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DAFTAR PUSTAKA

[1] Sucipta, "Borehole Disposal Limbah Radioaktif: Pengembangannya di Dunia & Potensinya di Indonesia," presented at the Webinar Daur Bahan Bakar Nuklir dan Limbah Radioaktif, Online, Apr. 14, 2023.

[2] Humas BRIN, "Borehole Disposal Sebagai Solusi Pengelolaan Limbah Radioaktif di Indonesia," *BRIN*, Apr. 15, 2023. https://brin.go.id/news/112271/borehole-disposal-sebagai-solusi-pengelolaan-limbah-radioaktif-di-indonesia (accessed Jul. 28, 2023).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, *Principles of Radioactive Waste Management Safety Fundamentals*. in Safety Series, no. 111- F. Vienna: INTERNATIONAL ATOMIC ENERGY AGENCY, 1995. [Online]. Available: https://www.iaea.org/publications/5192/principles-of-radioactive-waste-management-safety-fundamentals

[4] Committee on Principles and Operational Strategies for Staged Repository Systems, *One Step at a Time: The Staged Development of Geologic Repositories for High-Level Radioactive Waste*. Washington, D.C.: National Academies Press, 2003, p. 10611. doi: 10.17226/10611.

[5] C. Vestergaard, R. Price, and T. Le, "Geological Disposal of Spent Nuclear Fuel • Stimson Center," *Stimson Center*, Nov. 22, 2021. https://www.stimson.org/2021/geological-disposal-and-spent-nuclear-fuel/ (accessed Mar. 28, 2023).

[6] J.-S. Kim, S.-K. Kwon, M. Sanchez, and G.-C. Cho, "Geological storage of high level nuclear waste," *KSCE J. Civ. Eng.*, vol. 15, no. 4, pp. 721–737, Apr. 2011, doi: 10.1007/s12205-011-0012-8.

[7] S. Subadi, "KONFLIK PENGUASAAN DAN PENGUSAHAAN SUMUR TUA MINYAK DAN GAS BUMI DI KABUPATEN BOJONEGORO, JAWA TIMUR," *Arena Huk.*, vol. 16, no. 1, pp. 190–210, Apr. 2023, doi: 10.21776/ub.arenahukum.2023.01601.10.

[8] "Gas Reserves Reach 97.5 Trillion Cubic Feet, Indonesia Will Reactivate Old Wells | AsiaToday.id," Mar. 05, 2020. https://asiatoday.id/read/cadangan-gas-

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
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capai-975-trilliun-kaki-kubik-indonesia-akan-reaktivasi-sumur-tua (accessed Sep. 11, 2023).

[9] A. Johnson, "Anatomy of an oil well," *Aera Energy*, Jun. 18, 2019. https://www.aeraenergy.com/anatomy-of-an-oil-well/ (accessed Aug. 19, 2023).

[10] "Sakhalin-1 Sets Another Drilling Record," *The Maritime Executive*. https://maritime-executive.com/article/sakhalin-1-sets-another-drilling-record (accessed Aug. 19, 2023).

[11] D. Nataliana, N. Taryana, and R. A. Akbar, "Studi Korelasi antara Kapasitas Daya Motor Electrical Submersible Pump terhadap 4 Parameter Sumur Minyak," *ELKOMIKA J. Tek. Energi Elektr. Tek. Telekomun. Tek. Elektron.*, vol. 6, no. 1, p. 79, Apr. 2018, doi: 10.26760/elkomika.v6i1.79.

[12] Subariswanti, A. Hakim, and D. Suprayogi, "Analisis Pola Persebaran Pencemaran Air Tanah di Sekitar Penambangan Sumur Minyak Tua Desa Wonocolo, Kedewan, Bojonegoro: Analysis of Groundwater Pollution Distribution Patterns Around the Mining of Old Oil Wells Wonocolo Village, Kedewan, Bojonegoro," *J. Tek. Sipil Dan Lingkung.*, vol. 6, no. 2, pp. 133–142, Aug. 2021, doi: 10.29244/jsil.6.2.133-142.

[13] Internationale Atomenergie-Organisation, *DEVELOPMENT OF SPECIFICATIONS FOR RADIOACTIVE WASTE PACKAGES*. Vienna: IAEA, 2006.

[14] Internationale Atomenergie-Organisation, *QUALITATIVE ACCEPTANCE CRITERIA FOR RADIOACTIVE WASTES TO BE DISPOSED OF IN DEEP GEOLOGICAL FORMATIONS*. Vienna, 1990.

[15] *Issues relating to safety standards on the geological disposal of radioactive waste*. Vienna: IAEA, 2002.

[16] Internationale Atomenergie-Organisation and Internationale Atomenergie-Organisation, Eds., *Scientific and technical basis for the geological disposal of radioactive waste*. in Technical reports series / International Atomic Energy Agency, no. 413. Vienna: International Atomic Energy Agency, 2003.

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
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Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

[17] "NDA Report no DSSC/402/01 - Geological Disposal: Generic Disposal System Specification Part B: Technical Specification," *Part B*, 2016.

[18] J. R. Comberiati and A. M. Zammerilli, "Effects of petroleum-reservoir conditions on oil recovery by carbon dioxide injection," DOE/METC/TPR-83-4, 6276441, Nov. 1982. doi: 10.2172/6276441.

[19] Internationale Atomenergie-Organisation, Ed., *Siting of geological disposal facilities*. in Safety series G, no. 111 4,1. Vienna, 1994. [Online]. Available: https://gnssn.iaea.org/Superseded%20Safety%20Standards/Safety_Series_111-G_4.1_1994_Pub952e_web.pdf

[20] Internationale Atomenergie-Organisation, *Geological disposal facilities for radioactive waste*. in IAEA Safety standards series Specific safety guide, no. SSG-14. Vienna: IAEA, 2011. [Online]. Available: https://www-pub.iaea.org/mtcd/publications/pdf/pub1483_web.pdf

[21] "Peraturan Kepala Badan Pengawas Tenaga Nuklir Nomor 3 Tahun 2014 tentang Penyusunan Dokumen Analisis Mengenai Dampak Lingkungan Bidang Ketenaganuklirean."

[22] Ardika Giri Gahana, Ildrem Sjafri, Reza Moh Ganjar Gani, and Yusi Firmansyah, "KARAKTERISASI RESERVOIR MENGGUNAKAN ANALISIS PETROFISIKA PADA LAPANGAN Y FORMASI TALANG AKAR CEKUNGAN SUMATERA SELATAN," *Padjadjaran Geosci. J.*, vol. 3, no. 1, pp. 563–571, Feb. 2019.

[23] E. Priyanka, "Application of Borehole Image-Based Porosity Analysis in Carbonate Reservoirs to Assist in Permeability Calculation and Its Integration With Resistivity Inversion to Distinguish Productive Vuggy Zones and Tight Zones," in *Proceedings of Indonesian Petroleum Association, 46th Annual Convention & Exhibition, 2022*, Indonesian Petroleum Association, Sep. 2022. doi: 10.29118/IPA22-G-227.

[24] H. Yu *et al.*, "Corrections of fast neutron inelastic scattering effects on D-T neutron porosity logging," *Appl. Radiat. Isot.*, vol. 190, p. 110486, Dec. 2022, doi: 10.1016/j.apradiso.2022.110486.

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
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Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

[25] A. X. Chen, A. J. Antolak, and K.-N. Leung, "Electronic neutron sources for compensated porosity well logging," *Nucl. Instrum. Methods Phys. Res. Sect. Accel. Spectrometers Detect. Assoc. Equip.*, vol. 684, pp. 52–56, Aug. 2012, doi: 10.1016/j.nima.2012.04.053.

[26] Z. Bassiouni, *Theory, measurement, and interpretation of well logs*. in SPE textbook series, no. vol. 4. Richardson, TX: Henry L. Doherty Memorial Fund of AIME, Society of Petroleum Engineers, 1994.

[27] I. Murata, I. Tsuda, R. Nakamura, S. Nakayama, M. Matsumoto, and H. Miyamaru, "Neutron and gamma-ray source-term characterization of AmBe sources in Osaka University," *Prog. Nucl. Sci. Technol.*, vol. 4, pp. 345–348, 2014, doi: 10.15669/pnst.4.345.

[28] A. Didi, A. Dadouch, O. Jaï, J. Tajmouati, and H. El Bekkouri, "Neutron activation analysis: Modelling studies to improve the neutron flux of Americium–Beryllium source," *Nucl. Eng. Technol.*, vol. 49, no. 4, pp. 787–791, Jun. 2017, doi: 10.1016/j.net.2017.02.002.

[29] N. Hatefi Moadab and M. Kheradmand Saadi, "Optimization of an Am-Be neutron source shield design by advanced materials using MCNP code," *Radiat. Phys. Chem.*, vol. 158, pp. 109–114, May 2019, doi: 10.1016/j.radphyschem.2019.01.026.

[30] A. Bala, D. Jenkins, J. R. Brown, J. Bordes, P. Joshi, and P. Worthington, "Monte Carlo Comparison of Alternatives to 3He Thermal Neutron Detectors for Logging Applications," in *2019 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC)*, Oct. 2019, pp. 1–6. doi: 10.1109/NSS/MIC42101.2019.9059978.

[31] R. T. Kouzes, "The 3He Supply Problem," PNNL-18388, 956899, May 2009. doi: 10.2172/956899.

[32] H. Qing-Yuan, H. Xin-Miao, W. Geng-Fei, and J. Wen-DA, "A new chlorine logging tool: Application in the oilfield development with high salinity formation water," presented at the Second international conference on isotopes Conference proceedings, Australia, 1997, p. 332. [Online]. Available: http://inis.iaea.org/search/search.aspx?orig_q=RN:29057220

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
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Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

[33] M. N. Alatas, Sihana, and Muhammad Yusuf, "Pengaruh Sumber Neutron, Boron-Lining, dan Keberadaan Parafin dalam Sumur Bor terhadap Sensitivitas Pengukuran Porositas Formasi Tanah Menggunakan Metode CNL (Compensated Neutron Log)," Undergraduate Thesis, Universitas Gadjah Mada, 2021.

[34] M. Gierlik *et al.*, "Comparative Study of Large NaI(Tl) and BGO Scintillators for the EURopean Illicit TRAfficking Countermeasures Kit Project," *IEEE Trans. Nucl. Sci.*, vol. 53, p. 1737, Jun. 2006, doi: 10.1109/NSSMIC.2005.1596605.

[35] D. C. Stromswold, "Comparison of Sodium Iodide, Cesium Iodide, and Bismuth Germanate Scintillation Detectors for Borehole Gamma-Ray Logging," *IEEE Trans. Nucl. Sci.*, vol. 28, no. 1, pp. 290–294, Feb. 1981, doi: 10.1109/TNS.1981.4331182.

[36] P. Ghorbani, E. Bayat, and N. Ghal-Eh, "A comparison study on three different radiation detectors used for liquid levelmetry," *Radiat. Prot. Dosimetry*, vol. 156, no. 1, pp. 103–108, Aug. 2013, doi: 10.1093/rpd/nct046.

[37] A. Bala, D. G. Jenkins, and S. Namadi, "Radiation detectors for nuclear well-logging application: A review," *Dutse J. Pure Appl. Sci.*, vol. 8, no. 2a, pp. 80–93, Jun. 2022, doi: 10.4314/dujopas.v8i2a.9.

[38] Z. Lin, S. Lv, Z. Yang, J. Qiu, and S. Zhou, "Structured Scintillators for Efficient Radiation Detection," *Adv. Sci.*, vol. 9, no. 2, p. 2102439, Jan. 2022, doi: 10.1002/advs.202102439.

[39] E. A. A. Muraikhi, "Optimization of A Combined Carbon/Oxygen And Neutron Porosity Oil Well Logging Tool," Electronic Theses, United Arab Emirates University, UAE, 2017. [Online]. Available: https://scholarworks.uaeu.ac.ae/all_theses/624

[40] A. Drabina and Z. Tomasz, "Correlation between Measurements and Monte-Carlo Calculations for the NNTE Logging-Tool," Mar. 2014.

[41] E. F. Rif'ati, "ALTERNATIF STRATEGI PENANGGULANGAN MASALAH WAXY PARAFIN PADA TUBING SUMUR YANG MEMPRODUKSIKAN MINYAK PARAFINIK," *Swara Patra Maj. Ilm.*

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
Detektor Helium-3 dan Detektor Bismut Germanat dengan Metode Log NeutronÂ Terkompensasi**
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Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

PPSDM Migas, vol. 6, no. 1, Art. no. 1, Dec. 2016, Accessed: Mar. 31, 2023. [Online]. Available: http://ejurnal.ppsdmmigas.esdm.go.id/sp/index.php/swarapatra/article/view/114

[42] Y. Wang, J. Liang, Q. Zhang, X. Wang, W. Tang, and Y. Chen, "Development and verification of Geant4-based parallel computing Monte Carlo simulations for nuclear logging applications," *Ann. Nucl. Energy*, vol. 172, p. 109079, 2022, doi: https://doi.org/10.1016/j.anucene.2022.109079.

[43] T. Sato *et al.*, "Overview of particle and heavy ion transport code system PHITS," *Ann. Nucl. Energy*, vol. 82, pp. 110–115, Aug. 2015, doi: 10.1016/j.anucene.2014.08.023.

[44] R. García-Baonza, A. Murcia-Morales, and E. Gallego, "Comparison of PHITS2.88 and MCNP6.1 for the characterization of a LUPIN-II neutron area monitor," *Appl. Radiat. Isot.*, vol. 188, p. 110407, Oct. 2022, doi: 10.1016/j.apradiso.2022.110407.

[45] H. A. Pratama, "PEMILIHAN TAPAK POTENSIAL UNTUK DISPOSAL LIMBAH RADIOAKTIF OPERASI PLTN DI BANGKA SELATAN," vol. 17, no. 1, 2014.

[46] S. W. Sucipta, B. Setiawan, D. Suganda, A. S. Purnomo, and H. Sriwahyuni, "Studi Pemilihan Calon Tapak Disposal Limbah Radioaktif Operasi PLTN di Bangka Belitung: Penyusunan Konsep dan Rencana Disposal," *Pros. Pertem. Dan Present. Ilm. Penelit. Dasar Ilmu Pengetah. Dan Teknol. Nukl. PTAPB BATAN Yogyak.*, 2012.

[47] International Atomic Energy Agency, "Planning and design considerations for geological repository programmes of radioactive waste." International Atomic Energy Agency, 2014. [Online]. Available: https://www-pub.iaea.org/MTCD/publications/PDF/TE-1755_web.pdf

[48] E. Shalev (GSI), V. Lyakhovsky (GSI), S. Bauer, R. Choens, and W. Kibikas, "Characterization and borehole analysis of the Ghareb Formation for nuclear waste disposal.," in *Proposed for presentation at the American Rock*

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
Detektor Helium-3 dan Detektor Bismut Germanat dengan Metode Log NeutronÂ Terkompensasi**
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Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

Mechanics Association meeting held June 28-30, 2021 in Houston, TX, US., US DOE, May 2021. doi: 10.2172/1870575.

[49] T. S. Nguyen, Z. Li, G. Su, M. H. B. Nasseri, and R. P. Young, "Hydro-mechanical behavior of an argillaceous limestone considered as a potential host formation for radioactive waste disposal," *J. Rock Mech. Geotech. Eng.*, vol. 10, no. 6, pp. 1063–1081, Dec. 2018, doi: 10.1016/j.jrmge.2018.03.010.

[50] J. P. Turner, T. W. Berry, M. J. Bowman, and N. A. Chapman, "Role of the geosphere in deep nuclear waste disposal – An England and Wales perspective," *Earth-Sci. Rev.*, p. 104445, May 2023, doi: 10.1016/j.earscirev.2023.104445.

[51] B. Kochkin, V. Malkovsky, S. Yudintsev, V. Petrov, and M. Ojovan, "Problems and perspectives of borehole disposal of radioactive waste," *Prog. Nucl. Energy*, vol. 139, p. 103867, Sep. 2021, doi: 10.1016/j.pnucene.2021.103867.

[52] Q. Zhang, X. Wang, Q. Zhang, and J. Gao, "New development of sensitivity improvement for compensated neutron porosity tool in gas-filled boreholes," *Appl. Radiat. Isot.*, vol. 185, p. 110216, Jul. 2022, doi: 10.1016/j.apradiso.2022.110216.

[53] C. Gallé, "Neutron porosity logging and core porosity measurements in the Beauvoir granite, Massif Central Range, France," *J. Appl. Geophys.*, vol. 32, no. 2–3, pp. 125–137, Aug. 1994, doi: 10.1016/0926-9851(94)90015-9.

[54] C. R. Peeples, M. Mickael, and R. P. Gardner, "On replacing Am–Be neutron sources in compensated porosity logging tools," *Appl. Radiat. Isot.*, vol. 68, no. 4–5, pp. 926–931, Apr. 2010, doi: 10.1016/j.apradiso.2009.11.042.

[55] W. Wu, M. Tong, L. Xiao, and J. Wang, "Porosity sensitivity study of the compensated neutron logging tool," *J. Pet. Sci. Eng.*, vol. 108, pp. 10–13, Aug. 2013, doi: 10.1016/j.petrol.2013.04.020.

[56] A. M. G. Emam, "Boron-Lined NaI Detector as An Efficient alternative To He-3 Neutrons Detectors".

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
Detektor Helium-3 dan Detektor Bismut Germanat dengan Metode Log NeutronÂ Terkompensasi**
Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

[57] W. A. Metwally, "Porosity calculations using a C/O logging tool with boron-lined NaI detectors," *Appl. Radiat. Isot.*, vol. 69, no. 1, pp. 217–219, Jan. 2011, doi: 10.1016/j.apradiso.2010.08.003.

[58] W. A. Metwally and A. G. Emam, "Experimental validation and testing of a NaI boron-lined neutron detector," *Nucl. Instrum. Methods Phys. Res. Sect. B Beam Interact. Mater. At.*, vol. 422, pp. 7–11, May 2018, doi: 10.1016/j.nimb.2018.02.021.

[59] V. D. Ryzhikov, S. V. Naydenov, G. M. Onyshchenko, L. A. Piven, T. Pochet, and C. F. Smith, "Multi-layer fast neutron detectors based on composite heavy-oxide scintillators for detection of illegal nuclear materials," *Nucl. Instrum. Methods Phys. Res. Sect. Accel. Spectrometers Detect. Assoc. Equip.*, vol. 903, pp. 287–296, Sep. 2018, doi: 10.1016/j.nima.2018.06.074.

[60] M. Gierlik, J. Iwanowska, T. Kozlowski, M. Moszynski, L. Swiderski, and T. Szczesniak, "The comparison of large scintillators for high energy gamma-rays detection," in *IEEE Nuclear Science Symposuim & Medical Imaging Conference*, Knoxville, TN: IEEE, Oct. 2010, pp. 501–505. doi: 10.1109/NSSMIC.2010.5873811.

[61] J. Liu, F. Zhang, X. Wang, F. Han, and Z. Yuan, "Numerical study on determining formation porosity using a boron capture gamma ray technique and MCNP," *Appl. Radiat. Isot.*, vol. 94, pp. 266–271, Dec. 2014, doi: 10.1016/j.apradiso.2014.08.013.

[62] M. FAUZAN and P. D. Muhammad Yusuf, "Analisis Pengaruh Parameter Sumur Bor Terhadap Sensitivitas Pengukuran Porositas Menggunakan Metode Compensated Neutron Logging Dengan Simulasi MCNP," PhD Thesis, 2022.

[63] A. A. Olajire, "Review of wax deposition in subsea oil pipeline systems and mitigation technologies in the petroleum industry," *Chem. Eng. J. Adv.*, vol. 6, p. 100104, May 2021, doi: 10.1016/j.ceja.2021.100104.

[64] M. A. Theyab, "Wax deposition process: mechanisms, affecting factors and mitigation methods," *Open Access J. Sci.*, vol. 2, no. 2, Mar. 2018, doi: 10.15406/oajs.2018.02.00054.

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
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Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

[65] L. Zhao, H. Zhong, G. Liu, C. Zheng, J. Yang, and X. Dong, "Prediction and Simulation of Wax Deposition in Oil and Gas Wells," *Environ. Resour. Ecol. J.*, vol. 7, pp. 69–78, 2023.

[66] W. Kiyingi, J.-X. Guo, R.-Y. Xiong, L. Su, X.-H. Yang, and S.-L. Zhang, "Crude oil wax: A review on formation, experimentation, prediction, and remediation techniques," *Pet. Sci.*, vol. 19, no. 5, pp. 2343–2357, Oct. 2022, doi: 10.1016/j.petsci.2022.08.008.

[67] M. Yan, G. Li, and X. Li, "Study on the Effect of Crude Oil Composition on Waxing Characteristics of Waxy Crude Oil," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 452, p. 032018, Dec. 2018, doi: 10.1088/1757-899X/452/3/032018.

[68] M. Z. Abdul Aziz *et al.*, "Monte Carlo simulation of X-ray room shielding in diagnostic radiology using PHITS code," *J. Radiat. Res. Appl. Sci.*, vol. 13, no. 1, pp. 704–713, Jan. 2020, doi: 10.1080/16878507.2020.1828020.

[69] K. Kurosu, I. J. Das, and V. P. Moskvin, "Optimization of GATE and PHITS Monte Carlo code parameters for spot scanning proton beam based on simulation with FLUKA general-purpose code," *Nucl. Instrum. Methods Phys. Res. Sect. B Beam Interact. Mater. At.*, vol. 367, pp. 14–25, Jan. 2016, doi: 10.1016/j.nimb.2015.11.017.

[70] M. H. Bölükdemir, E. Uyar, G. Aksoy, H. Ünlü, H. Dikmen, and M. Özgür, "Investigation of shape effects and dead layer thicknesses of a coaxial HPGe crystal on detector efficiency by using PHITS Monte Carlo simulation," *Radiat. Phys. Chem.*, vol. 189, p. 109746, Dec. 2021, doi: 10.1016/j.radphyschem.2021.109746.

[71] R. Bedogni *et al.*, "Modelling the response of semiconductor based thermal neutron detectors with MCNP 6.2 and PHITS," *Nucl. Instrum. Methods Phys. Res. Sect. Accel. Spectrometers Detect. Assoc. Equip.*, vol. 1018, p. 165855, Dec. 2021, doi: 10.1016/j.nima.2021.165855.

[72] E. B. Podgorsak, *Radiation Physics for Medical Physicists*, 3rd ed. 2016. in Graduate Texts in Physics. Cham: Springer International Publishing : Imprint: Springer, 2016. doi: 10.1007/978-3-319-25382-4.

UNIVERSITAS
GADJAH MADA
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Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

[73] J. Kónya and N. M. Nagy, *Nuclear and radiochemistry*, 1st ed. in Elsevier insights. London ; Waltham, MA: Elsevier, 2012.

[74] G. Sibbens *et al.*, "Target preparation for neutron-induced reaction measurements," *EPJ Web Conf.*, vol. 229, p. 04003, 2020, doi: 10.1051/epjconf/202022904003.

[75] N. Tsoulfanidis and S. Landsberger, *Measurement & detection of radiation*, 4th edition. Boca Raton: CRC Press, Taylor & Francis Group, 2015.

[76] P. Reuss, *Neutron physics*. France: EDP Sciences, 2008.

[77] R. F. Barth, A. H. Soloway, and R. G. Fairchild, "Boron neutron capture therapy for cancer," *Sci. Am.*, vol. 263, no. 4, pp. 100–107, 1990.

[78] K. H. Lieser, *Nuclear and radiochemistry: fundamentals and applications*, 2nd, rev. ed ed. Berlin ; New York: Wiley-VCH, 2001.

[79] G. F. Knoll, *Radiation detection and measurement*, 4th ed. Hoboken, N.J: John Wiley, 2010.

[80] D. V. Ellis, *Well logging for earth scientists*, 2nd ed. Dordrecht, The Netherlands: Springer, 2007.

[81] H. Liu, *Principles and Applications of Well Logging*, 2nd ed. 2017. in Springer Geophysics. Berlin, Heidelberg: Springer Berlin Heidelberg : Imprint: Springer, 2017. doi: 10.1007/978-3-662-54977-3.

[82] T. Darling, *Well logging and formation evaluation*. in Gulf drilling guides. Amsterdam ; Boston : Burlington, MA: Elsevier ; Gulf Professional Pub, 2005.

[83] M. H. Rider, *The geological interpretation of well logs*, 2. ed., rev.Reprinted. Sutherland: Rider-French Consulting, 2006.

[84] O. Serra, *The well logging handbook*. Paris: Éd. Technip, 2008.

[85] L. S. Allen, C. W. Tittle, W. R. Mills, and R. L. Caldwell, "DUAL-SPACED NEUTRON LOGGING FOR POROSITY," *GEOPHYSICS*, vol. 32, no. 1, pp. 60–68, Feb. 1967, doi: 10.1190/1.1439857.

[86] A. Soloway, R. Barth, R. Gahbauer, T. Blue, and J. H. J. Goodman, "The rationale requirements for the development of boron neutron capture therapy

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
Detektor Helium-3 dan Detektor Bismut Germanat dengan Metode Log NeutronÂ Terkompensasi**
Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

of brain tumors," *J. Neurooncol.*, vol. 33, pp. 9–18, Jun. 1997, doi: 10.1023/A:1005753610355.

[87] W. A. Metwally, "Existing NaI detectors; an efficient alternative to He-3 detectors," *Nucl. Instrum. Methods Phys. Res. Sect. B Beam Interact. Mater. At.*, vol. 338, pp. 48–51, Nov. 2014, doi: 10.1016/j.nimb.2014.08.001.

[88] H. Wang, "A non-isothermal wellbore model for high pressure high temperature natural gas reservoirs and its application in mitigating wax deposition," *J. Nat. Gas Sci. Eng.*, vol. 72, p. 103016, Dec. 2019, doi: 10.1016/j.jngse.2019.103016.

[89] Y. K. A. Jaimes, "Flow Assurance of Waxy Crude Oil: Physical and Chemical Characterization, Critical Temperatures and Rheological Behavior for The Restart Problem-Experimental Study," Dissertation, Universidade Estadual De Campinas, Campinas, 2016.

[90] J. Wang *et al.*, "Experimental study of wax deposition pattern concerning deep condensate gas in Bozi block of Tarim Oilfield and its application," *Thermochim. Acta*, vol. 671, pp. 1–9, Jan. 2019, doi: 10.1016/j.tca.2018.10.024.

[91] C. J. Coberly, "Method of preventing wax deposits in tubing," US2303823A, Dec. 01, 1942 Accessed: Jun. 19, 2023. [Online]. Available: https://patents.google.com/patent/US2303823A/en

[92] Y. Wang, X. Liu, Z. Huang, Z. Wang, and Y. Liu, "Characterization of Wax Precipitation and Deposition Behavior of Condensate Oil in Wellbore: A Comprehensive Review of Modeling, Experiment, and Molecular Dynamics Simulation," *Energies*, vol. 15, no. 11, p. 4018, May 2022, doi: 10.3390/en15114018.

[93] D. V. Ellis, C. Flaum, J. E. Galford, and H. D. Scott, "The Effect of Formation Absorption on the Thermal Neutron Porosity Measurement," presented at the SPE Annual Technical Conference and Exhibition, Sep. 1987, p. SPE-16814-MS. doi: 10.2118/16814-MS.

[94] T. Trikasjono, D. Harsono, and C. Wulandari, "RANCANG BANGUN PENAMPIL PLATO DETEKTOR GEIGER MUELLER BERBASIS

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
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Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

PERSONAL KOMPUTER," *J. Forum Nukl.*, vol. 7, no. 2, p. 186, Jun. 2017, doi: 10.17146/jfn.2013.7.2.3472.

[95] M. Tohamy, E. K. Elmaghraby, and M. N. H. Comsan, "Reevaluation of the neutron emission probabilities from 241Am–Be neutron source," *Nucl. Instrum. Methods Phys. Res. Sect. Accel. Spectrometers Detect. Assoc. Equip.*, vol. 942, p. 162387, Oct. 2019, doi: 10.1016/j.nima.2019.162387.

[96] G. Bulubașa, I. Cristescu, A. Bornea, M. Zamfirache, L. Stefan, and G. Ana, "Studies on helium-3 separation at Cernavoda nuclear power plant," *Fusion Eng. Des.*, vol. 146, pp. 398–401, Sep. 2019, doi: 10.1016/j.fusengdes.2018.12.076.

[97] E. M. Souza, S. C. A. Correa, A. X. Silva, R. T. Lopes, P. L. F. Rocha, and I. C. B. Lima, "3He(n,p) reaction simulation for formation analyses," presented at the INAC 2009: International nuclear atlantic conference Innovations in nuclear technology for a sustainable future, Brazil, 2009. [Online]. Available: http://inis.iaea.org/search/search.aspx?orig_q=RN:41113400

[98] "Product | Helium-3 (3He) Neutron Proportional Counters | Centronic." http://www.centronic.co.uk/products/13/helium-3-3he-neutron-proportional-counters (accessed Sep. 11, 2023).

[99] F. Piscitelli, G. Mauri, A. Laloni, and R. Hall-Wilton, "Verification of He-3 proportional counters' fast neutron sensitivity through a comparison with He-4 detectors: He-3 and He-4 proportional counters' fast neutron sensitivity and evaluation of the cosmic neutron fluxes at ESS," *Eur. Phys. J. Plus*, vol. 135, no. 7, p. 577, Jul. 2020, doi: 10.1140/epjp/s13360-020-00600-8.

[100] MIT, "TGM Neutron Detectors - Helium-3 Neutron Proportional Counters." [Online]. Available: http://web.mit.edu/8.13/www/JLExperiments/38/tgm-neutron-detectors.pdf

[101] Reuter-Stokes, "Reuter Stokes Helium-3 filled proportional counter - Product Overview."

[102] D. A. Shea and D. Morgan, "The Helium-3 Shortage: Supply, Demand, and Options for Congress".

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
Detektor Helium-3 dan Detektor Bismut Germanat dengan Metode Log NeutronÂ Terkompensasi**
Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

[103] I. I. Novoselov, I. V. Makarov, V. A. Fedotov, N. V. Ivannikova, and Yu. V. Shubin, "Synthesis of a bismuth germanium oxide source material for Bi4Ge3O12 crystal growth," *Inorg. Mater.*, vol. 49, no. 4, pp. 412–415, Apr. 2013, doi: 10.1134/S0020168513030138.

[104] H. Vincke, E. Gschwendtner, C. W. Fabjan, and T. Otto, "Response of a BGO detector to photon and neutron sources: simulations and measurements," *Nucl. Instrum. Methods Phys. Res. Sect. Accel. Spectrometers Detect. Assoc. Equip.*, vol. 484, no. 1–3, pp. 102–110, May 2002, doi: 10.1016/S0168-9002(01)01966-0.

[105] D. S. McGregor, "Materials for Gamma-Ray Spectrometers: Inorganic Scintillators," *Annu. Rev. Mater. Res.*, vol. 48, no. 1, pp. 245–277, 2018, doi: 10.1146/annurev-matsci-070616-124247.

[106] C. L. Melcher, J. S. Schweitzer, A. Liberman, and J. Simonetti, "Temperature Dependence of Fluorescence Decay Time and Emission Spectrum of Bismuth Germanate," *IEEE Trans. Nucl. Sci.*, vol. 32, no. 1, pp. 529–532, Feb. 1985, doi: 10.1109/TNS.1985.4336887.

[107] A. Borella *et al.*, "Determination of the 209Bi()210Bi and 209Bi()210m,gBi reaction cross sections in a cold neutron beam," *Nucl. Phys. A*, vol. 850, no. 1, pp. 1–21, Jan. 2011, doi: 10.1016/j.nuclphysa.2010.11.006.

[108] S. Raychaudhuri, "INTRODUCTION TO MONTE CARLO SIMULATION," *Model. Anal. Semicond. Manuf.*, 2008, doi: 978-1-4244-2708-6.

[109] J.-C. Walter and G. Barkema, "An introduction to Monte Carlo methods," *Phys. Stat. Mech. Its Appl.*, vol. 418, pp. 78–87, Jan. 2015, doi: 10.1016/j.physa.2014.06.014.

[110] S. A. H. Feghhi, "An Introduction to MCNP." AGH University of Science and Technology, 2010. Accessed: Jun. 21, 2023. [Online]. Available: https://home.agh.edu.pl/~domanska/mcnpMANUIAL04.pdf

[111] Tatsuhiko Sato *et al.*, "PHITS: General Introduction." 2022. [Online]. Available: https://phits.jaea.go.jp/lec/phits-introduction-en.pdf

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
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Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

[112] F. Al-Aryani, A. Obeidi, J. Brahmakulam, and R. Ramamoorthy, "Pulsed Neutron Monitoring of the First CO2 EOR Pilot in the Middle East," in *All Days*, Manama, Bahrain: SPE, Sep. 2011, p. SPE-141490-MS. doi: 10.2118/141490-MS.

[113] B. Won, S. Hwang, and J. Shin, "An Analysis on Response Characteristics of a Dual Neutron Logging using Monte Carlo Simulation," *J. Eng. Geol.*, vol. 27, no. 4, pp. 429–438, Dec. 2017, doi: 10.9720/KSEG.2017.4.429.

[114] T. Cywicka-Jakiel, U. Woynicka, and T. Zorski, "The use of the MCNP code for the quantitative analysis of elements in geological formations," presented at the International conference on supercomputing in nuclear applications SNA'2003, France, 2003. [Online]. Available: http://inis.iaea.org/search/search.aspx?orig_q=RN:35106383

[115] R. Mcconn, C. Gesh, R. Pagh, R. A. Rucker, and R. Williams, "Compendium of Material Composition Data for Radiation Transport Modeling," Jan. 2011, doi: 10.2172/1023125.

[116] D. Sun, Z. Zhu, Z. Hu, and M. Wu, "Experimental and theoretical study on wax deposition and the application on a heat insulated crude oil pipeline in Northeast China," *Oil Gas Sci. Technol. – Rev. D'IFP Energ. Nouv.*, vol. 75, p. 3, 2020, doi: 10.2516/ogst/2019064.

[117] M. Obaseki and P. T. Elijah, "Dynamic modeling and prediction of wax deposition thickness in crude oil pipelines," *J. King Saud Univ. - Eng. Sci.*, vol. 33, no. 6, pp. 437–445, Sep. 2021, doi: 10.1016/j.jksues.2020.05.003.

[118] A. Shahri, N. Ghal-Eh, and G. R. Etaati, "Modelling boron-lined proportional counter response to neutrons," *Radiat. Prot. Dosimetry*, vol. 156, no. 3, pp. 349–355, Sep. 2013, doi: 10.1093/rpd/nct066.

[119] I. A. El-Mesady, A. E. Hussein, M. M. Semary, and S. M. Othman, "Investigation of the mechanical properties, shielding parameters and flux distribution in borate - Based glass system using PHITS code; a simulation study," *Opt. Mater.*, vol. 138, p. 113699, 2023, doi: https://doi.org/10.1016/j.optmat.2023.113699.

UNIVERSITAS
GADJAH MADA
**Analisis Pengaruh Ketebalan Lapisan Boron dan Keberadaan Wax terhadap Penentuan Porositas pada
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Rifqi Muhammad, Dr.-Ing, Ir. Sihana; Muhammad Yusuf, Ph.D.
Universitas Gadjah Mada, 2023 | Diunduh dari http://etd.repository.ugm.ac.id/

[120] H. Fithraturrahma, "ANALISIS DOSIS RADIASI BORON NEUTRON CAPTURE THERAPY (BNCT) PADA TERAPI KANKER PARU-PARU MENGGUNAKAN APLIKASI PHITS VERSI 3.20," Undergraduate Thesis, PROGRAM STUDI FISIKA FAKULTAS SAINS DAN TEKNOLOGI UNIVERSITAS ISLAM NEGERI MAULANA MALIK IBRAHIM MALANG, Malang, 2023.

[121] Dhani Nur Indra Syamputra, "ANALISIS DOSIS PENGOBATAN BNCT PADA KANKER Rhabdomyosarcoma DI KEPALA DAN LEHER DENGAN PHITS CODE," Undergraduate Thesis, PROGRAM STUDI FISIKA JURUSAN PENDIDIKAN FISIKA FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM UNIVERSITAS NEGERI YOGYAKARTA, Yogyakarta, 2018.