Revista de Ciencias Médicas de Pinar del Río

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

REVIEW ARTICLE

Location of a Nuclear Medicine Center in the province of Pinar del Río: approach and regulatory determinants

Jorge Milian-Baldor[1]

[1]Universidad de Ciencias Médicas de Pinar del Río. Hospital General Docente "Hospital General Docente Abel Santamaría Cuadrado"

Received: July 15, 2025
Accepted: September 17, 2025
Published: October 03, 2025

Citar como: Milian-Baldor J. Emplazamiento de un Centro de Medicina Nuclear en la provincia de Pinar del Río: enfoque y determinantes regulatorias. Rev Ciencias Médicas [Internet]. 2025 [citado: fecha de acceso]; 29(2025): e6836. Disponible en: http://revcmpinar.sld.cu/index.php/publicaciones/article/view/6836

ABSTRACT

Introduction: the design of a Nuclear Medicine center is essentially determined by the layout and size of the premises required to meet functional needs, and the mandatory requirements to comply with safety regulations in its work protocols.
Aim: analyze the general approach and regulatory determinants that dictate the architectural location of a Nuclear Medicine center.
Methods: a narrative literature review was conducted, consulting databases, technical archives, and interviews with experts. Relevant articles on hospital architecture, nuclear regulations, and urban planning factors were analyzed, focusing on care at the Nuclear Medicine Center. Eligibility criteria and a thematic approach were applied to synthesize conceptual and applied evidence.
Development: in hospital architecture, especially for nuclear medical centers, the site is much more than simply the location of a building. Selecting a site requires a meticulous analysis of various factors. Its location is therefore a critical factor that influences its technical feasibility, radiation safety, accessibility, and regulatory compliance, which stems from a legal hierarchy and technical precepts that require governance structures and those specifically regulating nuclear activity for their application.
Conclusions: the strategic location allows for the design of safe, functional, and contextualized nuclear centers, meeting architectural and regulatory objectives from the pre-investment stage, guaranteeing the assistance role without compromising the nuclear safety standards established for practice.

Keywords: Hospital Design and Construction; Nuclear Medicine; Nuclear Medicine Department, Hospital.

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

INTRODUCTION

The quote from Antonio Averlino "Filarete", which equates architectural creation to a conception between the architect and the world, serves as a starting point to analyze the complex process of locating a work.[1] In this context, hospital architecture, with origins in temples of ancient cultures, has evolved from symbolic and functional designs to contemporary approaches focused on evidence, patient well-being, and operational efficiency.[2,3]

Globally, governments face scarce budgets and growing health needs in the population, creating an investment gap. While several countries in the Americas region have increased their investments in health infrastructure, according to a study by the Inter-American Development Bank (IDB), the investment gap in public health is at least USD 153,114 million in Latin America and the Caribbean.[4,5]

Scarce resources present countries with the challenge of how to invest efficiently, an aspect that is unique in the Cuban scenario, given the more than six decades of the North American blockade, notably intensified in recent years. Without ignoring other edges of its cruel impact, the health system particularizes an expression of the criminality and perversity of its execution.[5]

In Cuba, public health policy has structured a health coverage system organized into categories of care (primary, secondary, and tertiary) and levels of complexity (low, medium, and high). Within this framework, the Nuclear Medicine and Molecular Imaging Center of Pinar del Río, classified at the medium level of complexity, was conceived to be integrated into the "Abel Santamaría Cuadrado" General Teaching Hospital, a second-level care hospital. This project is part of the development strategy for quality medical services of the Ministry of Public Health (Minsap), which for decades has included Nuclear Medicine among its prioritized investment policies.[6]

Considering that investments in health infrastructure are generally high and involve a diversity of actors during the design, construction, and commissioning phases; the entities responsible for these processes face great challenges, especially in the most complex projects.[3,4] Derived from the above, the need to exhaustively evaluate each investment or development project is rigorously imposed in our country, in order to enhance the creation of the greatest added value, based on the theoretical-methodological foundations that result from the particular research of each project. Given this, the present article is carried out, which aims to analyze the general approach and the regulatory determinants that dictate the architectural location of a Nuclear Medicine (NM) center.

METHODS

A narrative literature review with an integrative approach was carried out, aimed at analyzing the impact of architectural location on the design of NM centers. The search was conducted between January and May 2025 in scientific databases (Scopus, PubMed, SciELO), institutional technical documents, and specific archives related to the project of the Nuclear Medicine and Molecular Imaging Center of Pinar del Río. Advanced search strategies were used using Boolean operators, controlled terms (MeSH), and inclusion/exclusion criteria that considered publications in Spanish and English, from the year 2000 onwards.

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

In addition, gray literature such as government reports, interviews with specialists linked to the design of the center, and architectural plans available in local physical archives were incorporated. The process included systematic deduplication of references using tools such as Mendeley and Zotero, as well as verification of DOI/URL to ensure documentary traceability.

The evaluation of methodological quality was based on compliance with international regulations for non-systematic reviews, prioritizing studies with conceptual relevance and architectural applicability in the nuclear hospital context. A thematic matrix was used to categorize the findings according to criteria such as functionality, radiological safety, location regulations, accessibility, and urban sustainability.

DEVELOPMENT

The location of a center of this nature must be preceded by the preparation of a project, which must be based on network studies and have all the elaborated studies that support the project to be carried out, including the functional plan. If this support does not exist when the design is carried out, the project is susceptible to changes during the contracting or construction process, which implies higher costs and delays in its execution.

NM is defined as the medical specialty that uses radionuclides, radioactive isotopes, in the form of unencapsulated sources for prevention, diagnosis, therapy, and medical research.[7] This in turn is a fascinating and constantly evolving field that combines advanced technology, chemistry, physics, and medicine to diagnose and treat diseases. In addition to these branches of scientific development, it became necessary to merge other specialties that give body to NM, that which deals with hospital design, that is, Hospital Architecture, which is a specialized field within the world of design and construction, focused on creating healthcare environments that not only respond to the functional and operational needs of these establishments, but also promote the well-being and recovery of patients.[8]

In essence, hospital architecture must be responsible for designing spaces that are efficient for medical treatment and patient care. It also welcomes the design of NM facilities, which is nothing more than the care unit intended for diagnosis and treatment through the use of radioactive isotopes and radioactive counters. However, it goes beyond simple functionality.[4] In recent decades, there has been a growing recognition that the design of health care units can have a significant impact on patient recovery.[9]

The location of an NM center is a critical factor that influences its technical feasibility, radiological safety, accessibility, and regulatory compliance.[10] Site selection is the process by which a suitable location is chosen for a facility, as part of which an appropriate assessment is carried out and the corresponding design bases are defined. This process consists of the recognition, selection, and evaluation of sites, culminating in the fundamental milestone of awarding the license for the execution of the work.[11]

The determination of the implementation of an NM center is a complex exercise that integrates multiple technical aspects, called implementation determinants. These respond to care models and specific needs for the management of radioactive substances. The architectural preliminary project constitutes the preliminary design that defines the implementation on the land, the general zoning, and the functional distribution.[12] Although it does not allow construction, in this phase the central decisions that organize the building are established and that must be specifically adapted to its context. It is up to the architect to define a design methodology that

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

incorporates the participation of clinicians and is supported by tools such as evidence-based architecture.[13,14]

Master plan

The Master Plan, which is developed in a first phase, has as its main objective to establish and define the particular qualities and attributes of the place, and to illustrate how to make the best use of them in pursuit of an architectural idea that solves the problem presented by the health needs of the population in conjunction with urban and nuclear safety regulatory standards.[15]

The selection of the site for this center requires exhaustive planning that integrates multiple factors to guarantee the efficiency of the service, the safety, and the patient experience. This implies understanding the restrictions of the land, the existing infrastructure, and the budget; considering environmental aspects such as impact mitigation and solar orientation; analyzing the urban context and morphology for adequate community integration and topographic use; defining clinical functionality, adjacencies, and internal flows; prioritizing operational safety for people and the environment; and incorporating flexibility for future adaptations. A strategic and well-planned location improves access to medical care and ensures the quality and sustainability of the services offered.

The location of an NM service is crucial to ensure its efficient operation, the safety of the patient and staff, since it involves both technical and regulatory considerations, as well as the need for an adequate environment to guarantee optimal access to services by the population.[16]

An NM center should ideally be located in a main medical center, that is, it should be integrated into a health environment, near other radiology and diagnostic imaging services, it should be strategically located to maximize its accessibility and functionality. The location must also facilitate access to specialized equipment, such as gamma cameras or others in the nuclear medical environment. In addition, the location must consider radiological safety and the possibility of having an adequate space for carrying out procedures and managing radioactive materials.

Additional factors to consider for the location of a nuclear medicine center.[17]

The implementation in the plot and the architectural form are decisive to reduce heat gains by solar radiation and promote natural ventilation. To achieve this, it is essential to consider the solar orientation, the prevailing winds, the existing vegetation, and the urban context, evaluating the limitations of the land and the regulations. In buildings that require air conditioning, compact and closed volumes are prioritized. Improving the microclimate is possible through vegetation, water mirrors, and shading elements such as trees or pergolas, which reduce the temperature through transpiration and radiation absorption. On the contrary, dark paved surfaces significantly increase the ambient temperature, while light ones reduce heat absorption but can cause glare.[18]

The adequate distance between buildings equivalent to at least five times the height of the building upstream favors the natural ventilation of the structure located downstream. Likewise, it is essential that a Nuclear Medicine service is located within a hospital or reference health center, given its complementary nature with specialties such as oncology, cardiology, neurology, nephrology, and endocrinology. This physical proximity facilitates multidisciplinary collaboration and optimizes the comprehensive management of patients.[19] Taking into account the above,

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

the proposed site for said location in the "Abel Santamaria Cuadrado" General Teaching Hospital is shown in Figure 3.

Fig. 1 Site of the Nuclear Medicine and Molecular Imaging Center. "Abel Santamaria Cuadrado" General Teaching Hospital. Pinar del Río.

The selection of the location for a nuclear medicine center must prioritize clinical and operational integration. A location close to other medical services, such as emergency rooms, laboratories, magnetic resonances, and tomography, is crucial to optimize patient flow, facilitate referral and interdepartmental collaboration, and guarantee comprehensive care. This proximity, together with robust accessibility by public transport and for ambulances, is vital for operational efficiency and patient safety. Likewise, the availability of specialized personnel in the area and the analysis of potential local demand are determining factors for the sustainability and health impact of the center.

On the other hand, the site must rigorously comply with safety, regulatory, and infrastructure aspects. Zoning must be away from residential areas, complying with the required safety perimeters to minimize radiological risks. The land requires geological stability, sufficient space for equipment, shielding, and future expansion, in addition to reliable basic services. Compliance with national and international regulations for the management of radioactive materials is non-negotiable, covering everything from radiation control and waste management to the mitigation of anthropic threats. A multi-criteria analysis that evaluates all these technical, legal, and social factors is essential for a definitive and successful selection.

Key factors for site selection

The selection of the site for a nuclear medicine center is determined by critical factors that guarantee its safety, functionality, and viability. In terms of radiological safety, it is essential that the location allows the construction of adequate shielding for the protection of people, as well as controlled areas for the storage of radioactive sources and the safe management of waste.[20] The infrastructure must offer sufficient space for the installation of diagnostic and therapy equipment (SPECT, PET/CT), provide for future expansions, and have robust basic services (electricity, water, telecommunications, air conditioning).[21] Likewise, proximity to critical supplies, such as short half-life radiopharmaceuticals, and the availability of emergency plans and facilities are crucial.

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

Economic aspects must consider not only the initial costs of construction and equipment, but also long-term financial sustainability, supported by feasibility studies.[22] Finally, regulatory compliance is paramount, since the project must comply with national and international regulations on radiological safety, environmental and health protection, which implies obtaining all necessary licenses and permits. In Cuba, this process is regulated by the National Institute of Territorial Planning and Urbanism (INOTU), which supervises the construction license in compliance with territorial regulations, integrating the evaluation and approval of the location from the earliest stages of the project.[23,24,25]

Nuclear Medicine Center of Pinar del Río

Therefore, taking into account the above, and complying with the necessary requirements, the new location resulting from the redesign of the executive project, concluded in the month of July 2024, of the Pinar del Río NM and Molecular Imaging Center is certified and approved. For this purpose, the opinions granted by the commissions of experts from the ordered consultation bodies were considered:

1. Ministry of Science, Technology and Environment (CITMA): Micro-location consultation.
2. National Institute of Territorial Planning and Urbanism (INOTU): Micro-location certificate.
3. Cuban Civil Defense: Civil Defense requirements for investment.
4. National Institute of Territorial Planning and Urbanism (INOTU): Technical report.
5. National Institute of Hydraulic Resources (INRH): Analysis of the micro-location request.
6. Ministry of Industries of Cuba (MINDUS): Analysis of the micro-location request.
7. Ministry of the Revolutionary Armed Forces (MINFAR): Record of requirements for macro-locations and micro-locations.
8. Ministry of the Interior (MININT): Record of compatibility with the requirements of security and internal order.
9. Ministry of the Interior (MININT) – Cuban Fire Department: Analysis of the micro-location.
10. Ministry of Public Health (MINSAP) – Provincial Center of Hygiene and Epidemiology (CPHE): Sanitary technical opinion.
11. National Office for the Control of the Rational Use of Energy (ONURE): Endorsement for the micro-location.
12. National Electric Union (UNE): Response to deliver electrical service.

The National Center for Nuclear Safety (CNSN), attached to CITMA,[26] is the key entity in the regulation of nuclear and radiological safety in Cuba. Its main function is to develop and propose the legal and technical framework, in addition to exercising control over the use of nuclear energy and nuclear materials. It manages the Hierarchical System of Nuclear Regulations (SJRN),[27] a regulatory framework that, inspired by the standards of the International Atomic Energy Agency (IAEA), establishes everything from general principles to specific practical guides. This system was designed to integrate with the Cuban legal system and regulate all national activities, taking as a fundamental reference the international safety standards of the IAEA.[28,29]

In addition to the specific regulations, there is in Cuba a set of laws and regulations on various matters that, in a complementary way, affect the nuclear sphere. Instruments such as the Defense Law, the Penal Code, the Environmental Law, decree laws, and ministerial resolutions establish general provisions that are also applicable to the use of ionizing radiation sources. The policy to establish this legal framework allows the regulatory authority to respond coherently to proposals from other instances. All this regulatory framework is integrated and reflected in the Nuclear Safety File, the document that evaluates and authorizes the project from the analysis of the site to the final design.[29]

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

Regulations applicable in Cuba

- ✓ National regulations:

• Resolution No. 110/2020 of the Ministry of Public Health (MINSAP)
Updates the requirements for the authorization and operation of NM services.

- ✓ Regulatory entities:

• National Center for Nuclear Safety (CNSN): Supervises compliance with nuclear and radiological safety standards, and evaluates the granting of licenses for radioactive facilities and practices involving ionizing radiation.[29]
• Ministry of Public Health (MINSAP): Approves medical and radiological protection protocols.[30]
• Nuclear Energy and Advanced Technologies Agency (AENTA)
Manages projects related to nuclear technologies and advises on international standards (IAEA).[31]

- ✓ International commitments:

• Cuba follows IAEA (International Atomic Energy Agency) guidelines in the design and location of nuclear facilities.[32]

CONCLUSIONS

It is highlighted that the ideal location for an NM center is one that balances the needs of access to other services, the availability of specialized personnel, security measures, and accessibility for patients. For site selection, it is crucial to consider factors that ensure efficiency and guarantee effective operability in its functions. These criteria include radiological safety, proximity to the community, available infrastructure, and the ability to comply with health regulations.

Conflict of interest
The author declares that there is no conflict of interest.

Financing
The author did not receive funding for the development of this research.

BIBLIOGRAPHIC REFERENCES

1. Pablo J, Rosselli A. ¿Cómo concebir un proyecto arquitectónico? How should we conceive the architectural project? Dearq [Internet]. 2009 [cited 02/07/2025]; 5: 30-41. Available from: https://dialnet.unirioja.es/servlet/articulo?codigo=3622363

2. Grupo ORS. ¿Qué es la Arquitectura hospitalaria? [Internet]. *México: Interamericana*. 2022 [cited 02/07/2025]. Available from: https://grupoors.com.mx/2022/08/26/que-es-la-arquitectura-hospitalaria/

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

3. GRUPO ARTEDI. Evolución De La Arquitectura Hospitalaria - Pasado Y Futuro [Internet]. Arquitectos Especialistas en Hospitales; 2024 [cited 02/07/2025]. Disponible en: https://artedi.com.mx/iinnovaciones-en-salud-y-diseno/evolucion-de-la-arquitectura-hospitalaria/

4. PMMT. Arquitectura Hospitalaria [Internet]. Barcelona; 2025 [cited 02/07/2025]. Available from: https://www.pmmtarquitectura.es/arquitectura-hospitalaria

5. Minrex. El bloqueo viola el derecho a la vida, a la salud, a la educación y al bienestar de todas las cubanas y cubanos. [Internet]. Embajadas y Consulados de Cuba; 2023 [cited 02/07/2025]. Available from: https://misiones.cubaminrex.cu/es/articulo/el-bloqueo-viola-el-derecho-la-vida-la-salud-la-educacion-y-al-bienestar-de-todas-las

6. Domínguez-Alonso Emma, Zacea Eduardo. Sistema de salud de Cuba. Salud pública Méx [Internet]. 2011 Ene [citado 29/09/2025] ; 53(Suppl 2): s168-s176. Disponible en: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0036-36342011000800012&lng=es.

7. NIH. Medicina Nuclear [Internet]. NIH; 2024 [citado 29/09/2025]. Available from: https://www.nibib.nih.gov/espanol/temas-cientificos/medicina-nuclear

8. Estrada Farfán M. ARQUITECTURA HOSPITALARIA [Internet]. Aspaih; 2025 [cited 02/07/2025]. Available from: https://aspaih.com/works/arquitectura-hospitalaria

9. Ortega Montoliu F. Arquitectura para Medicina Nuclear en el Hospital Universitario Fundación Jiménez Díaz [Internet]. Hospitecnia; 2022 [cited 02/07/2025]. Available from: https://hospitecnia.com/servicios-hospitalarios/servicios-centrales-diagnostico-y-tratamiento/medicina-nuclear/arquitectura-medicina-nuclear-jimenez-diaz/

10. IAEA. Selección de emplazamientos para instalaciones nucleares [Internet]. Iaea.org; 2018 [cited 03/07/2025]. Available from: https://www.iaea.org/es/temas/seleccion-de-emplazamientos-para-instalaciones-nucleares

11 Susiati H, Widiawaty MD, Dede M, Sunardi N, Ryanto TA, Handono K. Criteria and methods in nuclear power plants siting: a systematic literature review. Cogent social sciences [Internet]. 2024 Jun 3 [cited 03/07/2025]; 10(1). Disponible en: https://www.tandfonline.com/doi/full/10.1080/23311886.2024.2354976

12. Armaq. Qué es un anteproyecto en arquitectura y su importancia [Internet]. Armaq Paraguay; 2025 [cited 03/07/2025]. Available from: https://armaq.com.py/blog/que-es-un-anteproyecto-en-arquitectura/

13. CURARQ. Diseño basado en evidencias [Internet]. CURARQ; 2021 [Actualizado 2021; cited 03/07/2025]. Available from: https://curarq.net/diseno-basado-en-evidencias/

14. Thomas L. Confounding Variables | Definition, Examples and Controls [Internet]. Scribbr; 2023 [cited 03/07/2025]. Available from: https://www.scribbr.com/methodology/confounding-variables/

15. Bid. Curso preparación de planes maestros de inversión con enfoque de red [Intenet]. Bid; 2017 [Citado 03/07/2025]. Disponible en: https://cursos.iadb.org/es/temas/desarrollo-instituciones/planes-maestros-inversiones-salud-enfoque-red

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

16. CASA SOLO Arquitectos. Elección del terreno para construir un hospital [Internet]. Hospitecnia; 2017 [cited 03/07/2025]. Available from: https://hospitecnia.com/arquitectura/eleccion-del-terreno-para-construir-un-hospital/

17. Ciemat. Diseño de una Instalación de Medicina Nuclear [Internet]. Ciemat; 2025 [cited 03/07/2025]. Available from: https://csn.ciemat.es/pluginfile.php/119/mod_folder/content/0/IR.SP.MN.PW04.15.pptx

18. Prezi. IMPLANTACIÓN DE LA OBRA [Internet]. Prezi; 2025 [cited 03/07/2025]. Disponible en: https://prezi.com/p/wd5xnmj2rja3/implantacion-de-la-obra/

19. Martínez A. MANUAL DE DISEÑO PARA EDIFICACIONES ENERGETICAMENTE EFICIENTES EN EL TRÓPICO [Internet]. Scribd; 2025 [cited 03/07/2025]. Available from: https://es.scribd.com/doc/139069081/MANUAL-DE-DISENO-PARA-EDIFICACIONES-ENERGETICAMENTE-EFICIENTES-EN-EL-TROPICO

20. Ejeh J, Adepoju A, Adedapo K, Onimode Y. Avoidable challenges of a nuclear medicine facility in a developing nation. Indian Journal of Nuclear Medicine [Internet]. 2013 [cited 03/07/2025]; 28(4):195-199. Diponible en: https://pmc.ncbi.nlm.nih.gov/articles/PMC3866662/

21. IAEA-TECDOC-2069. PROCESOS REGULADORES DE AUTORIZACIÓN E INSPECCIÓN DE INSTALACIONES DE PRODUCCIÓN DE RADIOFÁRMACOS CON CICLOTRÓN [Internet]. IAEA. VIENA; 2024 [cited 03/07/2025]. Disponible en: https://www-pub.iaea.org/MTCD/Publications/PDF/TE2069S_web.pdf

22. De Instrucción M, Procedimientos Y, De Costos M, Salud E, Página E. MINISTERIO DE SALUD PÚBLICA DIRECCIÓN DE ECONOMÍA 2012 MINISTERIO DE SALUD PÚBLICA [Internet]. 2013 [cited 03/07/2025]. Available from: https://instituciones.sld.cu/polmachaco/files/2016/07/Manual-de-Costos-Actualizados-2013.pdf

23. CNSN. Guía Para La Implementación de Los Reglamentos de Seguridad en la Práctica de la Medicina Nuclear. Gaceta oficial de la República de Cuba. Resolución No. 40/11 [Internet]. CNSN; 2011 [citado 08/11/2023]. Disponible en: http://www.medioambiente.cu/oregulatoria/cnsn/Docs

24. Los estándares en la legislación, una relación basada en la confianza . UNE [Internet]. 2022 [cited 03/07/2025]; (50). Available from: https://revista.une.org/50/los-estandares-en-la-legislacion-una-relacion-basada-en-la-c.html

25. La D, De R, Ministerio C, Justicia D. GACETA OFICIAL [Internet].La Habana; 2022 [cited 03/07/2025]. Available from: https://www.parlamentocubano.gob.cu/sites/default/files/documento/2022-11/goc-2022-o116.pdf

26. Centro Nacional de Seguridad Nuclear (CNSN) - EcuRed [Internet]. Ecured.cu; 2025 [cited 03/07/2025]. Available from: https://www.ecured.cu/Centro_Nacional_de_Seguridad_Nuclear_(CNSN)

27. OIEA. Normas de Seguridad [Internet]. Iaea.org; 2019 [cited 03/07/2025]. Available from: https://www.iaea.org/es/recursos/normas-de-seguridad

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6836

28. IAEA. Normas de seguridad del OIEA para la protección de las personas y el medio ambiente [Internet]. VIENA; 2016 [cited 03/07/2025]. Available from: https://www-pub.iaea.org/MTCD/Publications/PDF/P1578_S_web.pdf

29. Ministerio de Ciencia, Tecnología y Medio Ambiente Oficina de Regulación Ambiental y Seguridad Nuclear Centro Nacional de Seguridad Nuclear [Internet]. La Habana; 2022 [cited 03/07/2025]. Available from: https://vuceregulaciones.mincex.gob.cu/media/Modelo%20de%20la%20Autorizaci%C3%B3n(Permiso)_1.pdf

30. EcuRed. Centro Nacional de Seguridad Nuclear (CNSN) [Internet]. Ecured.cu; 2025 [cited 03/07/2025]. Available from: https://www.ecured.cu/Centro_Nacional_de_Seguridad_Nuclear_(CNSN)

31. EcuRed. Agencia de Energía Nuclear y Tecnologías de Avanzada (Cuba) [Internet]. Ecured.cu; 2025 [cited 03/07/2025]. Available from: https://www.ecured.cu/Agencia_de_Energ%C3%ADa_Nuclear_y_Tecnolog%C3%ADas_de_Avanzada_(Cuba)

32. OIEA. Selección de emplazamientos para instalaciones nucleares [Internet]. Iaea.org; 2018 [cited 03/07/2025]. Available from: https://www.iaea.org/es/temas/seleccion-de-emplazamientos-para-instalaciones-nucleares