 2008 to December 2008. During the period, continuous efforts were made to acquire the latest information relevant to the planning work from the Indonesian counter parts (hereinafter called “the CPs”), and the electric power development plan was produced through discussions held between two parties, JICA study team (hereinafter called “the Team”) and the CPs on several occasions. Both parties agreed on the prerequisites and the substances of the plan as described in the minutes of meeting. Moreover, the technology transfer for long-term planning and power system operation has been done to the CPs via discussions, workshops (held three times in the Study), and a technology transfer seminar.

The national overall electric power plan issued by MEMR, RUKN, is one of the most important sources for the JICA study. As of the early 2008, RUKN for the period between 2006 and 2026 (hereinafter called “RUKN2006”) had been effective and its revision, which was to be RUKN 2008-2027 (hereinafter called “RUKN2008”), was under way. Therefore, the Team decided to use RUKN2006 as an official document for reference. The final site investigation by the Team was made in October 19 through November 21, 2008. The Team inquired of MEMR counter part about the progress of the revision and new policy direction, if any, in RUKN. MEMR counter part told the Team that they could not provide any details until the RUKN update work would be completed

When the Team met with Ms. Emy, the director of electricity program supervision in MEMR on November 19, 2008, and asked the present progress of RUKN. She answered that Mr. Purnomo, the Minister of MEMR has approved new RUKN recently, and it would not be long until it is open to the public. The Team returned to Japan soon afterwards, before RUKN2008 was disclosed in the middle of December. However, the date of approval signed by Mr. Purnomo Yusgiantoro, the Minister of MEMR was November 13, 2008.

The Team examined RUKN 2008 and found that some descriptions of the final report of the Study, which was even produced based on the information provided from the CPs, are not in line with RUKN2008. Differences appear in parts of policy, electric power demand forecast, power supply equipment, primary energy, social environmental consideration, and investment fund. The Team investigated why these differences occurred, and the result is summarized in this booklet. It is expected that the CPs find this booklet helpful to produce or update long term power development plans in the future (December 17, 2008).

2. POLICY

A long-term electric power development plan is formulated by optimizing possible scenarios. In the Study, "policy oriented scenario" was produced which follows the existing policies and plans of the government of Indonesia such as RUKN2006 primarily. In addition, three scenarios such as "coal power acceleration scenario", "power source diversification scenario", and "carbon dioxide emission reduction scenario" were made. The Team and the CPs agreed through several discussions that "power source diversification scenario" is the optimal scenario among four alternative scenarios (the 3rd workshop proceedings, November 5, 2008).

It is stated in RUKN2008 that the primary energy demand of the power supply should satisfy the least cost principle. This statement may be misleading. The least cost should be attained by optimizing electric power development plan as a whole including not only primary energy but also capital investments and operations. It should be expressed in a more specific manner: "a long-term electric power development plan should be developed on the basis of the least cost including primary energy cost, capital investment and operation cost".

It is unclear whether RUKN2008 was actually produced on the least cost basis. In "Chapter 6, Necessity of investment fund", it mentions that the unit price of US$ one million per MW is uniformly multiplied by necessary capacity of power supply equipment to compute the overall capital investment. That means that the electric power development plan for the future is not examined on the least cost. A coal thermal power is considered to be the lowest cost power plant today. The proportion of coal in the total primary energy consumption was revised downward to 62% as of 2010, and 63% as of 2018 in RUKN2008 from 71% as of 2010 in RUKN2006. The change shows RUKN2008 turns to "power source diversification", using more proportion of gas and geothermal with less proportion of coal compared to RUKN2006 which placed more emphasis on cost reduction.

Moreover, the development plan of nuclear power is not incorporated in RUKN2008 regardless of its benefits of lower power generation cost and no emission of carbon dioxide. As a nuclear power development is a politically sensitive issue, it may have been omitted in RUKN. However, there is no official report so far that the government has withdrawn from the nuclear power development plan.

Subprime loan problems originated in the United States in 2007 burst out in the fall of 2008, devastating the economy worldwide. Along with it, oil prices shot up to the record high of $140 per barrel in July after passing $100 in February, then suddenly turned downward to reach around $40 as of December, 2008. Indonesian currency, rupiah, staying stable at about 9,000 against US dollar until the economic crisis, dropped to 11,000 as of early December.

This turbulence in global economy may pose effects on the demand and supply of electricity in Jamali region in various forms. Industrial productions will be lowered especially in export oriented industries, which put downward pressure on the demand growth. The fall of oil prices reduces the generation cost, while financial obligations on foreign loans and IPP payments will grow larger. The prices of generating equipment which have been going up for the last few years may rise or fall. We have no way of knowing how hard these shocks would be: they can be only short lived, or can be more damaging and persisting than those of the Asian economic crisis in the late 1990s. We cannot eliminate this kind of uncertainties and this is why we preferred the diversification scenario for the power development program. Our counterparts now have to observe closely the evolution of the crisis and at the same time make sure the realization of those projects under way and prepare for the recovery of the economy.

3. ELECTRIC POWER SUPPLY AND DEMAND

An average growth rate of the long-term electric power demand for Jamali region is expected at 10.1% annually in RUKN2008, which is much larger than the forecast value, 6.5% in JICA report. The growth rate in RUKN2008 was an upward revision of 6.6% in RUKN2006 while the average GDP growth rate for coming 20 years is exactly the same at 6.1% in RUKN2008 and in RUKN2006. JICA study result is, therefore, corresponding to RUKN2006 but not to RUKN2008.

The electric power demand in terms of peak load and energy sales had recorded a high of 10% or more a year before Asian economic crisis in 1998, but the rate is much lower after 2000 and the average growth rate between 2003 and 2007 was 6.5%. The Team uses the data after 2000 when the real economy was on the way of recovery from the economic crisis, and correlation between electric power demand and the economy was stable.

The GDP elasticity of electric power demand (demand growth rate/GDP growth rate) assumed in RUKN2008 is very high, at about 1.7 (1.5 nationwide). This is not in line with the track records of about 1.1 to 1.2 in recent years or the national target of one in the future, which will be attained by promoting energy conservation and rationalization of electricity use, etc. The promotion of energy conservation is also currently being studied by JICA. RUKN2008 makes no reference to the output of the Study at all. The elasticity used in JICA demand forecast, about 1.1 is close to the records in the last few years, and seems realistic.

The difference results from the thinking of MEMR and PLN that the materialized demand does not reflect the underlying actual demand due to the constrained power supply. However, power supply shortage became prominent only in recent year and the Team considers the lower demand growth in the 2000s compared with the 1990s is the result of not only the power supply shortage but also a structural change in power use. The demand growth in Japan after the oil crises in the 1970s slowed down to about 6-8% compared to that in the 1960s around 10% or more).

During the repeated discussions with the CPs, the Team was informed that the CPs considered an increase of the waiting list for the electric power connection in the past few years pointed to the supply constraints and immaterialized demand. The Team considers, however, that the sudden increase of the waiting list relates to the rise of crude oil price during the corresponding period. Large-scale electric power consumers with own generating plants reacted to the advantage of using cheaper electric power of PLN which is heavily subsidized by the government under the present circumstance. Adding the increased waiting list on top of demand growth would surely mislead the demand forecast for coming 20 years, simply leading to overvaluation.

Meanwhile, there is a possibility that the economic crisis that hit the global economy late in 2008 dampens the growth of Indonesian economy which is assumed in both RUKNs and JICA report at about 6%. The World Bank in November already forecasted the GDP growth rate of Indonesia in 2009 would be lowered to 4% level.

4. POWER SUPPLY FACILITIES

4.1 POWER SOURCES

(1) Transition to Non-oil Power Source

According to RUKN2008, oil-fired power plants will not be developed in the future except in areas where power shortage is critical in short-term. RUKN2008 also states that the existing oil-fired power plants will be terminated gradually as newly developed non-oil power plants are put on line.

All of four scenarios considered in the Study share this policy. Table 4-1 shows the development of installed capacity by fuel type for Scenario 2 (Power Source Diversification Scenario) for example. As shown in the table, all MFO-fired power plants will be terminated by 2017 and some of HSD-fired power plants will also be terminated or suspended gradually until 2023. From 2024 onward, a few HSD-fired power plants will come back into operation as a measure of power source diversification in expanding generation capacity. However, HSD-fired power plants will account for only 4.4% (in 2028) in the total capacity, which is far smaller than 24.0%, the sum of MFO & HSD-fired power plants, in 2009. Therefore the power resource development in the Study is in principle consistent with RUKN2008.

Table 4-1 Capacity by Fuel Basis

(Unit: MW)

Scenario 2 (Power Source Diversification)

YEAR	FUEL TYPE											TOTAL
	COAL	GAS	LNG	MFO	HSD	GEO	NUC	J-SI	PUMP	HYD	RENEW	
2009	11,371	3,713	-	718	5,128	886	-	-	-	2,574	-	24,390
2010	15,531	3,713	-	274	5,078	1,136	-	-	-	2,574	-	28,306
2011	16,261	4,688	-	192	5,078	1,526	-	-	-	2,574	-	30,319
2012	17,261	5,438	-	192	5,078	1,696	-	-	-	2,621	-	32,286
2013	17,261	5,438	-	192	5,078	1,696	-	-	-	2,621	-	32,286
2014	17,261	5,438	-	192	5,078	1,916	-	2,400	-	2,621	-	34,906
2015	17,261	5,438	750	192	5,078	2,026	-	3,000	500	2,731	-	36,976
2016	17,261	5,438	1,500	192	5,078	2,136	-	3,000	1,000	2,731	-	38,336
2017	21,261	5,237	2,250	-	3,918	2,246	-	3,000	1,000	2,731	-	41,643
2018	21,261	5,072	3,000	-	3,382	2,356	1,000	3,000	2,000	2,731	-	43,802
2019	23,261	5,072	3,000	-	2,834	2,466	1,000	3,000	3,000	2,731	-	46,364
2020	23,261	5,072	4,500	-	2,984	2,576	1,000	3,000	3,000	3,901	-	49,294
2021	25,261	5,072	4,500	-	2,984	2,686	2,000	3,000	3,000	3,901	535	52,939
2022	26,261	5,072	6,000	-	2,679	2,796	2,000	3,000	3,000	4,801	567	56,176
2023	29,261	5,072	6,000	-	2,679	2,906	2,000	3,000	3,000	4,801	1,207	59,926
2024	29,261	5,072	7,500	-	2,979	3,016	3,000	3,000	3,000	5,701	1,281	63,810
2025	32,261	5,072	7,500	-	2,979	3,126	3,000	3,000	3,000	5,701	2,038	67,677
2026	32,261	5,072	9,000	-	3,279	3,236	4,000	3,000	3,000	5,701	2,164	70,713
2027	36,261	5,072	9,000	-	3,579	3,346	4,000	3,000	3,000	6,001	3,063	76,322
2028	40,261	5,072	9,000	-	3,579	3,456	5,000	3,000	3,000	6,001	3,250	81,619

(Note: The above table is quoted from Appendix-6 Simulation Data of WASP IV 6)

(2) Progress of Fast Track Program Projects

RUKN2008 dated November 13, 2008 states that nine (9) projects out of ten (10) projects in Jamali region are under construction after signing of EPC Contracts.

The last information the Team obtained from PLN Head Office as of November 6, 2008 was that eight (8) projects out of ten (10) projects were under construction. It seems that T. Awar-awar project, which had not commenced the construction according to November 6 information, was put into construction stage some time in early November and was included in the nine started projects in RUKN2008.

4.2 TRANSMISSION SYSTEM

RUKN2008 makes reference to the expansion of transformer and development of new substation as follows.

- Regarding expansion of transformers, a priority is given to the existing substations where the load has reached 70% of their capacity.
- Development of new substations should be considered where the load has grown above 70% of transformer capacity of the substation and is over the preferable bank capacity.

A principle adopted in the Study for formulating transformer overload countermeasures seems to be shared by RUKN2008. In the Study, however, further considerations were made through and after the discussions with PLN and P3B. As a result, following recommendations were made in specific terms in the final report of the Study regarding transformer expansion and new substation development, taking into consideration the number of transformers in parallel and preferable power supply method etc.

- The following standers were adopted in transformer expansion:
  - for single transformer : Considering the restoration of power in the incident of stoppage, an introduction of another transformer should be examined when the load ratio reaches 60% of the capacity.
  - for dual transformers : Considering the restoration of power in the lower system, an introduction of additional transformer should be examined when the load ratio reaches 75% of the capacity.
  - for 3 or more transformers : Considering restoration of power in the lower system, an introduction of additional transformer should be examined when the load ratio reaches 100% of the capacity.

- Regarding the development of new substations, a standard of the maximum capacity of one trunk substation should be set at around 1,500 MVA (500 MVA for each of 3 units) or 1,000 MVA (in the case of restoration of the lower system). When the load ratio exceeds this maximum substation capacity, a development of new substation should be considered. However, a substation located in a high load area such as urban areas should be evaluated individually. Meanwhile, installing three or more units of transformers at a trunk substation may lead to possible problems described below, and should be avoided. In such case, a new substation should be developed.
  1) It is desirable to operate transformers in parallel, which, however, may lead to a short circuit capacity problem on the lower voltage side of a transformer, and further undermine the reliability of power supply.
  2) Load capacity of one trunk substation becomes too large to restore in the case of an upper system accident. Social influences of large area black out may turn out very serious.
  3) Adequate size of a supply area of one trunk substation in terms of the economy of power supply configuration varies from urban areas to rural areas. However, in general, the distance between trunk substations is 50 to 100 km at maximum in low demand area and around 3 units of transformers are maximum in one trunk substation.

5. PRIMARY ENERGY

5.1 PRIMARY ENERGY POLICY

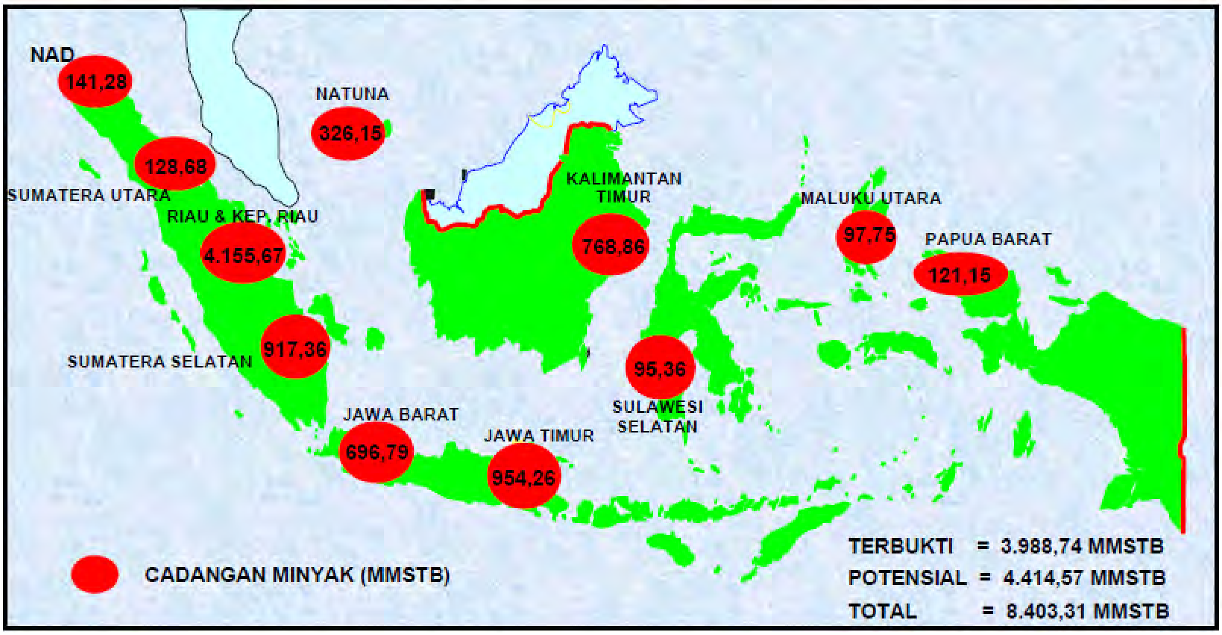
According to "National Energy Management Blueprint 2005-2025", hydro potential in Indonesia was 75.67GW, but it is somehow revised to 42.8GW in RUKN2008. These figures are potentials for the whole country, and the potential in Jamali region only is limited in any case, and Rajamandala, Jatigede and Upper Cisokan are listed as promising sites in both of these documents. Therefore, the optimal power development plan in the JICA report will not be influenced by either estimation.

5.2 SUPPLY AND DEMAND OF PRIMARY ENERGY

(1) Crude Oil

In the final report of the Study, "Area Map of Oil" is shown in Figure 4.1-2. This map is of year 2006 version, and year 2007 version is attached in RUKN2008.

Comparing these two versions, crude oil resources in Natuna is found revised from 54.41MMSTB to 326.15MMSTB, some minor increases are seen in south Sumatera and east Jawa, and decreases in all other regions. As a whole, total reserve in Indonesia was revised downward by approximately 10%.



Source : MEMR MIGAS (2007)

(2) Coal

In the material acquired in the Study from MEMR Coal-Geothermal Department, the coal reserve in Indonesia is shown to be around 61-63 billion tons. These values have been presented many times at international seminars and conferences, such as "New investment for the Future Indonesian Mining Industry" (Jan.2007; JMEC[1] and IMA[2] sponsored), "The Asia Miner Investing in Mining Conference" (Feb.2007, Australia), "5th Council Meeting and International Conference on Clean Coal and Excursion" (Jul.2007, Thailand)", "2nd Annual China Coal and Coal Chemical Summit" (Sep.2007, Beijing), "Clean Coal Day in Japan" (Sep.2008; JCOAL[3] sponsored), etc. In RUKN2008, however, the coal reserve is indicated as 93.1 billion tons. This value is 50% larger than those shown elsewhere and there are no indication of such an announcement made.

Besides, the total reserves of regions shown in Table5 "the energy potential data" of RUKN2008 becomes 159.7 billion tons which is nowhere near the value in the text, 93.1 billion tons, in the same document. This discrepancy seems difficult to be resolved.

Whichever is correct, a reasonable amount of proven coal reserve does exist in Indonesia, more than sufficient to support the coal consumption estimated in the optimal power development plan in the Study.

6. ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

While RUKN 2008 mentions abbreviations of official documents (ANDAL, RKL, RPL, UKL, UPL) to be produced as a result of EIA for a project in the electricity sector, their specific names were not referred to in the final report of the Study. Their full names are included, as supplemental information to page 2-84 of the final report, in "Errata of the Final Report".

7. FINANCIAL REQUIREMENT

The comparison between this report and RUKN2008 for the capital requirement estimation is not necessarily simple. First of all, the demand forecast is very different in these programs. RUKN2008, which assumes the demand growth rate much higher than that in this report, requires generation expansion twice as large as that in this report. Meanwhile, the unit construction cost of power plants in RUKN2008 is the same as in RUKN2006 at US$1,000 for 1 kW, without consideration of the recent hike of the prices of generation equipment. This report considers different unit costs for power plant types, leading to much higher average cost at US$1,790 for 1 kW of additional installed capacity. As a result, RUKN2008 estimates the total investment cost for generation expansion at US$140million, about 20% higher than that of this report, US$112million.

---

[1] JMEC; Japan Mining Engineering Center for International Cooperation
[2] IMA; Indonesian Mining Association
[3] JCOAL ; Japan Coal Energy Center

Final Report of JICA Study	RUKN2008
5.3.1 Financial Requirement of the Optimal Power Development Plan (pp.5-51, 5-53, Table 5.3-2) Power Plant 111,668 Transmission lines, substations 4,930 (-2015) 11,057 (-2028) Distribution lines 3,971 (-2015) 11,987 (-2028) [unit : US$ Million]	**Chapter 6 Necessary Investment Capital the third paragraph and Table 6** Power Plant 140,750 Transmission lines, substations 22,254 (-2015) Distribution lines 8,553 (-2015) [unit : US$ Million]

Comparison becomes more complicated for transmission, substation and distribution development than generation expansion. RUKN2008 states that US$30million is necessary until 2015, which is almost ten times larger than that in RUKN2006, and way higher than the estimate of this report, US$23million up to 2028. The detail of the investment and estimate is not shown in RUKN2008. But the ratio of the amount to that of generation expansion suggests an apparent overestimation in RUKN2008.

In the Study, the investment requirement for transmission, substation and distribution for the period up to 2015 was derived from RUPTL. For the period thereafter, from 2016 until 2028, necessary equipment to be installed was determined in the Optimal Power System Reinforcement Plan, there costs were evaluated using actual investment costs of recent projects, which were multiplied to obtain the investment requirement. The details were explained in the section 5.2.10 of the final report, which was also summarized in the figure below.

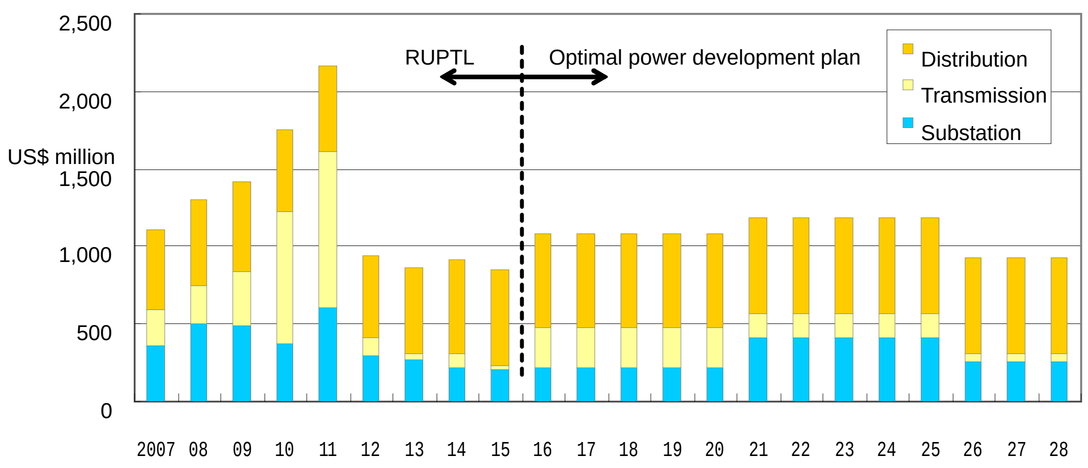


Fig. 5-1 Investment Schedule for Augmentation of Transmission System (Reproduction of Fig. 5.3-2 of Final Report)

RUPTL had examined necessary equipment to be installed, whose aggregates were used in calculating the investment requirement. This method is straight forward and the result seems plausible: the increase of investment until 2011 corresponds to rapid increase of installed capacity due to the coal thermal projects under Fast Track Program. The investment after 2016 estimated by the Team is at about the average of RUPTL figures for 2007 to 2015, and represents steady reinforcement needs of the power system in line with the expansion of generation capacity.

It is quite important and necessary to know the magnitude of the investment requirement for a power development plan. However, it has been just proven that the electricity business is quite susceptible to the global economic environment and the costs involved are variable. As discussed in detail in the final report of this study, the institutional provisions to enhance the flexibility of the business, including the revision to the tariff structure, is very much desired.