Annex V
INDONESIA

Annex V

NUCLEAR POWER PLANT DEVELOPMENT IN INDONESIA[1]

1. PAST ACTIVITIES

The first idea to have a nuclear power plant in Indonesia occurs in 1956 from university circle in Bandung and Yogyakarta in the form of seminars. The real task was started in 1972 when the Commission for Construction Preparation of NPP (KP2PLTN) was created by National Atomic Energy Agency (BATAN) and Civil Work Department (PUTL Dept.).

The Karangkates Seminar in 1975 organized by BATAN and PUTL Department has obtained the result about the decision of nuclear power development in Indonesia. It was proposed 14 possibilities of NPP location in Java Island, among them 5 locations were lately declared to become the potential site, and then the Muria site in Central of Java was chosen as the best site.

The first feasibility study for the introduction of a nuclear power plant was conducted in 1978 with the assistance of the government of Italy. However, following this study the Indonesian government deferred the decision until the nuclear research facilities in Serpong became fully operational.

In 1985, work began on updating the studies with the assistance of the International Atomic Energy Agency (IAEA), US government through the Bechtel International, the French government through the Sofratome and the Italian government through the Cesen. These updated reports, and the analytical capabilities developed by the Indonesian partners during the process of this cooperation, have become the foundation for the present planning activities.

In September 1989, the Indonesian government through the National Energy Co-ordination Board (BAKOREN) decided to perform a new NPP feasibility study including comprehensive investigations of the Muria Peninsula as a candidate site for NPPs. The study itself was carried out by the National Atomic Energy Agency (BATAN), under the directives of the Energy Technical Committee (PTE) of the Department of Mines and Energy, including other institutions as well.

In August 1991, an agreement was signed in Jakarta between the Indonesian Ministry of Finance and BATAN on behalf of Indonesia, and the consultant's company NEWJEC Inc. This agreement contract NEWJEC for a four and a half years period to perform a site selection and evaluation, as well as a comprehensive nuclear power plant feasibility study (Table 1). The principal part of the contract's value will be spent on studies related to the site, which is to be sought in the northern coast of the Muria Peninsula in Central Java.

In May 1996, the feasibility study for the first NPP in Indonesia was completed. The result of the feasibility study (Table 2), especially on the electrical system analysis (see Table 3) using the WASP-III of the ENPEP programme, shows that the introduction of nuclear power plants in the early 2000s to the Java-Bali electric system represents an optimal solution.

In addition after the feasibility study, other studies have been done, such as the preparation of bid invitation specification, development of financing study (BOO and Barter) and re-evaluation of nuclear energy for electricity planning. Considering the impact of the economic crisis in 1998, a re-evaluation study on electricity planning has been done. The result of this study shows that the construction possibility of NPP will be slightly postponed, after 2010s.

[1] Annex V contains information from Indonesia, which has submitted relevant information in the framework of the IAEA activity on integrated approach of nuclear power programme planning. In addition, the Secretariat has added the EEDB data and the international agreements.

TABLE 1. IAEA SUPPORT FOR NPP DEVELOPMENT IN INDONESIA.

No	NPP Development Activity	IAEA Support
1	Non-site studies: - Energy economics and financing - Technical and safety aspect - Fuel cycle and waste management - General management aspect - Preparation of bid invitation specification - Development of financing study - Re-evaluation of energy study.	Workshop, expertise, fellowship and scientific visit programmes under: - INS/0/012: Energy economic calculations with nuclear option - INS/0/028: Support for the first nuclear power plant
2	Site studies: - Investigation of site selection - Assessment of site selection - Site qualification/evaluation - Environmental, meteorology - Socio-economic, demography - Socio-cultural impact - Development of geology, seismology and volcanology study.	Workshop, expertise, fellowship and scientific visit programmes under: - INS/9/012: Nuclear power plant siting - INS/9/021: Nuclear power plant site confirmation and structural safety

TABLE 2. PROJECTION RESULT OF NUCLEAR POWER PLANT COMPETITION

CASE	Unit	ABWR	PWR	PWR	PHWR
Objective Function	M$	62,202	62,486	62,734	62,121
Appearance Year of NPP		2011	2015	2012	2011
• Unit Number		1	2	1	1
• Capacity	MW	1,300	2,000	1,500	700
• Capacity Factor	%	74.42	79.11	70.41	79.11
• Total Generation	GW·h	8,475	13,861	9,251	4,851
• Percentage of Electric Demand	%	6.09	7.05	6.08	3.49
NPP at the End of Study		2018	2018	2018	2018
• Unit Number		8	8	7	8
• Capacity	MW	10,400	8,000	10,500	5,600
• Total Generation	GW·h	918,520	972,056	923,281	673,020
• Percentage of Electric Demand	%	18.02	18.22	17.69	12.62

2. FUTURE PROGRAMME FOR NPP DEVELOPMENT IN INDONESIA (2001-2002)

TC Programme Title: Demonstration of a Clean and Safe Technology for Producing Electricity, Heat and Water in Support of Sustainable Development in Indonesia.

Objective: CDM will assist in achieving sustainable development and in contributing to commitment implementation of the greenhouse gas emission reduction, which is the ultimate objective of the UNFCCC and Kyoto Protocol. As a proven and environmentally benign technology and with its potential as a sustainable long-term energy supply into the distant future, nuclear energy can be an important contributor to sustainable development and economically competitive comparing

fossil energy. The Indonesian case study expects the result of understanding in what terms and how the CDM could be applied to NPP technology in Indonesia for producing electricity, heat and water.

TABLE 3. ELECTRIC ENERGY PROJECTION
Java-Bali 1998-2018

Year	PLN Electric Demand (GW·h)	Captive Demand (GW·h)	PLN Electric Production (GW·h)	PLN Electric Generation (MW)	PLN Electric Peak Load (MW)
1993	30,963	9,048	36,624	8,181	5,244
1994	35,434	9,387	41,693	9,769	6,784
1995	40,940	10,545	47,876	9,897	7,752
1996	46,828	11,031	54,678	10,791	8,791
1997	52,533	11,136	61,618	13,686	10,015
1998	50,800	9,407	59,586	13,074	9,684
1999	48,840	8,689	57,287	12,104	9,311
2000	48,545	8,544	56,940	12,031	9,254
2001	50,078	8,430	58,739	12,411	9,547
2002	53,054	8,462	62,230	13,148	10,114
2003	56,610	8,678	66,401	14,029	10,792
2004	61,011	9,118	71,563	14,539	11,631
2005	66,481	9,619	77,979	15,842	12,674
2006	73,552	10,224	86,273	17,527	14,022
2007	82,136	10,742	96,342	19,573	15,658
2008	91,402	11,377	107,210	21,781	17,424
2009	99,792	12,055	117,051	23,780	19,024
2010	110,464	12,318	129,568	26,323	21,058
2011	121,855	13,266	142,930	29,037	23,230
2012	133,196	14,382	156,233	31,740	25,392
2013	143,908	16,823	168,797	34,292	27,434
2014	157,025	18,573	184,183	37,418	29,935
2015	172,224	20,156	202,010	41,040	32,832
2016	189,122	21,903	221,830	45,067	36,053
2017	207,839	23,764	243,786	49,527	39,622
2018	228,433	25,860	267,941	54,343	43,547

-15% Economic Growth in 1998.

3. ENERGY AND ECONOMIC DATA

TABLE 4. POPULATION INFORMATION

								Growth rate (%)
	1960	1970	1980	1990	1998	1999	2000	1980 to 2000
Population (millions)	96.0	120.1	150.3	182.5	206.5	209.3	212.1	1.7
Population density (inhabitants/km²)	50.4	63.1	78.9	95.8	108.4	109.9	111.4	
Urban population as percent of total					39	40	N/A	
Area (1000 km²) 1904.6								

Source: IAEA Energy and Economic Database, Data & Statistics/The World Bank.

TABLE 5. GROSS DOMESTIC PRODUCT (GDP)

	1995	1996	1997	1998	1999
GDP at market prices (current billion US$)	202	227	216	99	143
GDP growth (annual %)	8.21	7.83	4.7	-13.01	0.31
GDP by Sector, value added (% of GDP):					
Agriculture	17.14	16.67	16.09	17.57	19.48
Industry	41.8	43.46	44.33	44.91	43.26
Services, etc.	41.06	39.87	39.58	37.52	37.27

Source: Data & Statistics/The World Bank).

TABLE 6. ESTIMATED ENERGY RESERVES

Exajoules

	Solid	Liquid	Gas	Uranium [1]	Hydro [2]	Total
Total amount in place	114.51	28.43	77.03	3.44	206.97	430.39

[1] This total represents essentially recoverable reserves.

[2] For comparison purposes a rough attempt is made to convert hydro capacity to energy by multiplying the gross theoretical annual capability (World Energy Council - 1998) by a factor of 10.

Source: IAEA Energy and Economic Data Base.

TABLE 7. ENERGY STATISTICS

Exajoules

							Average annual growth rate (%)	
	1960	1970	1980	1990	1999	2000	1960 to 1980	1980 to 2000
Energy consumption								
- Total [1]	0.33	1.35	2.29	5.01	6.61	6.86	10.24	5.63
- Solids [2]	0.02	0.88	1.14	1.46	2.13	2.16	22.36	3.24
- Liquids	0.20	0.41	0.97	2.19	3.17	3.28	8.10	6.29
- Gases	0.09	0.05	0.16	1.26	1.13	1.23	2.59	10.79
- Primary electricity [3]	0.01	0.01	0.03	0.11	0.18	0.20	6.78	10.04
Energy production								
- Total	0.97	2.72	5.03	7.93	10.94	11.42	8.58	4.19
- Solids	0.02	0.88	1.14	1.59	3.73	4.05	22.63	6.54
- Liquids	0.85	1.78	3.25	3.89	3.89	3.82	6.95	0.81
- Gases	0.09	0.05	0.61	2.35	3.14	3.35	9.73	8.92
- Primary electricity [3]	0.01	0.01	0.03	0.11	0.18	0.20	6.78	10.03
Net import (import - export)								
- Total	-0.62	-1.27	-2.57	-2.68	-4.10	-4.58	7.35	2.93
- Solids	0.00	0.00	0.00	-0.13	-1.68	-2.13	-7.58	37.71
- Liquids	-0.62	-1.27	-2.05	-1.47	-0.47	-0.21	6.14	-10.68
- Gases			-0.51	-1.09	-1.95	-2.24		7.64

[1] Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.

[2] Solid fuels include coal, lignite and commercial wood.

[3] Primary electricity = Hydro + Geothermal + Nuclear + Wind.

Source: IAEA Energy and Economic Database.

TABLE 8. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

	1960	1970	1980	1990	1999	2000	Average ann. growth rate (%) 1960 to 1980	Average ann. growth rate (%) 1980 to 2000
Electricity production (TW·h)								
- Total [1]	2.10	4.67	14.23	48.90	97.95	107.19	10.05	10.62
- Thermal	1.29	3.23	11.23	37.53	79.53	86.82	11.45	10.77
- Hydro	0.81	1.44	3.01	10.24	15.48	17.20	6.78	9.11
- Geothermal				1.13	2.95	3.17		
Capacity of electrical plants (GW(e))								
- Total	0.68	1.61	4.88	12.92	24.20	25.68	10.34	8.66
- Thermal	0.51	1.29	3.90	9.63	19.17	20.22	10.68	8.58
- Hydro	0.17	0.31	0.98	3.15	4.66	5.07	9.17	8.58
- Geothermal				0.14	0.38	0.40		

[1] Electricity losses are not deducted.

Source: IAEA Energy and Economic Database.

TABLE 9. ENERGY RELATED RATIOS

	1960	1970	1980	1990	1999	2000
Energy consumption per capita (GJ/capita)	3	11	15	27	32	32
Electricity per capita (kW·h/capita)	22	37	90	264	463	501
Electricity production/Energy production (%)	2	2	3	6	9	9
Nuclear/Total electricity (%)						
Ratio of external dependency (%) [1]	-191	-94	-112	-54	-62	-67
Load factor of electricity plants						
- Total (%)	35	33	33	43	46	48
- Thermal	29	29	33	44	47	49
- Hydro	55	53	35	37	38	39
- Nuclear						

[1] Net import / Total energy consumption

Source: IAEA Energy and Economic Database.

4. INTERNATIONAL, MULTILATERAL AND BILATERAL AGREEMENTS

AGREEMENTS WITH THE IAEA

- NPT related Agreement; INFCIRC/283 — Entry into force: 14 July 1980
- Project related safeguards agreement; INFCIRC/136 — Entry into force: 19 December 1969
- Additional Protocol — Signed on 29 September 1999
- Improved procedures for designation of safeguards inspectors — Accepted on 8 June 1989
- Supplementary agreement on provision of technical assistance by the IAEA — Entry into force: 4 July 1980
- RCA — Entry into force: 12 June 1987
- Agreement on privileges and immunities — Entry into force: 4 June 1971

OTHER RELEVANT INTERNATIONAL TREATIES etc.

• NPT	Entry into force:	12 July 1979
• Convention on physical protection of nuclear material	Entry into force:	8 February 1987
• Convention on early notification of a nuclear accident	Entry into force:	13 December 1993
• Convention on assistance in the case of a nuclear accident or radiological emergency	Entry into force:	13 December 1993
• Vienna convention on civil liability for nuclear damage	Non-Party	
• Joint protocol	Non-Party	
• Protocol to amend the Vienna convention on civil liability for nuclear damage	Signed on:	6 October 1997
• Convention on supplementary compensation for nuclear damage	Signed on:	6 October 1997
• Convention on nuclear safety	Signed on:	20 September 1994
• Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Signed on:	6 October 1997
• ZANGGER Committee	Non-Member	
• Nuclear Export Guidelines (INFCIRC/254)	Not adopted	
• Acceptance of NUSS Codes	No reply	
• Nuclear Suppliers Group	Non-Member	

REFERENCES

[1] Data & Statistics/The World Bank, www.worldbank.org/data.

[2] IAEA Energy and Economic Data Base (EEDB).

[3] IAEA Power Reactor Information System (PRIS).

Appendix

DIRECTORY OF THE MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

NATIONAL ATOMIC ENERGY AUTHORITY

National Atomic Energy Agency
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Nuclear Energy Advisory Assembly