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SECURITY-RELATED TERMS IN CHEMICAL AND RADIOLOGICAL DISCOURCE: TRANSLATION-FOCUSED APPROACH

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*The article examines linguistic and translation-related features of security-related terminology in chemical and radiological discourse. The study focuses on English terms denoting threat, risk, and preventive actions that form an essential component of professional communication in international safety and emergency-response contexts. This terminology is characterized by high semantic density and functional variability, which complicates accurate translation and terminological consistency in an interdisciplinary environment. The study aims to identify and systematize the main translation strategies for chemical and radiological terminology by analyzing their semantic and functional specificity, with a particular emphasis on the notional distinction between **"safety"** and **"security"** in specialized sources. The research data includes authoritative English glossaries and terminological resources of international regulatory practice, including the IAEA Safety Glossary (2022 Edition) and practical training guidelines such as the University of Michigan's Chemical Safety Training Course. Particular attention is paid to definitions, contextual usage, and domain-specific features of these sources, allowing for a comprehensive analysis of the notional and functional boundaries of safety and security terminology. The methodological framework combines semantic and contrastive analysis with descriptive translation studies. The study examines the transfer of key notions related to hazard assessment and preventive measures through terminological equivalence, modulation, explicitation, and descriptive translation in order to overcome semantic asymmetry between languages. The results indicate that translation of security-related terminology requires not only linguistic competence but also an understanding of the cognitive and semantic foundations of safety discourse. The findings emphasize the relevance of a strategic approach to terminology translation, ensuring accuracy, functional adequacy, and terminological consistency. The study contributes to translation-oriented terminological research and may be useful for translators, researchers, and students working with specialized safety and emergency-response texts.*

Key words: *security-related terminology, chemical biological radiological nuclear protection terms, chemical and radiological discourse, semantic asymmetry, translation strategies*

Statement of the problem. The contemporary framework of professional communication within international safety and emergency-response environments is fundamentally dependent on highly specialized terminology. This group of terms is characterized by high conceptual complexity and functional flexibility, posing a significant challenge for accurate translation. Within chemical and radiological discourse, precise terminology for threats, risks, and preventive measures is essential for ensuring operational safety, being more than just a matter of linguistic accuracy. The core of the problem lies in the difficulty of maintaining terminological consistency, particularly when addressing the conceptual distinction between ***"safety"*** and ***"security".***

While international standards from the IAEA clearly distinguish between these terminology units, they are often used interchangeably in Ukrainian, which leads to confusion in specialized texts.

The analysis of recent research and publications. The theoretical aspects of specialized terminology and its translation have been the subject of numerous studies, reflecting the interdisciplinary nature of the field. The foundation for modern research was laid by E. Wüster, whose General Theory of Terminology established the principles of concept-oriented language standardization (Wüster, 1979). In the Ukrainian academic tradition, these ideas were further developed and adapted for translation studies by T. Kyiak, who formulated the essential principles of translation-oriented terminology and emphasized the role of motivated term-formation (Kyiak, 2007). The principles of technical translation and equivalence have been extensively explored by P. Newmark, particularly in his distinction between communicative and semantic approaches, and M. Baker, who addressed the challenges of terminological equivalence in professional and cultural contexts. In Ukraine, V. Karaban contributed significantly by developing systematic methods for translating scientific and technical texts, highlighting the structural and semantic difficulties of English-Ukrainian transfer (Karaban, 2004). Further-more, the works of O. Selivanova provide a vital cognitive framework for understanding how conceptual structures and frames are formed within specialized discourse. This perspective is essential for analyzing the complex nature of ***"security"*** as a terminological concept and for overcoming semantic asymmetry in its translation within chemical and radiological discourse.

Setting the task. To achieve the stated aim, the study focuses on several key objectives. First, it defines the conceptual and functional boundaries of ***"security"*** within international safety frameworks, such as the IAEA. Next, the research analyzes the semantic structure and contextual use of security-related terms in specialized training and regulatory sources. The study identifies specific linguistic inconsistencies that arise when translating these terms into Ukrainian within the CBRN sector. Finally, it evaluates the effectiveness of various translation strategies, including modulation, explicitation, and descriptive translation, to ensure the functional adequacy of professional communication.

The purpose of the research is to identify the linguistic and cognitive specifics of the terminological entity ***"security"*** within English chemical and radiological discourse and to systematize effective translation strategies for its rendering into Ukrainian.

Presentation of the main material. The terminological analysis of ***"security"*** within chemical and radiological discourse requires a multidimensional approach that combines cognitive linguistics with translation studies. From a cognitive perspective, as outlined in the works of O. Selivanova, a term is not merely a linguistic label but a representation of a specialized conceptual frame (Selivanova, 2000). In the context of CBRN (Chemical, Biological, Radiological, and Nuclear) safety, the concept of ***"security"*** forms a complex structure that incorporates intentional threats, protective measures, and the regulatory environment.

General-purpose dictionaries often highlight the overlap between these terms; for instance, the *Cambridge Dictionary* defines **safety** as "a state of being safe from harm or danger," while **security** is described as "protection of a person, building, organization, or country against threats such as crime or attacks." However, within specialized discourse, these notions diverge significantly. Unlike the term ***"safety",*** which primarily refers to protection against accidental hazards or "the state of being free from danger or injury" (Merriam-Webster), ***"security"*** involves proactive measures against deliberate harmful acts, such as sabotage or unauthorized access to hazardous materials.

To establish a clear terminological framework, it is necessary to examine how these boundaries are further refined in international regulatory documents, particularly the IAEA Safety Glossary (2022 Edition). Within this framework, the distinction is fundamental: while ***"safety"*** is concerned with the averting accidents, ***"security"*** focuses on the prevention of, and response to, criminal or intentional unauthorized acts. However, the structural complexity of the ***"security"*** frame is further evidenced by its role as an "umbrella term" that branches into several distinct functional domains, including nuclear security, physical protection, security culture, and information security.

This classification demonstrates that the concept encompasses not only technical barriers but also administrative, human, and digital factors. Specifically, the glossary identifies such specialized components as the physical protection system, which integrates structural barriers like isolation zones and access control points with specific hardware and personnel to prevent sabotage or unauthorized removal (IAEA Safety Glossary, 2022). The human factor is represented through the trustworthiness of personnel, which involves rigorous reliability vetting and operational procedures such as the "two-person rule" to ensure that individuals with access to sensitive materials are consistently monitored. Additionally, the conceptual frame extends to computer security, addressing the protection of digital systems against cyber-attacks and ensuring the integrity of digital assets. The terminological complexity of this frame is complemented by security culture, which the IAEA defines as the assembly of characteristics, attitudes, and behavior of individuals and organizations, thereby highlighting the human-centric dimension of the terminological security frame (IAEA Safety Glossary, 2022).

A corresponding level of complexity is observed in the chemical security modules developed by the *University of Michigan.* While the IAEA focuses on the radiological aspect, the Michigan course emphasizes "cradle-to-grave" oversight, which integrates security directly into daily laboratory management. This approach identifies such critical components as chemical inventory management (using specialized tracking software to monitor the location and quantity of hazardous substances) and access control to high-risk materials (limiting physical and digital access only to authorized personnel).

Along the same lines, the curriculum highlights the importance of material accountability through the use of safety data sheets (SDS) and thorough labeling protocols to prevent the unauthorized redirection of chemical precursors (Chemical Safety

Training Course, University of Michigan). In this context, ***"security"*** is not just about physical guarding, but about a continuous system of monitoring and personal responsibility that ensures every hazardous agent is accounted for throughout its entire lifecycle.

From a translation perspective, such semantic density suggests that a simple substitution with the Ukrainian ***«безпека»*** often fails to reflect these proactive and preventative nuances. This creates a need for specific translational solutions to ensure the functional adequacy of the text in the target language.

The practical significance of the above-described terminological depth becomes evident when analyzing linguistic discrepancies that arise during the translation process. Specifically, the lack of a differentiated terminological pair in Ukrainian to match the English ***"safety"*** and ***"security"*** leads to several critical ambiguities:

1. Confusion in organizational mindsets (IAEA context). A prominent example is the synonymous translation of ***"safety culture"*** and ***"security culture"*** as ***«культура безпеки»***. According to the IAEA Safety Glossary (2022), these notions address different goals: the former aims to prevent accidents, while the latter focuses on preventing intentional theft or intentional destruction.

Implication: Such a translation blurs the boundary between accidental errors and malevolent acts, potentially leading to a misunderstanding of professional instructions by personnel.

2. Ambiguity in Operational Control (University of Michigan context). In the Chemical Safety Training Course (University of Michigan), the term "security measures" describes specific actions like "material accountability" and "access control." However, these are frequently rendered as «заходи безпеки», a term that traditionally implies protective equipment or fire safety.

Implication: This leads to the loss of precision, as the emphasis on strict monitoring of chemical precursors is lost within general safety guidelines.

To restore the terminological accuracy lost during interlingual transfer, it is essential to evaluate specific translational tools capable of bridging the gap between English and Ukrainian CBRN terminologies. Among the most effective strategies for achieving this goal is **explicitation.** This technique is defined by Kinga Klaudy as a process where the translator renders the implicit information of the source text explicit in the target text (Klaudy, 2008). In the CBRN sector, this strategy is indispensable for resolving the semantic ambiguity of the term ***"security".*** Since the Ukrainian ***«безпека»*** is a broader category, the translator must add clarifying lexical markers to restore the lost conceptual nuances. For instance, when translating *"security culture"* from the IAEA Safety Glossary (2022), applying explicitation results in the rendering *«культура фізичної безпеки та захищеності».* This addition of the adjectives *«фізична»* (physical) and *«захищеність»* (protectedness) clearly clarifies that the text refers to protection against malevolent acts, rather than accidental technical failures.

Another case for explicitation is the term *"security measures"* (IAEA Safety Glossary, 2022). A literal translation as *«заходи безпеки»* is too broad in Ukrainian, as it could imply fire safety or personal protective equipment (PPE). By applying explicitation, the term is rendered as *«заходи фізичного захисту та режимного контролю»*. The inclusion of *«режимний контроль»* (operational/regime control) specifies that these measures relate to administrative and physical barriers designed to prevent unauthorized access or theft of radioactive sources.

Similarly, the term *"computer security"* in the context of nuclear facilities requires more than a simple word-for-word translation (IAEA Safety Glossary, 2022). To distinguish it from general IT maintenance, it is translated through explicitation as *«кібербезпека та захист інформаційних систем від несанкціонованого втручання».* This descriptive expansion indicates that the focus is on protecting the integrity of digital assets against cyber-attacks, guaranteeing the uninterrupted performance of safety-critical functions.

Modulation serves as another vital instrument for ensuring conceptual accuracy. This strategy is described by Peter Newmark as a translation method that involves a variation in the point of view, which is essential when a literal rendering sounds unnatural or fails to convey the specific professional emphasis in the target language (Newmark, 1988). Within the Chemical Safety Training Course (University of Michigan), the term *"access control"* is often modulated to better fit the Ukrainian professional discourse. Instead of the literal *«контроль доступу»,* which may imply a simple technical barrier, it is rendered as *«пропускний режим»* or *«регламентація доступу».* According to Newmark's approach, this variation in perspective shifts the emphasis from the physical or technical action of "controlling" to the established legal and administrative "regime" that governs the facility. This ensures that the Ukrainian terminology carries the same weight of authority and regulatory compliance as the original English concept, highlighting that access is not merely monitored but strictly governed by a set of formal rules.

A further instance of modulation can be observed in the translation of *"personnel reliability vetting".* While a literal translation as *«перевірка надійності персоналу»* focuses on the action of checking, it is often rendered through modulation as *«кадрова безпека»* or *«режимний відбір персоналу»* (Chemical Safety Training Course, University of Michigan). This shift in perspective moves the focus from a one-time technical action to a continuous organizational state of safety. It highlights that the process is an integral part of the facility's protective framework rather than just a human resources procedure.

Achieving **terminological equivalence** in the CBRN domain is complicated by the lack of one-to-one correspondence between English and Ukrainian concepts. As noted by Mona Baker, equivalence is a relative notion that depends on a variety of linguistic and cultural factors (Baker, 2011). In specialized discourse, it is not the word itself that must be equivalent, but its functional role within the specialized frame.

A significant challenge in establishing equivalence involves the term *"physical protection".* While a literal translation as *«фізичний захист»* exists, its functional role in the IAEA frame is much broader than just mechanical barriers. To ensure conceptual alignment, it is often rendered as *«система фізичного захисту об'єктів та матеріалів»* (IAEA Safety Glossary, 2022). In this case, terminological equivalence is achieved not through formal symmetry, but through functional correspondence. By expanding the term to *«система фізичного захисту об'єктів та матеріалів»*, the translator aligns the Ukrainian target equivalent with the comprehensive operational scope defined in the IAEA Safety Glossary.

When a notion is so dense that neither explicitation nor modulation can determine compliance, the translator must employ **descriptive translation**. This strategy involves replacing a term with a description of its meaning or function (Baker, 2011).

A highly illustrative example of such terminological complexity is the term *"graded approach",* which functions as a fundamental principle and is difficult to render with a single word. While it is sometimes translated as *«диференційований підхід»,* this often fails to convey the underlying regulatory logic. Thus, descriptive translation is used: *«застосування вимог безпеки пропорційно до ступеня ризику»* (IAEA Safety Glossary, 2022). This description ensures that the Ukrainian reader understands the core functional mechanism: that controls and requirements are not one-size-fits-all, but scale according to the potential hazard.

Another complex construct found in the Chemical Safety Training Course (University of Michigan) is the term of *"cradle-to-grave"* (with reference to hazardous materials). A literal translation like *«від колиски до могили»* is stylistically inappropriate for a technical manual. Consequently, it is rendered descriptively as *«контроль за матеріалами на всіх етапах – від закупівлі та використання до остаточного знешкодження або утилізації».* By describing the lifecycle of the material, the translator establishes terminological correspondence. This ensures the Ukrainian specialist recognizes their continuous responsibility for the chemical precursor at every stage of its existence within the facility.

The linguistic analysis of specialized terminology within the framework of chemical and radiological safety demonstrates that the effective translation of the terminological unit "security" into Ukrainian requires a systematic departure from formal symmetry toward a functional, frame-based methodology. Given the conceptual asymmetry where the Ukrainian term ***«безпека»*** frequently overlaps with both ***safety*** and ***security*****,** the study confirms that the strategic application of **explicitation**, **modulation**, and **descriptive translation** is essential for maintaining operational clarity and regulatory compliance. By employing these transformations – ranging from the addition of clarifying markers in IAEA protocols to the shifting of perspectives toward administrative "regimes" in the Michigan University curriculum – the translator ensures that the multifaceted nature of security (encompassing physical protection, material accountability, and personnel reliability) is accurately reconstructed in the target language. Ultimately, the transition from a literal word-for-word rendering to a method of conceptual alignment is the primary factor in ensuring that Ukrainian terminological equivalents provide the same level of professional instruction and instructional weight as their English counterparts, thereby upholding international standards of CBRN protection.

Conclusions and further research perspectives. The linguistic analysis of specialized terminology within the framework of chemical and radiological safety demonstrates that the effective translation of the terminological unit *"security"* into Ukrainian requires a systematic departure from formal symmetry toward a functional, frame-based methodology. Given the conceptual asymmetry where the Ukrainian term ***«безпека»*** frequently overlaps with both *safety* and *security*, the study confirms that the strategic application of explicitation, modulation, and descriptive translation is essential for maintaining operational clarity and regulatory compliance. By employing these transformations – ranging from the addition of clarifying markers in IAEA protocols to the shifting of perspectives toward administrative "regimes" in the Michigan University curriculum – the translator ensures that the multifaceted nature of security (encompassing physical protection, material accountability, and personnel reliability) is accurately reconstructed in the target language. Further research in this field should focus on the development of a comprehensive English-Ukrainian bilingual glossary of CBRN security terms, categorized by functional frames, to further standardize the translation of safety-critical documentation. Additionally, exploring the cognitive-discursive aspects of how these translated notions are perceived by professionals in the Ukrainian civil protection sector remains a promising area for prospective academic inquiry.

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ТЕРМІНОЛОГІЯ СФЕРИ БЕЗПЕКИ У ХІМІЧНОМУ ТА РАДІОЛОГІЧНОМУ ДИСКУРСІ: ПЕРЕКЛАДОЗНАВЧИЙ АСПЕКТ

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У статті розглянуто лінгвістичні та перекладознавчі особливості термінології сфери безпеки у хімічному та радіологічному дискурсі. Дослідження зосереджене на англомовних термінах, що позначають загрозу, ризик і запобіжні дії, які є невід'ємними компонентами професійної комунікації в міжнародному контексті безпеки та реагування на надзвичайні ситуації. Ця термінологія характеризується високою семантичною насиченістю та функціональною варіативністю, що ускладнює точний переклад і забезпечення термінологічної послідовності в міждисциплінарному середовищі. Метою дослідження є виявлення та систематизація основних стратегій перекладу хімічної та радіологічної термінології шляхом аналізу їхньої семантичної та функціональної специфіки, з особливим акцентом на розмежуванні понять ***"safety"*** *та* ***"security"*** *у спеціалізованих англомовних джерелах. Матеріали дослідження становлять авторитетні англомовні глосарії та термінологічні ресурси міжнародної нормативної практики, зокрема Глосарій МАГАТЕ з безпеки (видання 2022 року) та практичні навчальні посібники, такі як Курс із хімічної безпеки Мічиганського університету. Особливу увагу приділено дефініціям, контекстуальному вживанню та галузевим особливостям цих джерел, що дає змогу здійснити комплексний аналіз поняттєвих і функціональних меж термінології безпеки. Методологічна база поєднує семантичний і зіставний аналіз із методами описового перекладознавства. У роботі досліджується передача ключових понять, пов'язаних з оцінкою небезпек і запобіжними заходами, через термінологічну еквівалентність, модуляцію, експлікацію та описовий переклад з метою подолання семантичної асиметрії між мовами. Результати свідчать, що переклад термінології сфери безпеки потребує не лише лінгвістичної компетентності, а й розуміння семантичних основ дискурсу безпеки. Отримані дані підкреслюють важливість стратегічного підходу до перекладу термінології, що забезпечує точність, функціональну адекватність і термінологічну послідовність. Дослідження робить внесок у орієнтовані на переклад термінологічні студії та може бути корисним для перекладачів, дослідників і студентів, які працюють зі спеціалізованими текстами з питань безпеки та реагування на надзвичайні ситуації.*

Ключові слова: *термінологія сфери безпеки, терміни захисту в хімічній, біологічній, радіологічній та ядерній галузях, хімічний та радіологічний дискурс, семантична асиметрія, стратегії перекладу.*

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