Review and Assessment on Regulation, Licensing Process, and REIA Study of NPP Site Candidate in Indonesia

Country Report: Indonesia

BADAN PENGAWAS TENAGA NUKLIR

Jl. Gajah Mada No. 8, Jakarta Pusat

Kontak Presenter

BADAN RISET DAN INOVASI NASIONAL

IAEA-Asian Nuclear Safety Network (ANSN)

Regional Workshop on Radiological Environmental Impact Assessment for Nuclear Installations

Manila 24-28 October 2022

Indonesia Participants

Participants:

1. Yudi Pramono – (Regulatory Assessment Centre for Nuclear Installation and Material) BAPETEN
2. Ade Awalludin – (Directorate of Licensing for Nuclear Installation and Material) BAPETEN
3. Mahrus Salam - (Directorate of Nuclear Facility Management) BRIN
4. Murdahayu Makmur – (Centre of Radiation Safety, Metrology and Nuclear Standard) BRIN

Nuclear Energy Regulatory Agency

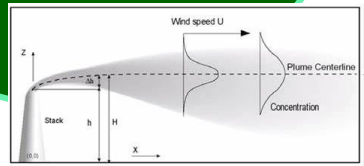
National Research and Innovation Agency

CONTENT

Regulation on Site Licensing & Environmental Impact Assessment

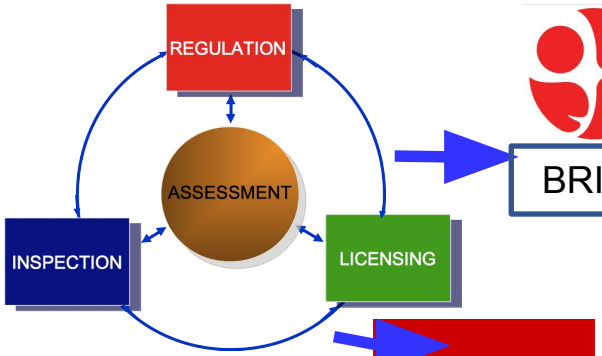
R & D Site Evaluation Study

Case Study for Research Reactor



NUCLEAR REGULATORY SYSTEM

Safety
Security
Safeguards



BRIN

- Research Reactor, Fuel Fabrication, Rad Waste, Isotope production, Research on application, Other R&D

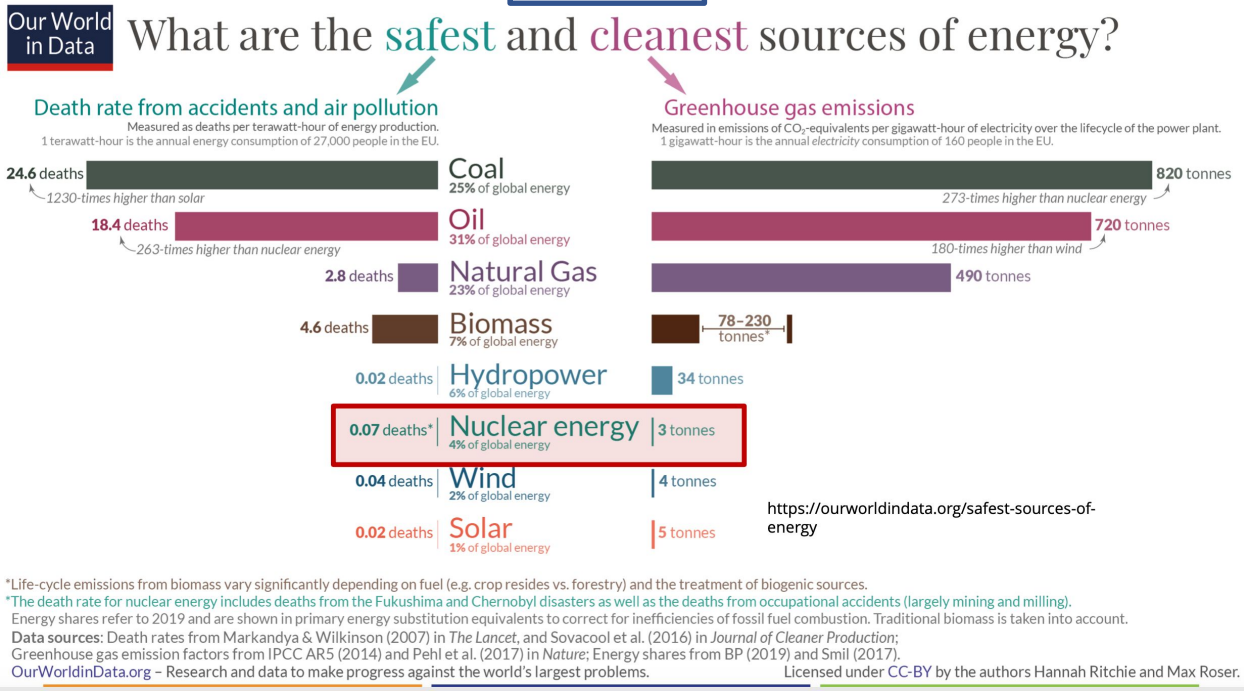
NPP …

Hospitals

Other Industries (such as PT Inuki)

Oil Companies

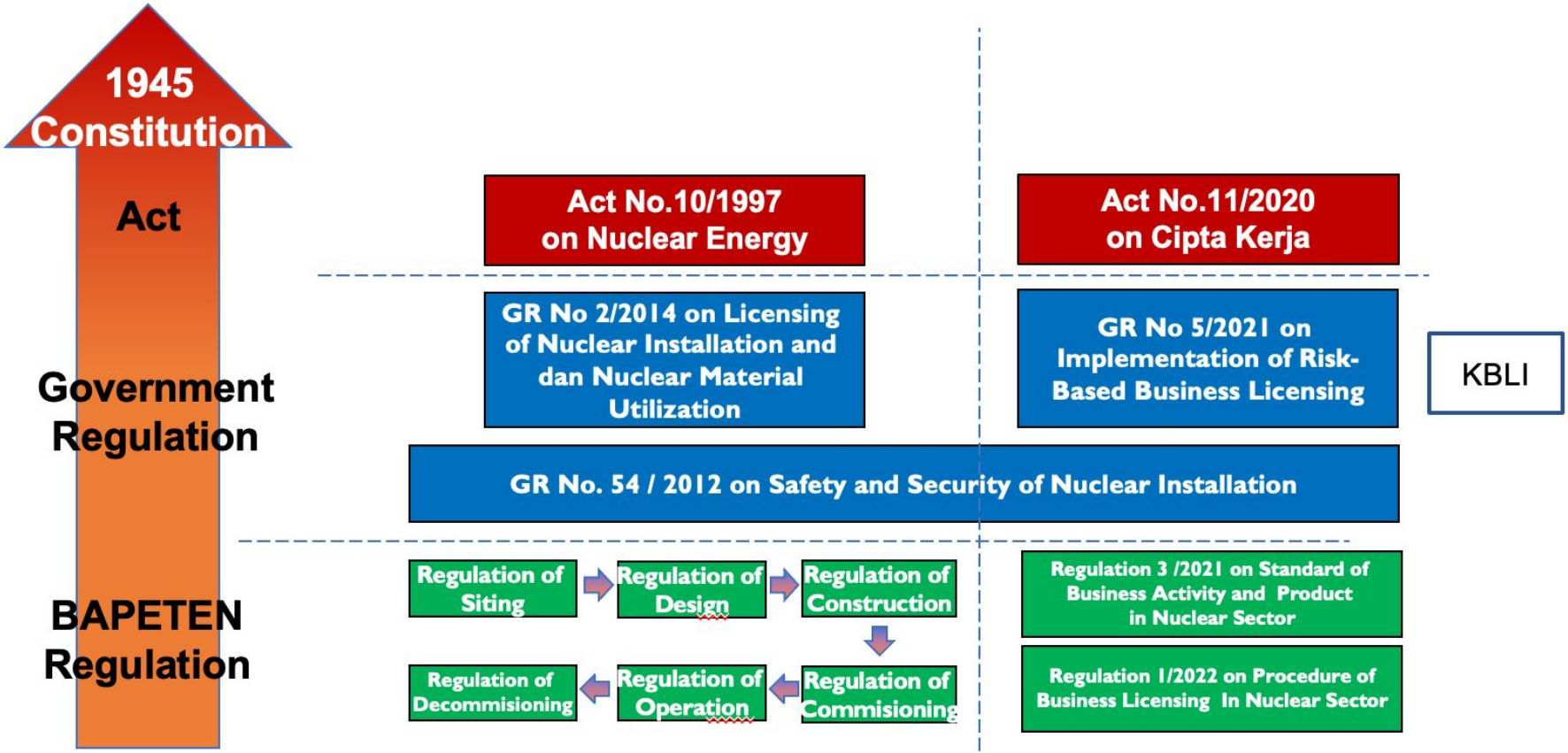
NDT Companies



I. Current regulations on NPPs in Indonesia

II. Current regulatory assessment on SMRs

REGULATORY FRAMEWORK FOR NUCLEAR INSTALLATION AND MATERIAL



Regulatory Framework

Agt 2022

ACT

Act No. 10 1997

GOV. REGULATION

- GR No. 8 Year 2015 — Safety Transport of Radioactive Source
- GR No. 46 Year 2009 — Nuclear Liability Limits
- GR No. 61 Year 2013 — Radioactive Waste Management
- GR No. 2 Year 2014 — Licensing of Nuclear Inst & NM Utilization
- GR No. 33 Year 2007 — Safety of Ionizing Radiation & Security of radioactive sources
- GR No. 29 Year 2008 — Licensing the use of Ionizing Radiation Sources and Nuclear Materials
- GR No. 27 Year 2009 — Types and Tariff of Non-Tax State Revenues Applicable On BAPETEN
- GR No. 46 Year 2009 — Limit of Nuclear Liability
- GR No. 54 Year 2012 — Safety & Security of Nuclear Installation
- GR No. 58 Year 2015 — Radiation Safety and Security in Transportation of Radioactive Materials

BAPETEN CHAIRMAN REGULATIONS

SITING

- BCR No. 4 Year 2018 — Site Evaluation for Nuclear Installation NS-R-3
- BCR No. 8 Year 2013 — Seismic aspect of Site Evaluation for NI
- BCR No. 5 Year 2015 — Volcano aspect of Site Evaluation for NI
- BCR No. 4 Year 2019 — Dispersion of Radioactive Material in Air And Water in Site Evaluation For Power Reactor
- BCR No. 4 Year 2008 — Geotechnical Aspect of Site Evaluation and Foundation for Power Reactor
- BCR No. 6 Year 2014 — Meteorological & Hydrology aspect of Site Evaluation for NI
- BCR No. 6 Year 2019 — External Human Induce Event in Site Evaluation for NPP

DESIGN

- BCR 3 Year 2011 — Safety for NPP Design NS-R-1 (being revised)
- BCR No. 6 Year 2012 — Software for Computer Based System Important to Safety in NPP NS-G-1.1
- BCR No. 3 Year 2010 — Design of Fuel Handling and Storage System For NPP NS-G-1.4
- BCR No. 1 Year 2012 — Protection Against Internal Fires and Explosion In the Design of NPP NS-G-1.7
- BCR No. 7 Year 2011 — Design of Emergency Power System for NPP NS-G-1.8
- BCR No. 2 Year 2012 — Protection against Internal Hazard Other Than Fire and Explosion Design of Power Reactor, NS-G-1.11
- BCR No. 12 Year 2020 — Safety Classification of SSC's in Nuclear Installation
- BCR No. 1 Year 2020 — Radiation Protection Aspects of Design for NPP NS-G-1.13
- BCR No. 11 Year 2020 — Format and Content of SAR for NPP
- BCR No. 3 Year 2022 — Design of Reactor Core for NPP
- Design of the Reactor Coolant System and Associated Systems NS-G-1.9
- Instrumentation and Control Systems Important to Safety NS-G-1.3
- Design of Reactor Containment Systems NS-G-1.10

CONSTRUCTION

- SSG-38 — Construction for Nuclear Installations

OPERATION

- BCR No. 3 Year 2009 — Operation Limit & Condition and Operating Procedures For NPP NS-G-2.2

DECOMMISSIONING

- BCR No. 4 Year 2009 — Decommissioning of Nuclear Reactor WS-G-2.1

Legend

- In Planning
- In Preparation
- In Reviewing Process
- Published

BAPETEN REGULATION (BR) RELATING TO SITE

BCR No. 1 Year 2008 on Power Reactor Evaluation's Site For Aspects of Seismic
BCR No. 2 Year 2008 on Evaluation Power Reactor Site's of Volcanology Aspects
BCR No. 3 Year 2008 on Power Reactor Site Evaluation for Determining Dispersion Aspects of Radioactive Substances in Air and Water and Consideration of Population Distribution Around Tread Power Reactor
BCR No. 4 Year 2008 on Power Reactor Site Evaluation for Geotechnical and Foundation Aspects of Reactor Power
BCR No. 5 Tahun 2008 on Power Reactor Site Evaluation for Meteorology Aspect
BCR No. 6 Year 2008 on Power Reactor Site Evaluation for External Aspects of Human Induced
BCR No. 5 Year 2007 on Safety Requirements for Nuclear Reactor Site Evaluation
BCR No. 4 Year 2019 on Nuclear Installation Site Evaluation for Dispersion Aspects of Radioactive Substances in Air and Water
BCR No. 6 Year 2019 on Nuclear Installation Site Evaluation for External Aspects of Human Induced
BCR No. 4 Year 2018 on Safety Requirements for Nuclear Installation Site Evaluation
BCR No. 5 Year 2015 on Nuclear Installation Site Evaluation for Volcanology Aspect
BCR No. 6 Year 2014 on Nuclear Installation Site Evaluation for Meteorology & Hydrology Aspect
BCR No. 8 Year 2013 on Nuclear Installation Site Evaluation for Meteorology & Hydrology Aspect
BCD No. 01-P/Ka-BAPETEN/VI-99 on Guidance for Determining Nuclear Reactor Site

BAPETEN REGULATION (BR)

EPR	•BR No. 1 Year 2010 on Nuclear Emergency Responses and Preparedness •BR No. 1 Year 2015 on Management of Emergency Response of BAPETEN .
Environmental	•BR No. 7 Year 2013 on Dose Limit for Environmental Radioactivity •BR No. 3 Year 2014 on Composing Document of Analysis for Environmental Impact of Nuclear Energy Field -BR No. 7 Year 2017 on Revision of Regulation on Dose Limit for Environmental Radioactivity
Worker	•BR No. 6 Year 2010 on the Health Monitoring for Radiological Workers •BR No. 6 Year 2013 on Working License for Operator of Installation and Nuclear Material
Management System	•BAPETEN CHAIRMAN REGULATION (BCR) No. 4 Year 2010 on the Management System of Nuclear Energy Facility and Utilization Activity

NEW ACT & EVALUATION MECHANISM

Ministry of Environment and forestry is responsible for evaluating EIA Documents (all sector including nuclear installation)

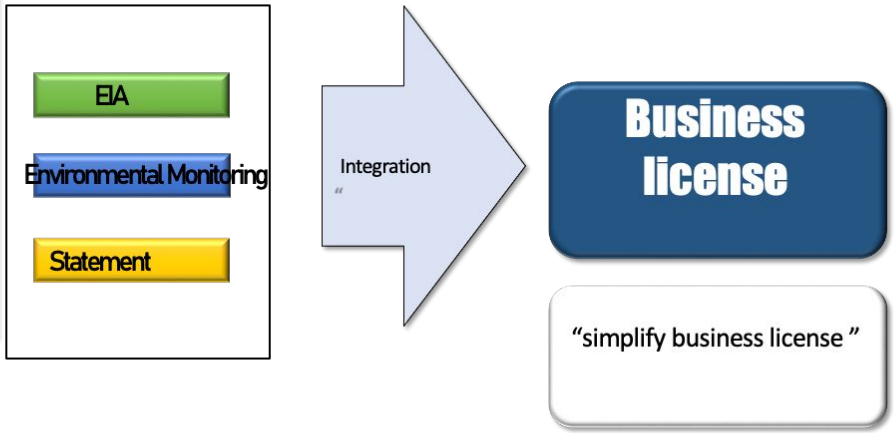
BAPETEN (Nuclear regulatory Body) will act as technical supporting organization to evaluate EIA documents

BAPETEN assess EIA document based on BCR N0 3 of 2014 on Preparation of Environmental Impact Analysis Documents for Nuclear Installation

Duration
- Licensee fill out environmental scooping form (20 working days)
- Evaluation environmental scoping report by Ministry of Environmental and Forestry (max 10 working days)
- Licensee submit environmental impact assessment report (max 180 working days)
- Evaluation of EIA by Ministry of Environmental and Forestry (max 50 Working days)

Environmental Oversight through Act Number 11 of 2020 on Job Creation

Environmental Approval



Challenge in Evaluation

Limited time to evaluate documents

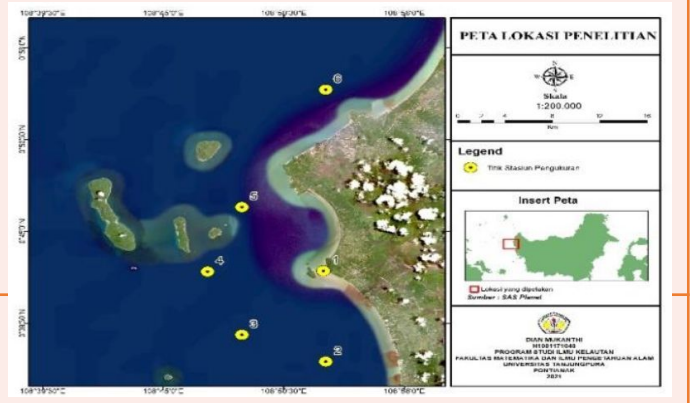
Strategy to overcome :"

"Pre-licensing like"

consultation Public consultation is made before application

"Environmental Permits are not revoked but their purposes and functions are integrated into Business Licensing"

PUBLICATIONS RELATING TO DISPERSION/REIA

TITLE	JOURNAL	(METHODS)/(SOFTWARE)/ (EQUIPMENTS)	OTHERS
Study of Seawater Quality and Cesium 137 Dosage in Biota at Gosong Beach, West Kalimantan as a Candidate for a NPP Site (Murdahayu Makmur et al)	*Jurnal Pengembangan Energi Nuklir Vol. 23, No. 2, (2021) 109-117*	(Purposive sampling, Erica Tool simulation/analysis, Frederica DB)/(-)/(Water Quality Checker (WQC), gamma spectrometer)	

Tabel 1. Kualitas Perairan Pantai Gosong

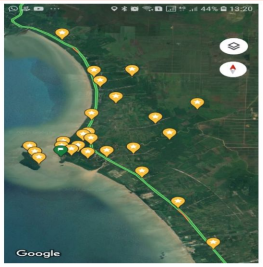
Stasiun	Suhu (°C)	pH	Salinitas (‰)	TDS (Mg/L)
Sta. 1	30,15	8,4	22,9	21,7
Sta. 2	30,7	8,74	32,04	30
Sta. 3	29,97	8,92	31,96	29,8
Sta. 4	31,1	8,33	21,55	20,2
Sta. 5	28,37	6,76	0,04	
Sta. 6	31,93	9,08	30,3	

Tabel 3. Hasil dosis Cs-137 pada biota

No	Biota	External Dose Rate ^{137}C [µGy h^{-1}]	Internal Dose Rate ^{137}Cs [µGy h^{-1}]	Total Dose Rate ^{137}Cs [µGy h^{-1}]
1	Crustacean	$2{,}36\times10^{-4}$	$1{,}43\times10^{-2}$	$1{,}45\times10^{-2}$
2	Macroalgae	$2{,}10\times10^{-4}$	$2{,}02\times10^{-2}$	$2{,}04\times10^{-2}$
3	Mollusc-bivalve	$2{,}61\times10^{-4}$	$1{,}12\times10^{-2}$	$1{,}15\times10^{-2}$
4	Pelagic Fish	$4{,}35\times10^{-4}$	$2{,}27\times10^{-2}$	$2{,}31\times10^{-2}$
5	Phytoplankton	$6{,}04\times10^{-4}$	$8{,}54\times10^{-4}$	$1{,}46\times10^{-3}$
6	Zooplankton	$5{,}25\times10^{-4}$	$2{,}34\times10^{-2}$	$2{,}39\times10^{-2}$
7	Polychaele Worm	$4{,}29\times10^{-5}$	$3{,}78\times10^{-2}$	$3{,}78\times10^{-2}$
8	Benthic Fish	$2{,}44\times10^{-4}$	$2{,}14\times10^{-2}$	$2{,}17\times10^{-2}$

PUBLICATIONS RELATING TO DISPERSION/REIA

TITLE	JOURNAL	(METHODS)/(SOFTWARE)/ (EQUIPMENTS)	OTHERS
Dose Rate of Environmental Gamma Radiation in Some Locations of West Kalimantan as A Site Candidate of Nuclear Power Plant (G. Suhariyono et al)	AIP Conference Proceedings 2381, 020087 (2021); https://doi.org/10.1063/5.0066764	(in-situ measurement)/(-)/ (Portable Gamma Ray Surveymeter, the Ludlum brand GPS)	



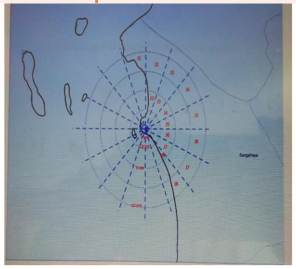
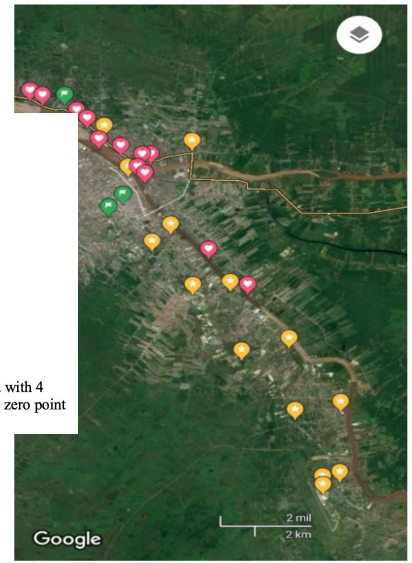
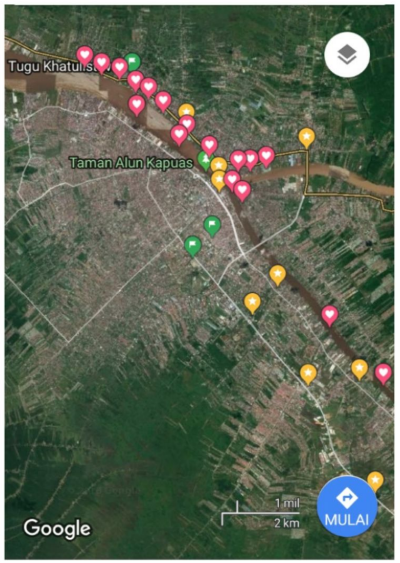


FIGURE 1. Maps of sample points for dose rate measurement (yellow color) in Bengkayang regency area with 4 radiuses (0 - 1 km, 1 - 2.5 km, 2.5 -5 km and 5 - 10 km) and 16 sections. The green point is the location of the zero point as the coordinate center on Gosong Beach, near Semesak Island.

TABLE 6. Comparison of radiation dose rates in West Kalimantan with other tropical areas

No.	Location	Average Dose Rates (nSv/jam)
1	West Kalimantan	48.92 ± 8.57 (0.43 mSv/tahun)
2	Jawa	51.93 ± 36.53 (0.46 mSv/tahun)
3	Belgia [11]	285.19 ± 16.89 (2.50 mSv/tahun)
4	Iran [12]	55.90 ± 7.48 (0.49 mSv/tahun)
5	Brasilia [13]	65.80 ± 8.40 (0.58 mSv/tahun)
6	Etiopia [13]	72.10 ± 9.10 (0.63 mSv/tahun)
7	Sumatera [14]	50.32 ± 25.02 (0.44 mSv/tahun)
8	Jepang [15]	27.38 ± 5.23 (0.24 mSv/tahun)
9	Saudi Arabia [16]	17.80 ± 4.22 (0.16 mSv/tahun)





(a) On the road, 19 km (yellow points) (b) On the river, 11 km (red points)

FIGURE 3. Map of sample points for measuring dose rates in Pontianak City and its surroundings.

PUBLICATIONS RELATING TO DISPERSION/REIA

TITLE	JOURNAL	(METHODS)/(SOFTWARE)/ (EQUIPMENTS)	OTHERS
Modeling on 137Cs Radioactive Dispersion in Gosong Coast as The Candidate Location for Nuclear Power Plant (H. Suseno et al)	*Jurnal Kelautan Tropis November 2021 Vol. 24(3):291-301 P-ISSN : 1410-8852 E-ISSN : 2528-3111*	(Simulation)/(Delft3D-Flow module)/(-)	

Table 1. Waste input scenario

Simulation	Waste Volume (m^3)	Disposal Duration	Waste Discharge ($m^3.s^{-1}$)	^{137}Cs Concentration ($Bq.m^{-3}$)
Scenario I	10	1 hour		
Scenario II	50	5 hours	0,00278	$2.\ 10^5$
Scenario III	100	10 hours		

$$\frac{\partial \zeta}{\partial t} + \frac{1}{\sqrt{G_x}\sqrt{G_y}} \frac{\partial((d+\zeta)U\sqrt{G_y}}{\partial x} + \frac{1}{\sqrt{G_x}\sqrt{G_y}} \frac{\partial((d+\zeta)V\sqrt{G_x}}{\partial y} = (d+\zeta)Q, \quad (1)$$

$$\frac{\partial u}{\partial t} + \frac{u}{\sqrt{G_x}} \frac{\partial u}{\partial x} + \frac{v}{\sqrt{G_y}} \frac{\partial u}{\partial y} + \frac{\omega}{d+\zeta} \frac{\partial u}{\partial z} - \frac{v^2}{\sqrt{G_x}\sqrt{G_y}} \frac{\partial \sqrt{G_y}}{\partial x} + \frac{uv}{\sqrt{G_x}\sqrt{G_y}} \frac{\partial \sqrt{G_x}}{\partial y} - fv = -\frac{1}{\rho_0 \sqrt{G_x}} P_x + F_x + \frac{1}{(d+\zeta)^2} \frac{\partial}{\partial z} \left(V_v \frac{\partial u}{\partial z} \right) + M_x \quad (2)$$

$$\frac{\partial v}{\partial t} + \frac{u}{\sqrt{G_x}} \frac{\partial v}{\partial x} + \frac{v}{\sqrt{G_y}} \frac{\partial v}{\partial y} + \frac{\omega}{d+\zeta} \frac{\partial v}{\partial z} + \frac{uv}{\sqrt{G_x}\sqrt{G_y}} \frac{\partial \sqrt{G_y}}{\partial x} + \frac{u^2}{\sqrt{G_x}\sqrt{G_y}} \frac{\partial \sqrt{G_x}}{\partial y} - fu = -\frac{1}{\rho_0 \sqrt{G_y}} P_y + F_y + \frac{1}{(d+\zeta)^2} \frac{\partial}{\partial z} \left(V_v \frac{\partial v}{\partial z} \right) + M_y \quad (3)$$

The continuity equation (Eq 2) & momentum equations of x & y axis (Equation 3, 4)

The ocean current considers to analyze the distribution of radioactive ^{137}Cs in coastal water through two processes, which are advection and diffusion. The advection process explains the radioactive dynamic base on the water current, while the diffusion process defines the dissolution of radioactive elements in the ocean (Kawamura *et al*., 2017; Periáñez *et al*., 2019). In Delft3D, the advection-diffusion formula is:

$$\frac{\partial (d+\zeta)c}{\partial t} + \frac{1}{\sqrt{G_x}\sqrt{G_y}} \left\{ \frac{\partial \left[\sqrt{G_y}(d+\zeta)\, uc \right]}{\partial x} + \frac{\partial \left[\sqrt{G_x}(d+\zeta)\, vc \right]}{\partial y} \right\} + \frac{\partial \omega c}{\partial z} = \frac{d+\zeta}{\sqrt{G_x}\sqrt{G_y}} \left\{ \frac{\partial}{\partial x} \left[D_H \frac{\sqrt{G_y}}{\sqrt{G_x}} \frac{\partial c}{\partial x} \right] + \frac{\partial}{\partial x} \left[D_H \frac{\sqrt{G_x}}{\sqrt{G_y}} \frac{\partial c}{\partial y} \right] \right\} + \frac{1}{\partial + \zeta} \frac{\partial}{\partial z} \left(D_V \frac{\partial c}{\partial z} \right) - \lambda_d (d+\zeta) c + S \quad (4)$$

PUBLICATIONS RELATING TO DISPERSION/REIA

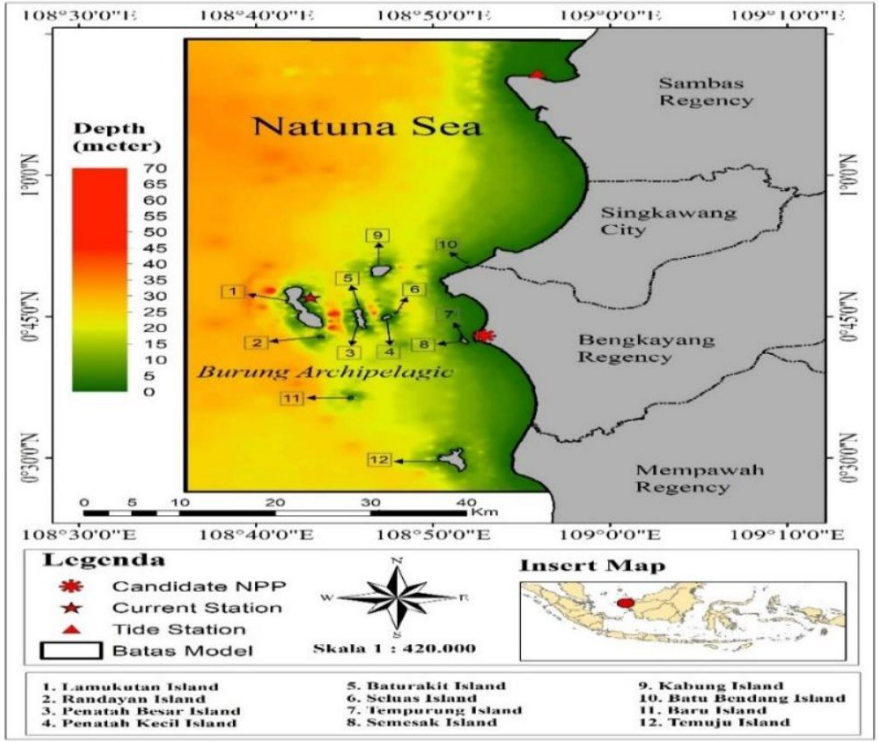


Figure 1. Boundary model and bathymetry

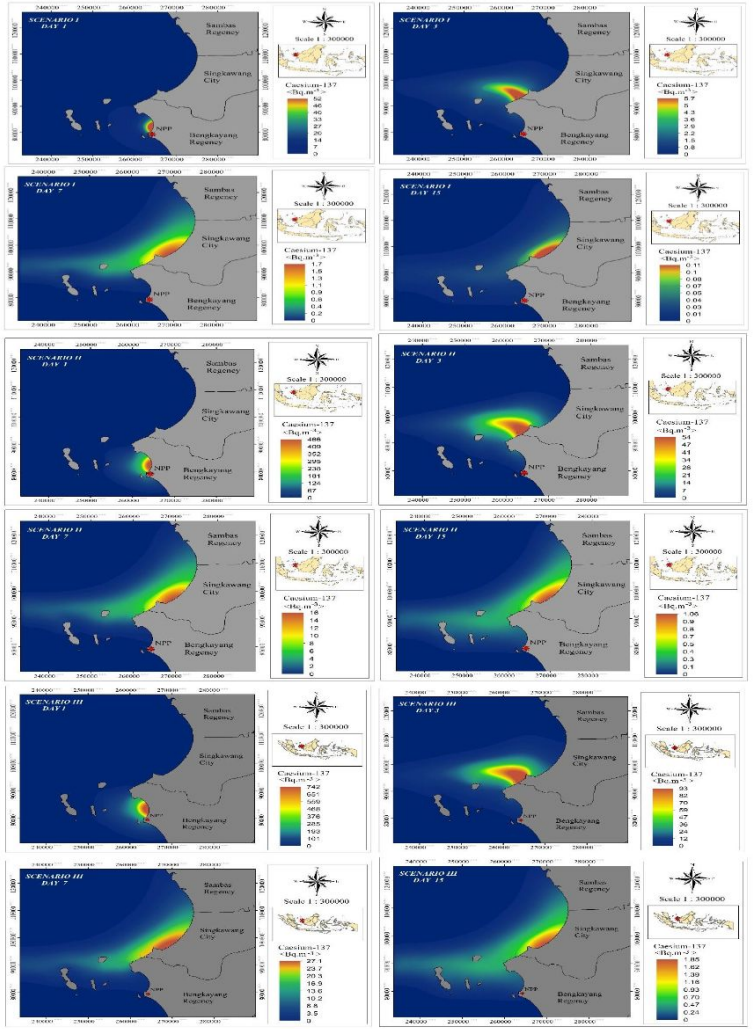
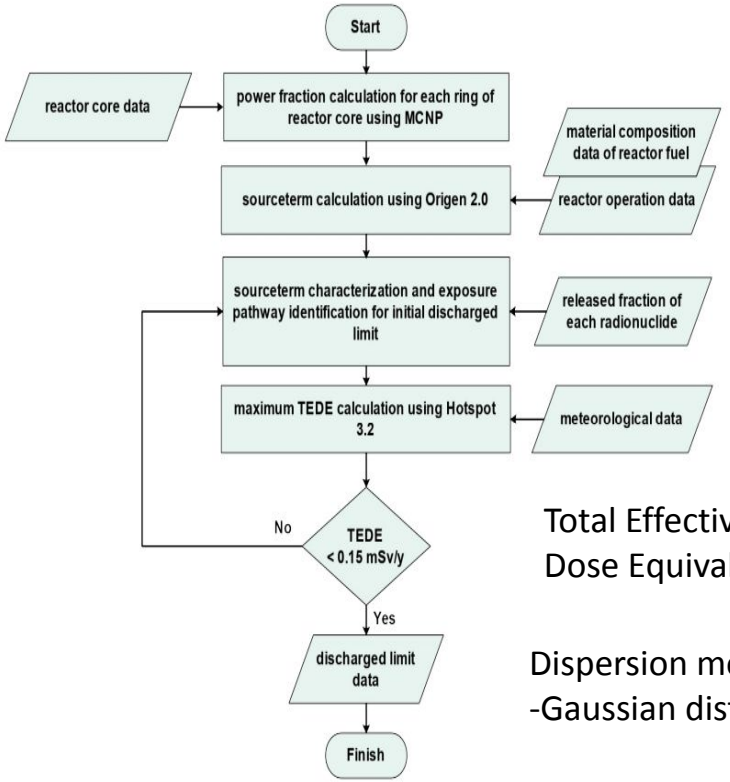


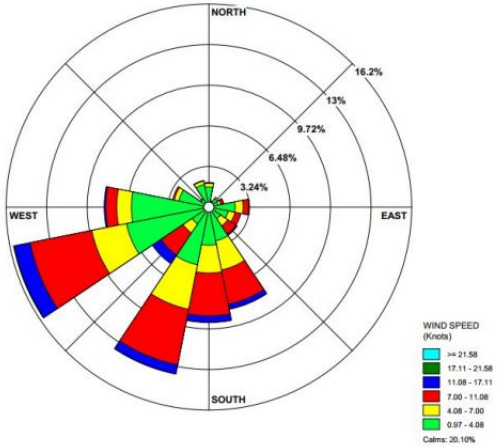
Figure 4. ^{137}Cs disperse simulation

PUBLICATIONS RELATING TO DISPERSION/REIA

TITLE	JOURNAL	(METHODS)/(SOFTWARE)/(EQUIPMENTS)	OTHERS
Concentration of NORM (238U, 232Th and their decay products) and Cs-137 in air particulate at around the NPP site candidate in West Kalimantan	AIP Conference Proceedings 2381, 020039 (2021); https://doi.org/10.1063/5.0067312 Published Online: 11 November 2021	/ /	
Etc.			
Radiation dose estimation to determine the discharged limit from Kartini research reactor (M. Salam, et al)	AIP Conference Proceedings **2381**, 020076 (2021); https://doi.org/10.1063/5.0066327	(Simulation)/(Hotspot 3.0.1)/ Description is explained in next slide	

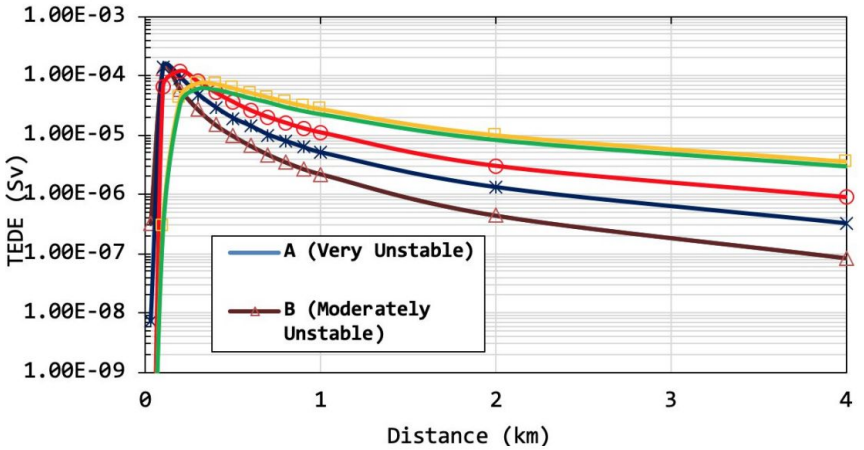
Case Study for Research Reactor





Total Effective Dose Equivalent

Dispersion model
-Gaussian distribution



$$C(x,y,z,H) = \frac{Q}{2\pi\sigma_y\sigma_z u} exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right]\left\{exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]\right\} exp\left[-\frac{\lambda x}{u}\right] DF(x)$$

NEXT PARTICIPATION

-IAEA-Asian Nuclear Safety Network (ANSN) - Regional Workshop on Radiological Environmental Impact Assessment for Nuclear Installations Manila 24-28 October 2022

-Technical Meeting on the Effects of Climate Change on Meteorological and Hydrological Hazards for Nuclear Installations IAEA, 14-18 November 2022

-Second Technical Meeting on Methods for Radiological and Environmental Impact Assessment (MEREIA), IAEA, 28 November 2022 – 2 December 2022

Thank You
Terima Kasih