The Language of Nuclear Security: New Case Studies Exploring Online Open-Source Information from Turkey, India, and Jordan

Zenobia S. Homan
King's College London

Shraddha Rane
Purdue University

Yara Shaban
The Royal Scientific Society

Fadime Ö. Özkan
Istanbul Technical University

Eunha Yun
King's College London

Follow this and additional works at: https://trace.tennessee.edu/ijns

Part of the Defense and Security Studies Commons, and the Language Description and Documentation Commons

The Language of Nuclear Security: New Case Studies Exploring Online Open-Source Information from Turkey, India, and Jordan

Zenobia S. Homan,[1] Shraddha Rane,[2] Yara Shaban,[3] Fadime Ö Özkan,[4] and Eunha Yun[1]
[1]King's College London
[2]Purdue University
[3]The Royal Scientific Society
[4]Istanbul Technical University

Abstract

This paper presents a novel internet search methodology and new data on the language of nuclear security. Through three case studies (Turkey, India, and Jordan), it describes what openly accessible information exists about nuclear security in a given national context, where more information is needed, and why. In doing so, the paper highlights the importance of documenting the social and geopolitical context of key nuclear concepts. It also examines the role of language and publicly available information on nuclear security and safety to facilitate the articulation and adoption of international best practices.

The case studies demonstrate how someone may acquire open-source information on nuclear security through an internet search and how to conduct such a search successfully. Accordingly, it should be possible to apply the presented methodology in any country or language context in the future. Overall, we found that openly available information on nuclear security is scarce, less information is available in the local languages, and mistranslation is a source of confusion. We want to encourage the nuclear community to look beyond internationally dominant languages in acquiring information and in publishing information in the first place, as well as to contribute to clarifying the language of nuclear security and enhance global nuclear security practices.

Keywords: open-source intelligence, nuclear security, language, diversity

1. Introduction

Nuclear security[1] is not a common, easy, or accessible topic of discussion. Nevertheless, the human factor in nuclear security—and how people communicate or do not communicate—has played a major role in almost all international nuclear incidents, ranging from the case of A. Q. Khan [1] to ongoing negotiations at Zaporizhzhia in Ukraine [2]. It is widely acknowledged that nuclear security threats—especially nuclear terrorism—demand continuous attention. Therefore, understanding nuclear language will lead to strengthening nuclear security practices.

Why does this understanding of language differences in the nuclear security field matter? Preventing misinterpretation among professionals working with nuclear materials will improve local, regional, and international knowledge exchange. As speakers learn more about one another and build up a shared background, their mutual understanding improves. Also, when speakers know less about each other, they are more likely to misunderstand one another linguistically, socially, and culturally. Misunderstandings are especially prominent between native and non-native speakers of a language because of differing customs, modes of interaction, appropriateness or politeness, and language. Some misunderstandings may not be recognized at all, and others might be recognized but not commented on. "The most conversationally 'dangerous' situation arises when interlocutors lack shared background, linguistic system, and specific beliefs, yet do not seek to negotiate meaning" [3]. Furthermore, most nuclear newcomer countries [4] have a primarily English-language nuclear security information landscape. In particular, less information about nuclear security practices is available in local languages than what is available in English, and mistranslation is an acknowledged source of confusion [5].[2]

There are key divergences between the availability of information about nuclear security in English and other languages that have not yet been documented or explained. Accordingly, this study is part of a broader project looking at the language of nuclear security in different national contexts [6][3] and language diversity in online open-source information [7, 8]. In this paper, we will present a novel internet search methodology and new data that we produced on the language of nuclear security for Turkish, Hindi, and Arabic. Our study underlines the importance of documenting the social and geopolitical context of key nuclear concepts. Specifically, in support of ongoing International Atomic Energy Agency (IAEA) efforts to build a nuclear security knowledge database [9], our paper seeks to examine the role of language and publicly available information on nuclear security and safety to facilitate the articulation and adoption of international nuclear security and safety best practices.

---

[1] Please see the next section for a discussion of the meaning and definition of this term.
[2] Previous qualitative case studies on English, Dutch and Turkish are available in [5].
[3] An appendix documenting key nuclear terminology in Hindi and Urdu can also be found in [6].

a. Background

In this paper, nuclear security is combined with anthropological linguistics (the place of language in its wider social and cultural context). This field of linguistics emphasizes the idea of language as created by speakers and normalized by a specific speech community. Additionally, language has a cascading effect, and translation and interpretation strategies actively shape collective knowledge, as well as national and international communication [10].

Although "we now live in an era where information is accessible through our fingertips and search engines are used as portable libraries," the majority of nuclear knowledge is stored in closed internal portals and archives [9]. It is difficult to access, search for, and connect information because the nuclear sector handles a large volume of restricted, confidential, or classified information, which cannot be distributed publicly. However, effectively disseminating and preserving knowledge would empower the current generation of researchers and nuclear professionals. To work toward this goal, researchers as well as practitioners have suggested that using a common, established vocabulary would increase the quality of information and that open sources are "crucial for building a more informed global society" [11] However, the use of different languages and categories across various organizations and departments can lead to uncertainties with respect to the exact meaning of terms, as well as misunderstandings [12], without considering challenges relating to translation and culture.

Specifically, English has been the dominant search language of the World Wide Web since its origin in the second half of the twentieth century. At the time of writing this article, over a quarter of all Internet searches are made in English. However, this number represents a warped reflection of real life: on a national level, users tend to navigate the Internet in their native language or the language that is most popular in their area. So, when searching for country- or region-specific information, it is essential to consider in which languages the information is required and available. Although this consideration has been acknowledged by the open-source intelligence (OSINT) community, the mechanics of this process remain imprecise. What is available in a given language, and what is missing? Should search methods differ between languages, and how?

2. Methods

OSINT is a term used to indicate any intelligence that may be freely gathered from public sources; generally, it refers to the information that can be found on the internet. OSINT comprises various public sources, such as academic publications, media sources, web content, open government documents, social media, and satellite imagery. Acquisition and analysis of such open-source information involve filtering and validating a large volume of data for actionable intelligence. The diversity of the internet is reflected in not only its range of users and its information content but also in languages and locations. Knowledge and language move collectively regarding distinctions based on region or nationality. This paper aims to illustrate what openly accessible information exists about nuclear security in a given national context, where more information is needed, and why it is needed. With the help of the Google

Advanced search tool, we effectively collected region-specific, relevant information and filtered and organized it in a clear and accessible manner to assess its relevance.

In a previous study of information relating to security, an open-source search methodology was developed, which can be used by individuals with no prior knowledge or training in either search techniques or the subject in question, avoiding specific coding, programming, software, or other tools [13]. This method was adapted for the project described here, creating an analytical approach to identifying publicly available sources on nuclear security that was tailored to specific countries and languages. In doing this, we are emphasizing the human factor in open-source investigation and considering the accessibility and usefulness of different sources. We paid particular attention to information categories, content themes, conceptual accuracy, and publication dates.

Nuclear materials form a particularly sensitive category of information and, therefore, a challenge in the open-source arena. Broad media categories we worked with were academia, archives, blogs, careers, government, industry, magazines, news, policy, and social media (see **Appendix I** for a full description of each). We then coded the media categories iteratively depending on the themes in each country case study. The categories were further refined and combined to represent the broad range of content themes that frequently occurred in search results, such as "nuclear engineering," "nuclear technology," and "nuclear science." We came across web pages belonging to national regulators, companies, and organizations, as well as specific content such as individual resumes shared on social platforms. We divided the results into primary and secondary content categories, such as "nuclear energy" followed by "international relations" (see **Appendix II** for an overview of all categories).

A key area of exploration was the difference between *security* and *safety*. In many languages, these terms are the same word or understood interchangeably—meaning that an English language search for "security" alone may not be accurate or exhaustive. The *2022 Interim Edition of the IAEA Nuclear Safety and Security Glossary* explains [14], referring to "nuclear security" as prevention, detection, and response relating to criminal and unauthorized acts (such as theft or sabotage) involving nuclear or other radioactive materials, whereas "nuclear safety" relates to prevention, mitigation, and protection in case of accidents (such as a flood or fire) and consequences resulting from radiation risks. Helpfully, the glossary notes that there is not necessarily an exact distinction in the general understanding of "security" and "safety" but that security can be understood to refer to threats and intentional actions by people that could harm other people. In contrast, safety is concerned with a broader context of unintended consequences for people and the environment. Overlap and interaction nearly always exists between the two situations (for instance, an intended threat can lead to unintended risks, and vice versa). As a result of the relative complexity of this language and its translation, our keyword search was conducted separately for "safety" and "security" to better understand their use in national information landscapes.

a. Data Acquisition

Different search engines will deliver different results. We used Google across all searches. Notably, the Google algorithm lists results based on assigned importance, which means that results will almost always look different when the search is repeated. With that said, sources of information on nuclear security are scarce (under 100 search results for most countries at the time of writing), so even though the outputs will appear in a different order, they currently do not change rapidly over time.

It is essential to establish a useful set of keywords for the search to achieve high sensitivity and specificity. Using advanced search settings, we set the search region and language to the target country. We also used the "allintext" function to avoid pages linking to unrelated articles or archives. An example search line would be <allintext: Turkey "nuclear security">. Specifically, we conducted searches for "nuclear safety" and "nuclear security" in English and then the equivalent in other languages. In the case of India, this method meant three searches (the same word is used for both safety and security); in the case of Turkey, this method meant four searches; and for Jordan, more than four searches were done (multiple translations for safety). We carefully studied the content of each page and noted whether the words "safety" and "security" were used according to the IAEA definitions. All categorizations and definitions were verified by a second researcher to avoid bias.[4]

Some sources can be considered useful from the outset, prior to the general internet search. It is, therefore, important to link the search strategy to individual components of nuclear security. Government or regulator web pages are often a country's decisive source for this information. Additionally, a country may have worked with the IAEA or other organizations, whose web pages will provide information on nuclear security in specific contexts. Nuclear security has also formed a topic of academic and policy research for the last decade, meaning that exploring journals and academic networks such as Academia.edu and ResearchGate for high-quality information is worthwhile. Finally, information about nuclear security may be explored through related subjects, such as nonproliferation, deterrence, technology, and energy.

Analysis of the information we found resulted in refinement of the initial research questions. Quality, quantity, and themes of the search output varied strongly between all country case studies. In one case, we were aware of several ongoing projects concerning nuclear security, but none emerged when searching for "nuclear security." This lack of result meant that we had to investigate, first, which keywords were more relevant to those projects and, second, whether there was a straightforward way for people to arrive at those pages when conducting an internet search. We also explored less-conventional sources of information, such as social media and video materials because these are becoming increasingly popular in UK and US context, but this method did not result in significant additional sources for any of the selected countries.

---

[4] With thanks to Antonin Lelong for assisting with the initial methodology development.

A full analysis and discussion of these data sets covering diversity and inclusion in nuclear security, multilingualism in the nuclear sector, differences in online vs. offline language use, and digital sociology (internet access) is available in [7].

3. Case Studies

The countries we selected for case studies were Turkey, India, and Jordan. These countries were chosen because they all fall under different language groups (Turkic, Indo-Aryan, and Semitic, respectively) and use different scripts (Latin, Devanagari, and Arabic, respectively). Moreover, Turkey and Jordan are emerging nuclear states, but India can be categorized as a mature nuclear state [15, 16]. Each search was conducted by a native speaker with experience in the nuclear security field, which meant that we could question and verify any information encountered. The searches were all completed between August 2020 and December 2020, with verification occurring in April 2021 and July 2021. The goal of these case studies was to establish how someone working in any of these countries may acquire open-source information on nuclear security through an internet search and to produce advice on conducting such a search successfully. We compared which language resulted in a higher quantity or quality of results and examined information gaps. Accordingly, it should be possible to apply this methodology in any country or language context for future studies.

a. Case Study: Turkey[5]—Different Interpretations of Key Vocabulary

Introduction

Turkey established its first nuclear regulatory body in 1956, and it was one of the founding members of the IAEA in 1957 [17]. Subsequently, Turkey has spent many decades capacity-building at the institutional level, as well as ratifying international agreements regarding nuclear safety and security [18]. It currently operates a TRIGA MARK II research reactor at Istanbul Technical University (ITU), which first reached criticality in 1979. With that said, Turkey is known as a "nuclear newcomer" [4]: it is in the process of completing its first nuclear power plant in the Mersin province. The agreement for the Akkuyu project was signed in 2010, and the groundbreaking ceremony for the first reactor unit occurred in 2018. This reactor is currently scheduled to become operational in the mid-2020s. A second power plant project was being developed in the Sinop province, but plans are on hold at the time of writing [17].[6] In 2021, the IAEA's International Physical Protection Advisory Service observed that Turkey had established a nuclear security regime with essential elements of the IAEA's guidance on the fundamentals of nuclear security [19].

Turkey has a population of around 82 million people, and Turkish is the most widely spoken language. An important minority language is Northern Kurdish, and some

---

[5] Please note that this research was conducted before Turkey officially changed its name to Türkiye in 2022.

[6] Development of a feasibility report, for site suitability evaluation and a financial model, was completed in June 2018. According to a review of this report, however, it was decided to cease cooperation with Japan. Turkey is seeking other possibilities to continue the project.

communities speak Armenian, Assyrian, Arabic, and Greek, amongst others. Schools often teach foreign languages, including English, and some universities use English as a language of instruction [20]. With that said, overall national proficiency in English remains "very low" [21]. The reason Turkish is of interest in the context of language diversity is because of how it uses the concepts of safety and security. In day-to-day speech, the word *güvenlik* indicates *both* safety and security. This conflation happens especially in health and safety contexts and is associated with trust and reliability. However, another word can be used to refer to *security* on its own: *emniyet*. It is less common in daily use, and it is mostly used to refer to the police [5].

To separate between the two concepts as is done by the international community, the Turkish Atomic Energy Authority (TAEK) has been using *güvenlik* for safety and *emniyet* for security. However, several Turkish ministries (Foreign Affairs, Defence) use the word *güvenlik* for security and *emniyet* for safety—that is, they choose to distinguish the concepts the other way around. This decision is because *güvenlik* is the most common word for either, but security threats are a bigger concern than safety risks for these ministries. As a result, it is often difficult to know which concept is meant by a Turkish speaker, especially when translating from Turkish to English or vice versa.

English Language Search

The English language search "allintext: Turkey 'nuclear security'" yielded 74 unique results. Of these, 18.5% of pages could be classified as an unclear or incorrect definition of "security," and 47% covered an accurate understanding of security. The remainder could not be classified (e.g., they only included the words used in the search string without further explanation or clarifying context).

URLs were categorized according to a primary subject and a secondary subject, as well as an overarching media category. For example, a page would be assigned the primary category "nonproliferation" and the secondary category "nuclear security" if it discussed nuclear nonproliferation in the Middle East with a paragraph dedicated to nuclear security. A page would be assigned the primary category "nuclear energy" and the secondary category "international relations" if it discussed nuclear energy needs in Turkey and included a paragraph on cooperation with China. The biggest category overall was "nuclear energy," which was the primary category for 21.5% of results (**Figure 1a**). Other significant categories were "Nuclear Security Summit" (13.5%) and "international relations" (13.5%). "Nuclear security" was also the primary category for 13.5% of results and the secondary category for another 20% of results. In other words, nuclear security was mentioned on many of these pages (as intended through the search string) but did not form the main topic of discussion.

The pages that included a flawed understanding of security primarily fell in the "nuclear energy" category. Several of these pages reported on nuclear regulation or licensing in Turkey; they mention security together with safety ("nuclear safety and security") and proceed to discuss safety factors only. This indicates a difficulty in separating the two ideas. Several other pages mention security in the context of nuclear waste, and two cover security concerns following the Fukushima disaster. However, when expanding

on this, these pages only address safety concerns. This can likely be attributed to issues in conceptual translation from Turkish *güvenlik* and *emniyet*.
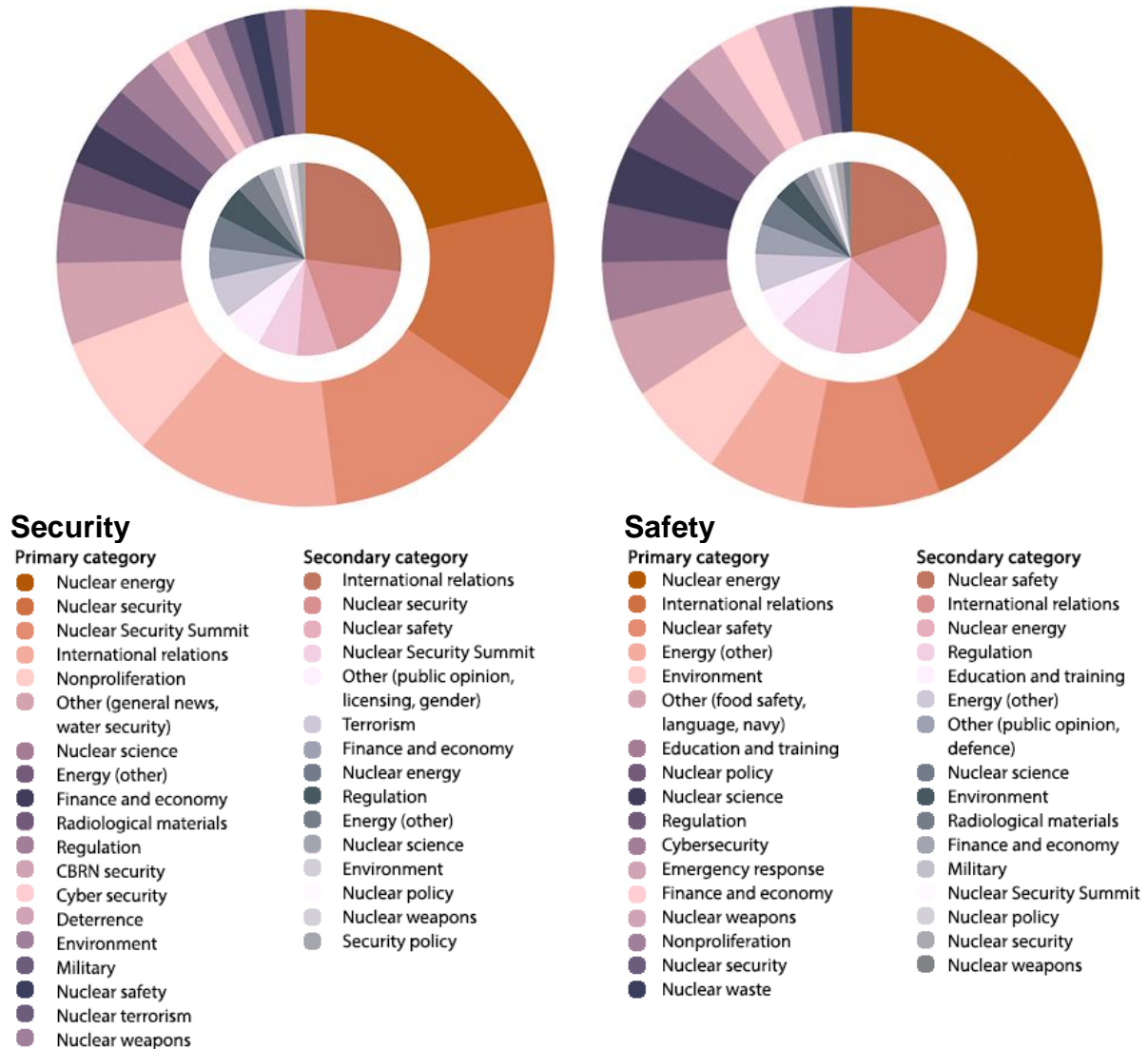

Figure 1. (a) Open-source internet search for "Nuclear Security" in Turkey—English. (b) Open-source internet search for "Nuclear Safety" in Turkey—English.

On the pages where security was described accurately, security was often in the context of nuclear weapons or nuclear terrorism, discussing threat rather than risk. Overall, nuclear security was most frequently mentioned in the context of Turkey's participation in the Nuclear Security Summits.[7] These articles announce meetings between national leaders, such as Erdoğan and Obama, and do not discuss nuclear security in detail; some do not mention security but focus on broader international relations. Additionally, foreign events and organizations had a significant influence on the search results. For example, several pages mention the US National Nuclear

---

[7] The Nuclear Security Summits were four summits held between 2010 and 2016 in Washington, DC; Seoul; and the Hague. They were an initiative of the United States, which called nuclear terrorism "one of the reatest threats to international security."

Security Administration, which was generally paired with an accurate explanation of security.

Turkish news media or research institutes produced several of the collected articles but did not address nuclear security in Turkey; instead, they reported on nuclear security in other regions such as the broader Middle East. In general, international meetings, negotiations, and events formed an important context for many pages mentioning nuclear security. Few results discussed nuclear security in an exclusively domestic context.

The oldest result is dated October 2006 (a US case study on Turkey published on the website of the Economic Policy Research Foundation of Turkey). The 2006 report was the only result dated pre-2011. The Nuclear Security Summits (NSS) dominated results dated between 2014 and 2016. There was no clear increase in the accuracy of the use of the word *security* from earlier to later results, although all results for 2020 demonstrated an appropriate understanding of security.

The first results of the search included an Istanbul-based think tank and a state-run news agency, and the tenth result was an article from the Turkish Ministry of Foreign Affairs on the Nuclear Security Summit in the Hague. The search output also included a page from the TAEK, but this source appeared much lower in the results. News media were responsible for the largest number of results. Some of the most insightful results came from academic articles and student theses. Otherwise, the search also yielded two CVs and LinkedIn profiles belonging to academics working in the nuclear field and several company websites, particularly technology-oriented companies (e.g., security-oriented software and analysis). Apart from profiles or articles belonging to academics there, the search yielded no results relating to Turkish universities working on nuclear security internationally, nor any mention of the research reactor run by ITU.

The lack of results can be attributed to not many academics working on nuclear security in Turkey, and nuclear security as a field of study is relatively new. The most notable universities with nuclear engineering programs are Hacettepe, ITU, and Sinop, and several other universities, such as Ankara University and Ege University, have nuclear science programs. They have scholars working primarily on nuclear policy (including nuclear security) from a social science point of view, nuclear safety, and nuclear engineering under bachelor of science and graduate programs. Nuclear safety and security concepts are generally covered under separate courses or research projects rather than, for example, dedicated master of arts programs. International collaboration, such as workshops, also exists but is not always advertised publicly, which is why it is unlikely to appear in open-source search results. Additionally, security concepts related to the research reactor are, understandably, confidential. The reactor is not used for security education for students; instead, it is used for research and training purposes, including graduate dissertations.

Notably, only two of the search results (both academic) related to nuclear materials outside of the civil nuclear industry—specifically, the B61 nuclear bombs Turkey stores

for the United States at the Incirlik Air Base and interest in Russia's S-400 antiaircraft missile system. This topic has seen increasing international media attention throughout 2019 and 2020 but did not feature in "nuclear security"–related media searches in English with the search region set to Turkey. A separate search with the specific keywords "allintext: turkey B61 'nuclear security'" yielded eight new results, almost all of which were academic or policy output. The only news report among them (Turkish language) dates to 2016 and reports on the cost of the missiles. Although more information on this topic is available when searching for keywords related specifically to defense strategy, Turkey does maintain a policy of opaqueness about tactical nuclear weapon discourse. It is, therefore, not surprising that this kind of information is more difficult to come by, and it did not affect the relevance of our case study data.

The English language search "allintext: Turkey 'nuclear safety'" yielded 79 unique results. Of these, 6% of pages could be classified as an unclear or incorrect definition of safety, 54% of pages covered an accurate understanding of safety, and the remaining pages could not be classified. Additionally, nine results overlapped with the "security" search (pages that mentioned both safety and security or identified either incorrectly).

The biggest category overall was "nuclear energy" again—the primary category for 31.5% of results (**Figure 1b**). The second largest category was "international relations," which was the primary category for 12.5% of results and the secondary category for another 19%. "Nuclear safety" formed the third largest category as the primary category for 9% of results and the secondary category for another 19% of results. Again, nuclear safety was mentioned on numerous pages (as intended through the search string), but it did not form the main topic of discussion. The Nuclear Security Summits featured far less in this search, with only one page mentioning them.

The pages that included a flawed understanding of safety did not fall into one specific category. However, these results had in common that the text generally included comments on security and policy. For example, one page mentioned "geopolitical safety" where security was meant; others used "security" and "safety" interchangeably. This conflation strengthens the sense that it is sometimes difficult to separate between the two words in English or possibly between the two concepts more generally.

On the pages where safety was described accurately, safety was often in the context of nuclear energy and the environment, discussing risks rather than threats. Overall, nuclear safety was most frequently mentioned in the context of Turkey's power plant projects or power plants in other countries. As with security, news articles announce meetings between national leaders or ministries, as well as broader meetings between the European Union and Turkey, and do not discuss nuclear safety in detail. Notably, several pages only occurred in the search output because they mention the German Federal Ministry for Environment, Nature Conservation, Building, and Nuclear Safety. These pages could generally either not be classified (did not discuss the concept of safety further) or provide an accurate description of safety.

The oldest results are dated February 2001 (a document about a European Union [EU] energy project in Turkey). The results for the safety search dated back further in time than the security search and occurred more frequently. Another 10 results dated to 2011 or earlier. These sources were primarily EU progress reports or documents detailing nuclear energy discussions between Russia and Turkey.

The first results of the search included articles from state-run news agencies, academic articles or conferences, and TAEK pages. Although the TAEK pages were few and far between in the "security" search and only occurred much later, they were much more prominent in the "safety" search output, indicating the traditional area of focus for this organization. Many results are related to speculation about or scientific research on the potential environmental impact of nuclear and radiological materials in Turkey. Although numerous results covered other countries and regions, they focused more on Turkey domestically than the "security" output. Akkuyu power plant was mentioned several times, Sinop twice, and Incirlik Air Base once (in a security context). The search also resulted in several company web pages, with work relating to nuclear engineering and environmental consulting. Several job vacancies also appeared; only one was for a position in Turkey (others included Germany, the United Kingdom, and Finland). One result near the end of the search outputs was from a language learning website that used "he worked as a nuclear safety regulator for 10 years" as an example.

Turkish Language Search

The Turkish language search for "allintext: Türkiye 'nükleer emniyet'" yielded 87 unique results. Turkey is the only country we studied that had more local language results than English language results. Of these results, 14% of pages could be classified as an unclear or incorrect definition of security," 63% covered an accurate understanding of security, and the remainder could not be classified. The biggest category overall was "nuclear energy" again—the primary category for 34.5% of results (**Figure 2a**). The second-largest category was "Nuclear Security Summit," which was the primary category for 17% of results. "Nuclear security" was the ninth largest category (3.5%) after others such as "nuclear science," "regulation," and "nuclear safety." A large secondary category was "international relations," with 18% of results.

Pages that specifically addressed nuclear security included an article on Russian detector development, an article on security plans for nuclear facilities ("to prevent theft, sabotage, unauthorised access"), a risk analysis of nuclear energy in Turkey, and two sources relating to the police. The majority of sources focused on nuclear cooperation (e.g., between Germany and Turkey), plans for the Akkuyu power plant, and Turkey's energy strategy. These sources mostly mentioned both security and safety but emphasized nuclear safety.
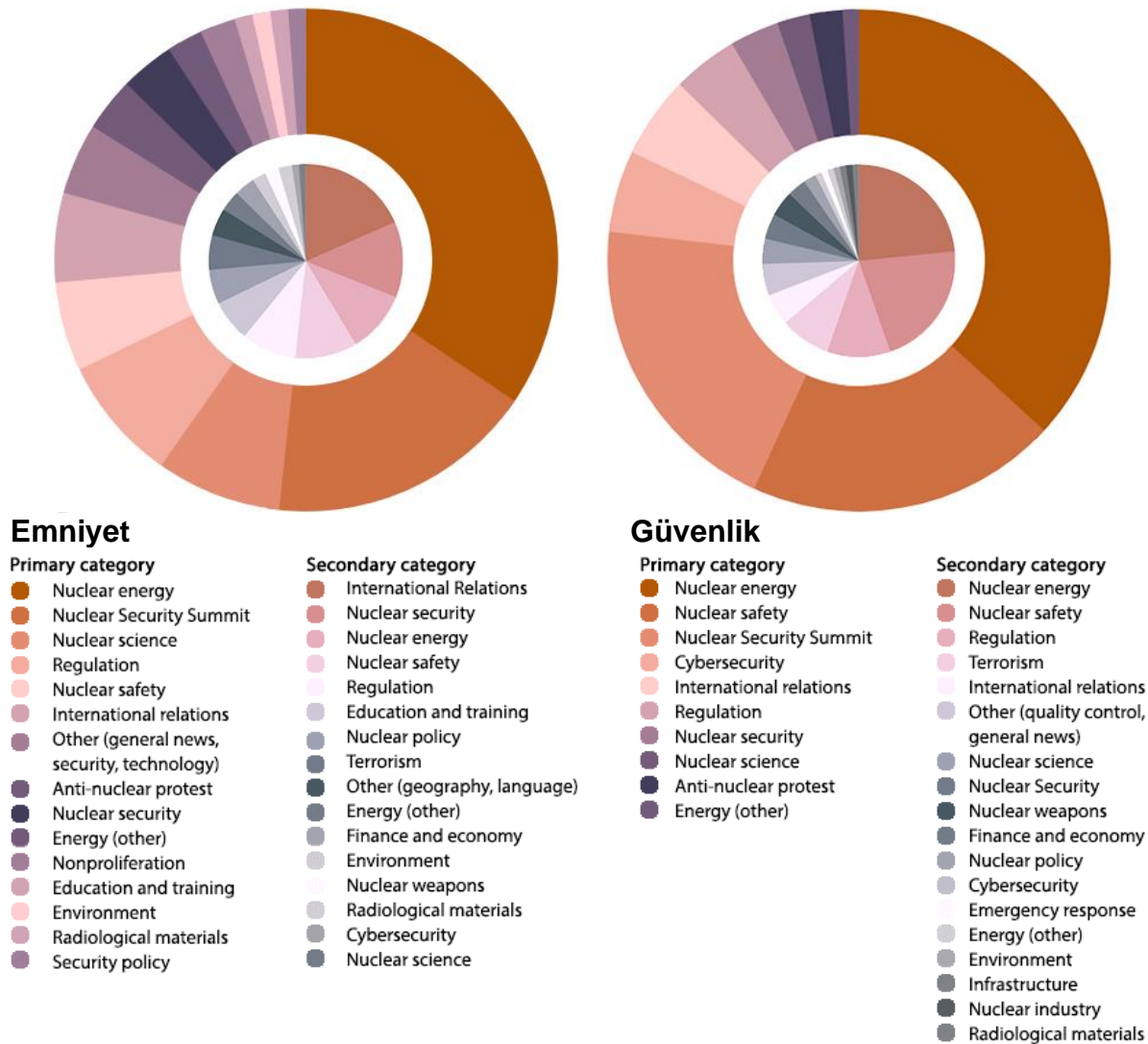
Figure 2. (a) Open-source internet search for "Nuclear Security" (*nükleer emniyet*) in Turkey—Turkish. (b) Open-source internet search for "Nuclear Safety" (*nükleer güvenlik*) in Turkey—Turkish.

The oldest results were regulations dating back to 1983—notably much older than the English language search outputs. This result was followed by energy policy documents from 2007. The top 10 results included policy papers and government pages relating to regulation. The Turkish search outputs included more Turkish news media and more Turkish government pages. Istanbul-based think tank Center for Economics and Foreign Policy Studies (edam.org) was amongst the first results for both the English and Turkish searches.

The Turkish language search "allintext: Türkiye 'nükleer güvenlik'" yielded 95 unique results. Of these, 23% of pages could be classified as an unclear or incorrect definition of safety, 61% covered an accurate understanding of safety, and the remainder could not be classified. The biggest category overall was "nuclear energy," which was the primary category for 37% of results and the secondary category for another 23% of

results (**Figure 2b**). The second-largest categories were "nuclear safety" and the "Nuclear Security Summit" (20% each); "nuclear safety" was also the secondary category for another 21% of results. In total, nine pages overlapped with the "nükleer emniyet" search.

Pages addressing nuclear safety included regulation, newspaper articles on Akkuyu, and compliance with international nuclear safety standards. There was also a specific page on the establishment of a nuclear safety advisory committee. The output also included an article about a plant in Armenia and environmental concerns, an article about Chernobyl and Fukushima, and several articles on global nuclear and radiological incidents in general.

Notably, these results were more relevant to acquiring information on nuclear safety than the *emniyet* results were for nuclear security. With that said, several articles addressed cybersecurity, where *güvenlik* was chosen as the translation for security. The results were still dominated by news on the Nuclear Security Summits, even though the contents of the pages and articles did not address nuclear safety.

b. Case Study: India—English as the Dominant Language for Security

Introduction

Ever since the country's independence in 1947, India has developed, demonstrated, and deployed various technologies and scientific prowess in the civilian aspects of nuclear sciences. Notably, India's nuclear trajectory has been largely indigenous, relying on its own research and critical infrastructure. Accordingly, India has a well-developed national nuclear oversight infrastructure, and it was also one of the founding members of the IAEA in 1957.

At the time of writing, India has 23 operable reactors, 6 under construction, and 16 more planned based on cooperation with Russia, France, and the United States [16]. The country currently obtains 3% of its electricity from nuclear reactors, but it plans to expand the energy security and sustainable development plans to 25% by 2050. Recognizing the country's vast reserves of thorium-232, India is pursuing a three-stage nuclear power program using a mix of pressurized heavy-water reactors, fast breeder reactors, and light-water reactors. The program is based on a *reprocess to reuse* strategy, where it strives to extract the maximum energy from the limited uranium resources, minimize the generation of nuclear waste, and provide proliferation resistance, ensuring long-term energy security. Although India has completed the first stage of its sequential civil nuclear program, the second stage is still in process, with the first 500 MW pressurized fast breeder reactor, BHAVINI, being set up in Kalpakkam, Tamil Nadu [22, 23].

Notably, these developments fit in with India's broader postcolonial, technopolitical aims to modernize the economy and deter adversaries [24]. India also has a significant nuclear weapons program, having tested its first nuclear device in 1974. Tensions

between India and Pakistan are well-documented, as are more recent security concerns relating to China. As a result, India maintains a stockpile of weapons-grade plutonium and highly enriched uranium, with a policy of "credible minimum deterrence" and "no first use" [25].

Hindi is the most-spoken language in India. Of the 121 languages recorded in the 2011 language census data, 43.63% of the Indian population declared that they speak Hindi as their first language [29]. The 2011 census data also showed English as the primary language/mother tongue of 256,000 people, the second language of 83 million people, and the third language of another 46 million people, making it the second-most widely spoken language after Hindi. As the most prominent remnant of the British colonial administration, the English language remains a vital part of India.

English Language Search

The English language search "allintext: India 'nuclear security'" yielded 58 unique URLs. This search result is notably less than Turkey, which is a much smaller country with far less experience with nuclear materials. Many results were journalism, such as reports on the Nuclear Security Summits. The search content did not reveal relevant data on regulations, policy, physical protection systems, defense in depth, graded approach, or other important factors relating to nuclear security. Of these results, 2% of pages could be classified as an unclear or incorrect definition of security, 73% covered an accurate understanding of security, and the remainder could not be classified. As a public, open-source user and a civilian, it is difficult to obtain a clear picture from the outside of the security measures in place. Given India's reliance on secrecy, as a vital component of counter-strategy, a social science researcher would need some technical skills and insider access to obtain information that in principle should be available to the public. Often, the unavailability of information can be misconstrued as the absence of measures.

The biggest category overall was "nuclear security;" however, it was the primary category for 41% of results (**Figure 3a**). Other common themes were the Nuclear Security Summits, nuclear energy, and nuclear policy. Nuclear weapons and terrorism occurred more often as themes than in our other country case studies. The biggest media category was "news," contributing 43% of results, followed by academia, government, and policy. None of the results were from the nuclear or radiological industry.

Three web pages in the search results discussed India being ranked lower than Pakistan in the Nuclear Threat Initiative nuclear security index. This topic is pertinent information related to nuclear security, which warrants further inquiry or explanation from the Department of Atomic Energy (DAE) or Atomic Energy Regulatory Board, especially because India has a robust nonproliferation record and a long history of dealing with nuclear materials. The search output yielded a page on "Amity Institute of Nuclear Science and Technology" as the only academic/institutionally related webpage. This result was, however, included toward the very bottom (page 5 out of 7) of the search. Results yielded a few web pages from the Observer Researcher Foundation

that focused on global nuclear security and a comprehensive threat analysis of nuclear security in India. The only government web page output resulting from this search was listed as a memorandum by the DAE reaffirming its commitment to nuclear security.

The results identify bureaucratic inertia from the government and the nuclear establishments, the nature of the topic (nuclear security), and the intertwining concepts of safety and security (in the Indian region and Hindi language) as parameters affecting the effectiveness of the search results in the public domain. The results also show that the data challenges in India (irrespective of the nature of the topic searched) range from the inadequacy of available data (e.g., incomplete information, nonacademic articles, outdated articles) to the restricted access to available data (e.g., no public use, regulations, policy, paid university access) and no access to available data (e.g., need to pay for data).

Security

Primary category	Secondary category
Nuclear security	Terrorism
Nuclear Security Summit	Security policy
Nuclear safety	Nuclear Security Summit
Deterrence	Nuclear security
Energy (other)	Nuclear weapons
International relations	International relations
Nuclear science	Nuclear energy
Nuclear smuggling	Nuclear safety
Nuclear weapons	Cybersecurity
Terrorism	Deterrence
	Environment
	Nuclear policy
	Nuclear smuggling
	Other (insider threat)

Safety

Primary category	Secondary category
Nuclear safety	Nuclear safety
Nuclear energy	Nuclear energy
Nuclear security	Regulation
Regulation	International relations
Nuclear science	Nuclear policy
International relations	Nuclear security
Anti-nuclear protest	Legislation
Radiological materials	Security policy
	Cybersecurity
	Nuclear Security Summit
	Nuclear science
	Other (mining)

Figure 3. (a) Open-source internet search for "Nuclear Security" in India—English. (b) Open-source internet search for "Nuclear Safety" in India—English.

The English language search "allintext: India 'nuclear safety'" yielded 64 unique results. Of the overall results, 2% of the pages could be classified as an unclear or incorrect definition of safety, 67% covered an accurate understanding of safety, and the

remainder could not be determined (the words occurred on the page without further contextual explanation or indication of relevance or understanding).

The biggest category overall was "nuclear safety"—the primary category for 48% of results and the secondary category for another 22% of results (**Figure 3b**). Another significant category was nuclear energy (also 22% of results). Again, the largest source of these pages was news media, contributing 38% of the results. Also, 14% of the results were linked to government pages, and 16% came from academia. Some results also came from industry for this search, as well as more from magazines—for example, an article questioning the safety of nuclear reactors in India.

The topic of nuclear security, like nuclear weapons, nuclear energy, and military medicine, lacks transparency in India. One motivation for imposing secrecy on the nuclear program involves its restriction to peaceful applications. Secrecy and lack of transparency have resulted in limited information and the inaccessibility of information to the public. Based on the 1962 Atomic Energy Act [27] and Official Secrets Act [28], the DAE possesses the right to restrict any information related to atomic energy and prohibits the "misuse" of official information regarding facilities relating to the military establishment or energy "works," especially with "foreign agents." The judiciary has also frequently interpreted these laws favoring secrecy rather than the people's right to know [29].

Hindi Language Search

With the linguistic differences in keyword matching, it was essential to conduct searches for both "nuclear safety" and "nuclear security" in English and Hindi. The words *safety* and *security*, though different, are translated as the same word in Hindi (*suraksha*, सुरक्षा), which is used to indicate safety or security depending on the context. *Surakhsa* is a compound of *su* (सु) and *raksha* (रक्षा). The prefix *su* in Devanagari script means something positive in terms of beauty or quality, it is also translated as *good* or *pure*. The word *raksha* has three main meanings: protection or to protect from; care; and defense or to defend against. The most common use is protection, as it is derived from the verbal root *raks—to protect.* Put together, *suraksha* evokes a feeling of safekeeping and assuredness.

The search line <allintext: India (*parmanu suraksha*) "*परमाणु सुरक्षा*"> examined the available open-source internet information for definition accuracy and the difference in connotation and terminology usage of the word *suraksha*. The search line resulted in a combination of safety and security web page results. The majority of the resulting outcomes consisted of newspaper articles, magazine issues, and other commercial advertisements. Very few web pages were government or academically inclined. A notable observation in the two (nuclear security in English [EN] and *parmanu suraksha* in Hindi [HN]) search outcomes was the substantial coverage of Nuclear Security Summit–related reports. This result, however, was not observed in the search with "India: nuclear safety EN," implying that the underlying concept of *safety* vs. *security* was generally understood by a small group of people, including journalists and academics, among others.

Since the 2016 Nuclear Security Summit, India, like many other countries, has given a high level of political attention to nuclear security and weapon-usable nuclear material threats. The momentum of fostering nuclear security in the international community was clearly reflected in our searches through Nuclear Security Summit reports dated between 2010 and 2016. The definition of *security* and *safety*, although not quite exact, was presented by many newspaper articles as a wider conceptual understanding of the difference between the two ideas. Notably, despite *suraksha* being the synonymic terminology for both safety and security in the Hindi language, very few web page results were seen to misconstrue the words.

The Hindi language search "allintext: India 'parmanu suraksha'" yielded 59 unique results (Figure 4). Of the overall results, 10% of pages accurately addressed security, 10% accurately addressed safety, and the remainder used both interchangeably or could not be classified. Considering that *parmanu suraksha* should cover both nuclear safety and nuclear security, the Hindi search yielded far fewer (almost half) the results of the English search. The biggest categories were nuclear security (17%) and nuclear safety (12%). However, themes were more varied. Other significant categories were "nuclear security summit," "military," and, notably, an increase in results featuring "nuclear weapons."

Most web page articles and reports used *suraksha* with a safety undertone when describing the process or situations with inherent threats (i.e., an accident or a malfunction). Meanwhile, the same word had a *security* undertone when used for describing processes or situations involving threats (i.e., intentional or malicious) from external factors or entities. The searches also revealed that the volume of reports from the United States on the governance of India's nuclear security was higher than those from the Indian government or academic journalism. To showcase the general outlook of the open-source information related to both nuclear safety and nuclear security discourse among the Indian population, an analysis of the media content was also performed. It was discovered that India's strategic nuclear debate, essays, and current affairs are traditionally centered in English-language newspapers. The opinion content pieces and nuclear-based editorials by the elites in the Indian nuclear industry were found to be published on English daily newspaper websites of India. Our searches showed that newspapers and magazines are the preferred medium of communication in India. Specifically, 40% of the websites related to "nuclear safety-EN" were English newspapers; 80% of the search sites in the Hindi language were recognized as English and Hindi daily newspaper editorial issues, and 66% of the "nuclear security-EN" search covered newspaper articles. The "nuclear safety-EN" search, out of the remaining two searches, had the majority of government and academic publications and web pages.
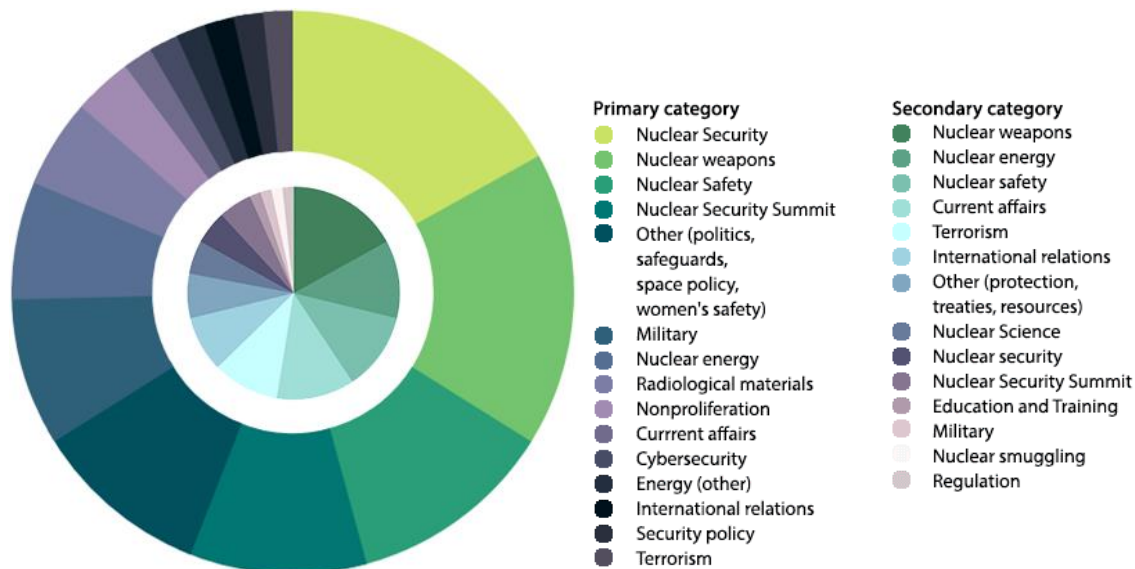
Figure 4. Open-source internet search for "suraksha" in India—Hindi.

c. Case Study: Jordan—The Impact of Script

Introduction

Jordan imports 95% of its energy and, consequently, set up the Jordan Atomic Energy Commission (JAEC) in 2007. It was established to develop a road map to a peaceful nuclear energy program. At that time, Jordan's national energy strategy was envisaging electricity generation from nuclear energy by 2020 [30, 31]. When it gradually became clear that large reactor plans were not feasible, Jordan began looking into different options. In a 2009 interview, Dr. Khaled Touken, chairman of JAEC, said that "electricity and water drive the need to go to nuclear energy," and he believed that the peaceful use of nuclear energy according to international laws and regulations would shift Jordan from a "culture of conflict" to a "culture of prosperity" [32]. At the beginning of 2021, Dr. Toukan added that Jordan is now planning to generate electricity and heat or desalinate water using nuclear energy from small modular nuclear reactors around 2030 and beyond [33].

The vision to put Jordan on par with other nuclear countries included building the infrastructure and introducing the vocabulary of nuclear energy. These steps were initiated by establishing Jordan's first nuclear engineering program at the Jordan University of Science and Technology in early 2007. The university also houses Jordan's Research and Training Reactor, which is the country's first licensed nuclear reactor. It became operational in 2017 and underwent rigorous IAEA safety assessments [34]. The research reactor produces isotopes for medical and industrial uses and serves as the establishment to educate and train nuclear engineers and scientists. Furthermore, Jordan has a large uranium-ore reserve. The Jordan Uranium Mining Company opened a pilot plant in 2021 intending to produce yellowcake [35].

Jordan is a keen proponent of establishing a weapons of mass destruction–free zone in the Middle East. It shares borders with Syria, Iraq, Saudi Arabia, the Palestinian

territories, and Israel, all of whom are involved in various forms of conflict. Accordingly, Jordan's nuclear security priorities include countering terrorism, security during the transfer of radioactive materials, and preventing smuggling [36]. Radiological materials are sold on the global black market, and it is a major concern that in the wrong hands, these materials could be used in acts of terrorism and mass disruption. Notable recent incidents in the region include uranium being taken by insurgents from Mosul University and the theft of an industrial radiography device in Basra [37].

Jordan has a population of around 10 million, and its main language is Arabic. Different versions of Arabic are spoken in different regions, but most people are familiar with Modern Standard Arabic and Levantine Arabic. Important minority languages include Circassian, Chechen, and Armenian. Many schools also teach English, which is the second language taught in state schools. In universities, a mix of English and Arabic is used (e.g., English textbooks, Arabic lectures) [38].

English Language Search

The language of nuclear security and nuclear safety online reflects Jordan's milestones in its nuclear program. The English language search "allintext: Jordan 'nuclear security'" yielded 37 unique results. A total of 32 of these results were dated after 2010, and 19% of pages could be classified as an unclear or incorrect definition of security, 24% covered an accurate understanding of security, and the remainder could not be classified. The largest category overall was "nuclear security"—the primary category for 21.5% of results (**Figure 5a**). One of the second largest category was "nuclear smuggling," which is a topic that had not come up in the other countries' case studies—the primary category for 11% of results. A large secondary category was "international relations," which could be attributed to another 11% of results. Notably, the majority of results were government web pages (38%), followed by career-related content (such as profiles, CVs, and job listings; (24%), and academia (11%). There were not many news media outputs.
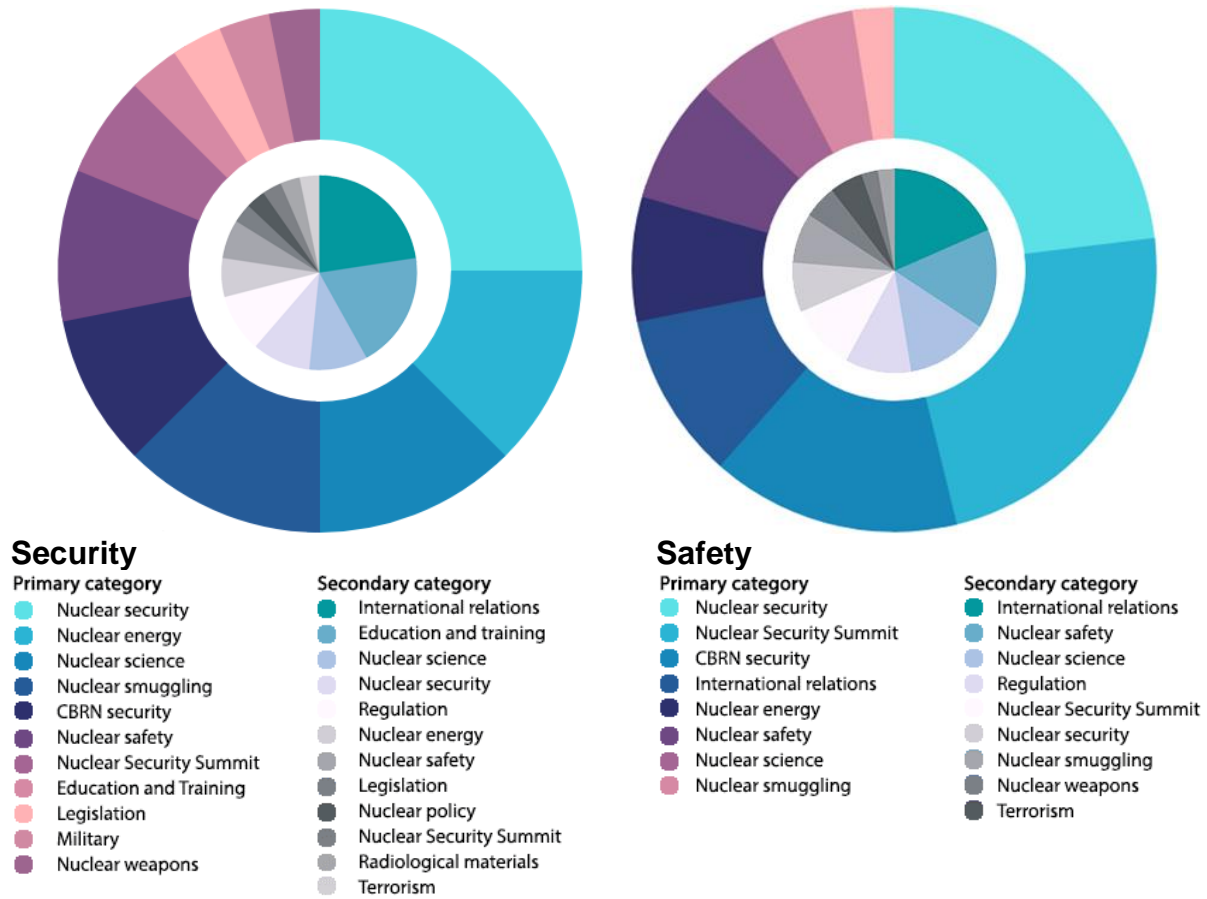
The results were mainly from governmental websites that report on collaborative efforts between the Jordanian and US or EU governments regarding nuclear smuggling, illicit trafficking at the borders, or managing the life cycle of radioactive sources. Other official websites of the royal family, such as King Abdullah II and Crown Prince Al Hussein, report their Majesty's participation in national and international events—mainly Nuclear Security Summits—and affirm Jordan's commitment to pursue a region free of weapons of mass destruction. The results also included agency sources such as Roya TV, Ammon, and Jordan's news agency Petra that reported on the same themes of nuclear smuggling and nuclear security.

Although Jordan is the smallest country out of the three we studied and the newest to the nuclear field, we did not think 37 results were an accurate reflection of the information landscape. Therefore, we tried to expand the search criteria by eliminating the word "Jordan" from the advanced search while still focusing on results from the Jordan region. This yielded the same themes: nuclear smuggling, Nuclear Security Summits, and nuclear safety and security (of 36 results, 11 were the same as the

previous search). There were slight variations in some outputs, however. For example, two outcomes were of an academic library catalog on the theme of nuclear security. It is important to note that results from the "academia" category in both searches were mostly the resumes of university professors who specialized in nuclear engineering or attended nuclear security workshops.

We reconsidered the search parameters a second time and replaced "Jordan" as a search word with the "Hashemite Kingdom of Jordan." Notably, this gave us much fewer results (17 results; 6 were duplicates from the previous search) but also arguably provided more useful results. Most sources were governmental entities, such as the Jordanian Embassy in Washington or the American Embassy in Jordan, reporting on collaborative efforts on the themes of nuclear security and nuclear smuggling. However, one result that did not appear in previous searches was the Ministry of Energy and Mineral Resources annual report for 2016, which detailed the strategic objectives and accomplishments in the energy field in Jordan [39].

The English language search "allintext: Jordan 'nuclear safety'" yielded 45 unique results. Similar to the other two case studies, there were noticeably more results for "safety" than for "security." Of these results, 10% of pages could be classified as an unclear or incorrect definition of safety, 14% covered an accurate understanding of safety, and the remainder could not be classified. The biggest category overall was "nuclear safety"—the primary category for 20% of results **(Figure 5b)**. Even though Jordan does not currently have plans for a nuclear power plant, it is a topic being discussed. This search has a larger volume of news (13%) and industry (11%) output, but the majority of pages could be classified as academia (31%) or government (20%).

Security

Primary category
- Nuclear security
- Nuclear energy
- Nuclear science
- Nuclear smuggling
- CBRN security
- Nuclear safety
- Nuclear Security Summit
- Education and Training
- Legislation
- Military
- Nuclear weapons

Secondary category
- International relations
- Education and training
- Nuclear science
- Nuclear security
- Regulation
- Nuclear energy
- Nuclear safety
- Legislation
- Nuclear policy
- Nuclear Security Summit
- Radiological materials
- Terrorism

Safety

Primary category
- Nuclear security
- Nuclear Security Summit
- CBRN security
- International relations
- Nuclear energy
- Nuclear safety
- Nuclear science
- Nuclear smuggling

Secondary category
- International relations
- Nuclear safety
- Nuclear science
- Regulation
- Nuclear Security Summit
- Nuclear security
- Nuclear smuggling
- Nuclear weapons
- Terrorism

Figure 5. (a) Open-source internet search for "Nuclear Security" in Jordan—English. (b) Open-source internet search for "Nuclear Safety" in Jordan—English.

Academic research results were scarce, and the pages again mostly showed the CVs of professors or reporting of workshops conducted on themes related to nuclear safety. The main news agencies that appeared were Petra, Ammon, and Roya, reporting on cooperative efforts between Jordan and other countries on matters of nuclear safety and nuclear security. One exception was an opinion piece published by 7iber.com in 2014 titled "The Eventual Meltdown of the Nuclear Program in Jordan" [40].

Expanding the search results by removing "Jordan" as a search word yielded an increased number of results (of 59 results, 22 were duplicates from the previous search). For example, the academic pages included entries from other universities such as Zarqa University and the American University of Madaba. These academic pages reflected themes such as nuclear engineering, the program lists, degree requirements, and library catalogs. Another result was the website of the Ministry of Planning and International Cooperation, listing a description of joint projects with the European Union regarding energy, including nuclear energy. The opinion piece on 7iber.com did not appear in this search output.

Arabic Language Search

The Arabic language search "allintext: الأمن النووي ،الاردن" yielded 20 unique results. Of these results, 20% of pages could be classified as an unclear or incorrect definition of security, 25% covered an accurate understanding of security, and the remainder could not be classified. The biggest category was "nuclear security" (45%), followed by "Nuclear Security Summit" (15%) (**Figure 6a**). Here, most results are dated to 2016, with themes reflecting security discussed in governmental collaborative efforts and conducted workshops. A noticeable difference with the English results is that the news sources included news agencies and websites such as Jafra News, Jordan Zad, and Kaberni, catering to a Jordanian audience. The results contained no opinion pieces, and the academic category did not reflect research papers on nuclear engineering, security, or power in Jordan.

Again, we decided to adapt the search parameters to ensure we were not missing anything. Removing "الاردن" (*Al-'urdun*, "Jordan") as a search word expanded the outputs by a few entries (26 results total). The results reflected the same categories, themes, and content as before. Nevertheless, the search yielded unique results (only one duplicate with the previous search)—for example, an article translated from Politico about hackers getting into the American national nuclear security administration networks dating to 2020. Another example is an opinion piece written in Addustour, a prominent Jordanian news agency, on the future of nuclear security. It is worth noting that the article only approached the topic from a historical perspective, and the word "Jordan" did not appear.

These minor variations in the output of search criteria prompted us to dig deeper into how possible variations in the search parameters would affect the search results. In one test, we removed "ال" (*al,* the Arabic word for "the") from nuclear security, "أمن نووي" (*'amn nawawi*), as a search word and kept "الاردن" (*Al-'urdun*, "Jordan") as a search word requirement. The search yielded only eight results at the time. All the results were from news agencies reporting on themes of nuclear security and the Nuclear Security Summits. However, the most recent result was an article from the website Ahdath24 that reported the installation of radiation detection equipment at King Hussein Airport in Aqaba. The article had "أمن نووي" (*'amn nawawi* without *al-* in the title), which may explain why this result did not show in previous searches. However, this slight variation limited the outputs of the search query drastically, and it went against a reasonable assumption that removing "ال" could expand the results rather than limit them.

In another test, we searched for "الأمن النووي" (*al'amn alnawawi*), but instead of "الأردن" (*Al-'urdun*, "Jordan"), we entered "المملكة الأردنية الهاشمية" (*almamlaka al'urdunia alhashimia*, "The Hashemite Kingdom of Jordan"). The search query yielded a similar number of pages as the search for "الأردن." Only two academic sources reported on workshops conducted on nuclear security and safety and societal security. The remainder of the results fell into the "government" and "news" categories. The government results appeared on the first page of the search outcome, and news results followed. Notably, the results included the official page of the Prime Ministry dating back to 2017, listing several governing regulations, including the regulation for the Nuclear and Radiological Security

Centre. News media included an article published in 2011 on AlmadenahNews reporting on a keynote speech by Prince Ali during a workshop titled "Nuclear Security and Proliferation" conducted at the University of Jordan.

The Arabic language search "allintext: ،الأمان النووي الأردن"" yielded 33 unique results. This again gave us fewer results than the English search but more results than the security search. Of these results, 22% of pages could be classified as an unclear or incorrect definition of "security," 22% covered an accurate understanding of security, and the remainder could not be classified. The biggest category overall was "nuclear safety" – the primary category for 45% of results (**Figure 6b**). Important secondary categories were "international relations" (12%) and "education and training" (6%).

The majority of results were from news outputs (64%), with only three academic pages. The news agencies reported on themes concerning nuclear safety, security, and energy. Many articles reported on workshops and Jordan's commitment to safety regarding its nuclear program. The results reflected the various news websites reporting for a Jordanian audience, such as JFRANews, Hala, GerasaNews, JordanZad, and others. Removing "الأردن" as a search word did not yield an increased number of results. The outputs were all news items that reflected similar themes as the first search query.

However, the word "أمان" (*amaan*) is not commonly used when talking about nuclear safety. Rather, experts and practitioners often refer to "سلامة" (*salama*) or "السلامة النووية" (*alsalama alnawawia*). The word shares a common root with the word for peace, "سلام" (*salaam*). Therefore, we adjusted the parameters once more to include "السلامة النووية" (*alsalama alnawawia*), but we did not limit the search to include "الاردن." The search query yielded many more results in Arabic than when we searched for " الأمان النووي" (*al'amaan alnawawi*) but slightly fewer than the outputs of the English query. However, similar to the security searches in Arabic, the majority of the items were news articles spanning additional news websites such as AlNasNews, AlBawaba, and AlArrabNews. The articles reported on themes related to nuclear safety, such as Jordan abiding by safety standards according to IAEA inspectors, and international cooperation to regulate nuclear and radiological safety.
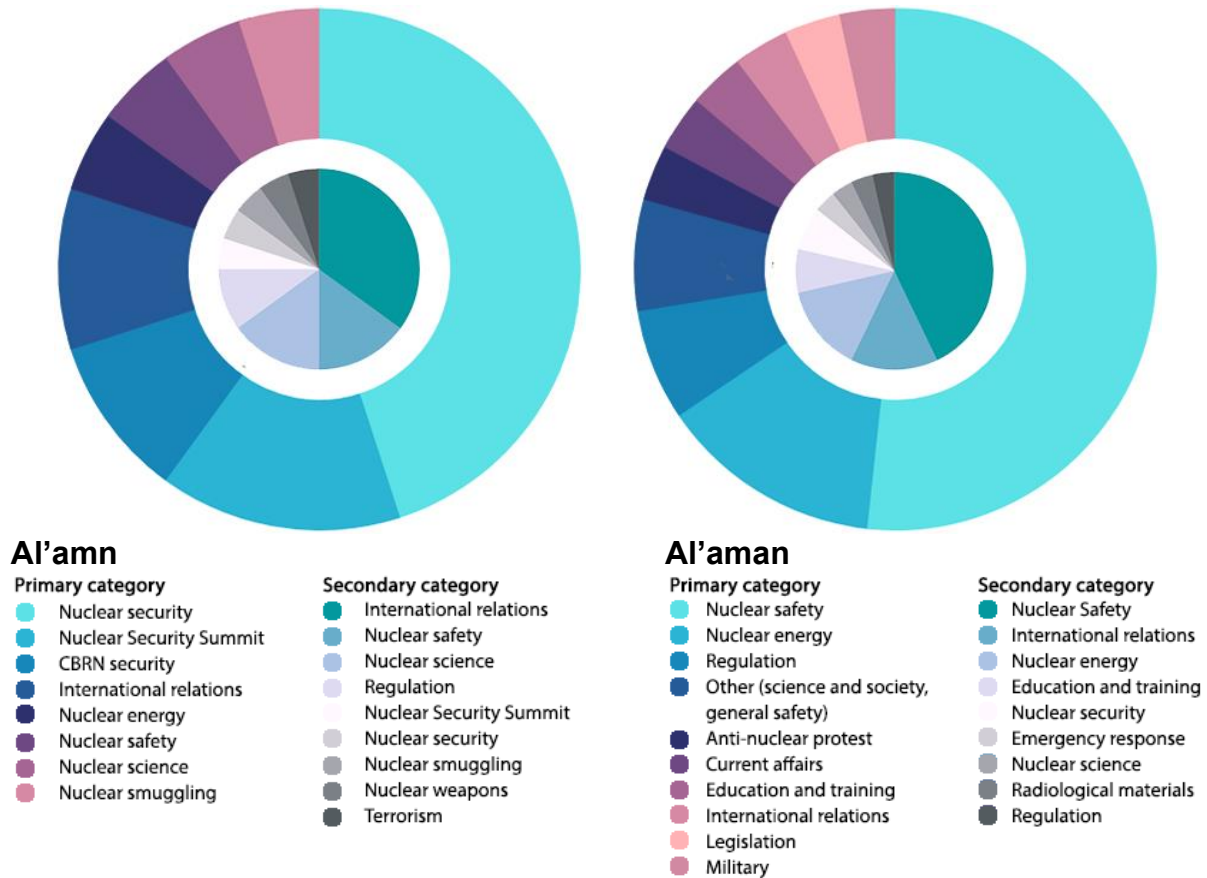
Figure 6. (a) Open-source internet search for "Nuclear Security" (*al'amn* alnawawi) in Jordan— Arabic. (b) Open-source internet search for "Nuclear Safety" (*al'aman alnawawiu*) in Jordan— Arabic.

It is important to note that the phrase "السلامة والأمان النووي" (*alsalama wal'amaan alnawawi*, "safety and nuclear safety") is also commonly used when addressing nuclear safety topics. The terms "سلامة" (*salama*) and "أمان" (*amaan*) are often mentioned together without a specific or intuitive linguistic indication if grouping them adds or alters their individual meanings. Another term used in the nuclear safety field is "الوقاية الأشعاعية" (*alwiqaya al'ish'a'ya*, "radiation protection"). Searching for this exact term and narrowing the search results for region and language (Jordan and Arabic, respectively) yields mostly news items addressing the topic of radiation protection in industrial applications, agriculture, and medicine. Additionally, it shifts the focus from talking about nuclear energy to the effects of radiation on human beings, food, and medicine. Out of 32 results, only 1 was a duplicate from the previous search.

Overall, the English language searches for "nuclear security" and "nuclear safety" resulted in more sources than the Arabic searches. The primary open sources of information on nuclear security and safety in Jordan are news articles, many of which were copied from one site to the other. If in Arabic, they were sometimes translated from English into Arabic (rather than vice versa). There were hardly any academic or industry results: the only industry-related result linked to the Middle East Scientific

Institute for Security, as well as in the safety search, was this result, and it this only came up in English, not Arabic.

Variation in keywords was more significant than in the other two countries and languages we had investigated. In particular, the use of the definite articles differs significantly between Arabic and non-Arabic writing, and Arabic uses more synonyms for safety and security than the other languages we considered. The question is, of course, how much the search output relates to Jordan and how much relates to Arabic. As a test, we applied the same search method to the United Arab Emirates (not rigorously collecting data), which showed a higher volume of results but similar language-related obstacles. This research area is undoubtedly the next avenue we will explore.

4. Conclusions and Recommendations

The three case studies have helped identify the confusions and pitfalls that can arise in languages that do not distinguish between the concepts of nuclear safety and nuclear security. The findings from Jordan's Arabic case study showed relatively greater variation in the semantic, web-styled search compared with non-Arabic searches from Turkey and India. With the lack of intelligible shorthand keywords across native and nonnative languages, a logical translation from source to target language seems less rendering and probable. To improve the overall interpretation and translation, nuclear sector experts should work to develop concise, harmonized nuclear knowledge and make it accessible to all relevant organizations, as well as on an international scale.

Overall, in these three case study countries, we found that openly available information on nuclear security is scarce; less information is available in the local languages, and mistranslation is a source of confusion. Crucially, online information is limited in its usefulness. Many sources of information are classified or embedded within company or organization information systems that are not publicly shared. Inevitably, some information is only available in printed or spoken form rather than digitally. Although this is, of course, essential to the maintenance of a strong nuclear security culture, it is also important to reflect on areas where it may be useful to improve transparency. Education and other training are particular areas of interest here. We want to encourage the nuclear community to look beyond internationally dominant languages in acquiring and publishing information in the first place, contributing to the clarification of the language of nuclear security, and enhancing global nuclear security practices. This research will allow newcomers to the field to orient themselves more clearly, and it will allow outsiders such as journalists to report on nuclear issues more accurately.

Based on these conclusions, we would like to make the following three practical policy recommendations regarding the language of nuclear security.

1. *Building nuclear security terminology:* Confusion and pitfalls can be avoided by more conscious, descriptive, and uniform use of terms across languages. The international nuclear community should work toward a robust nuclear security glossary, which will greatly facilitate discourse and interpretation. This glossary

should not only factor in the literal translation efforts from one language to another. Instead, there must be the flexibility to accommodate the richness of language, which entails engaging with solutions offered by experts and practitioners. This glossary is particularly relevant to problems faced by nuclear newcomers such as Jordan because it allows for the emergence of novel meanings.

2. *Working on a communicative approach to translation:* It is not enough to master a specific set of professional vocabulary and meanings. It is also important to understand the power of words in influencing the thoughts and behaviors of people and the relationship of words to other aspects of communication. The ability to communicate in the appropriate language and awareness of specific meanings and connotations in that language can not only make a difference when it comes to respect and trust but also clarity and significance. The discussion of Turkish showed that nuclear security practices can be enhanced and expanded by the cultural and political histories of the participants' language.

3. *Addressing bias stemming from language:* Appreciation of specific meanings, values, and ideas can be addressed by raising awareness of both target and recipient culture. Restriction and exclusion can occur when the materials are only available in one language, especially if it is not the native language of the target audience—as demonstrated in the India case study, there can be *colonizing influence* (i.e., bias towards *dominant* cultural value systems). It is important not to operate under the assumption that one system is right (e.g., the more experienced speaker) and that others need to adapt. Nuclear security should be examined from all perspectives—meaning all languages—to reach a common understanding in support of the ultimate goal: the security of people and materials.

5. References

1. Hobbs, C.; Moran, M. Insider Threats: An Educational Handbook of Nuclear and Non-Nuclear Case Studies. King's College London: London, 2015.
2. International Atomic Energy Agency. *Nuclear Safety and Security in Ukraine*. https://www.iaea.org/nuclear-safety-and-security-in-ukraine (accessed 2023).
3. Varonis, E. M.; Gass, S. M. Miscommunication in Native/Nonnative Conversation. *Language in Society* **1985**, *14* (3), 341. DOI: 10.1017/S0047404500011295.
4. Homan, Z. S.; Tzinieris, S. T.; Udum, S. Nuclear Security for Newcomer Countries. In *The Oxford Handbook on Nuclear Security*; C. Hobbs, S. T. Tzinieris, S. K. Aghara, Eds.; Oxford Handbooks; Oxford University Press: Oxford, 2023 (forthcoming). DOI: 10.1093/oxfordhb/9780192847935.001.0001.
5. Homan, Z. S.; Udum, S. (2019). The Influence of Language on Nuclear Security Education and Training. In *Institute of Nuclear Materials Management Annual Meeting Proceedings*, Vol. 60. Institute of Nuclear Management: Mount Laurel, 2019.

6. Homan, Z. S.; Dewey, K.; Mirza, E.; Set, S. *Communicating Deterrence: Drivers of Misperception in India and Pakistan*; King's College London: London, 2021.

7. Homan, Z. S.; Rane, S.; Shaban, Y. The Language of Nuclear Security: Language Diversity in Open Source Internet Searches. *The International Journal of Intelligence and CounterIntelligence* **2023**, *36*, 870–891.
DOI: 10.1080/08850607.2022.2074282.

8. Homan, Z. S.; Shaban, Y.; Rane, S.; Özkan, F. Ö. The Language of Nuclear Security: Learning and Teaching Nuclear Language. In *Institute of Nuclear Materials Management Annual Meeting Proceedings*, Vol. 62; Institute of Nuclear Materials Management: Mount Laurel, 2021.

9. Daya, P. *Managing Nuclear Knowledge with Semantic Technologies*, 2021. International Atomic Energy Agency.
https://www.iaea.org/newscenter/news/managing-nuclear-knowledge-with-semantic-technologies.

10. Zanettin, F. The deadliest error: translation, international relations and the news media. *The Translator* **2016**, *22* (3), 303–318.
DOI: 10.1080/13556509.2016.1149754.

11. Fisher, M. *World Science Day: International Nuclear Information System Highlights Open Access*, 2019. International Atomic Energy Agency.
https://www.iaea.org/newscenter/news/world-science-day-international-nuclear-information-system-highlights-open-access.

12. International Atomic Energy Agency. *Exploring Semantic Technologies and Their Application to Nuclear Knowledge Management*; IAEA Nuclear Energy Series; No. NG-T-6.16; International Atomic Energy Agency: Vienna, 2021.

13. Homan, Z. S.; Bricknell, M. C. M.; Leone, R. M.; Lelong, A. Analyzing International Military Medical Services: Developing a Methodology for Information Acquisition from Open Source Data. *International Journal of Intelligence and CounterIntelligence* 2020, 34, 235–258. DOI: 10.1080/08850607.2020.1807781.

14. International Atomic Energy Agency. IAEA Nuclear Safety and Security Glossary: Terminology Used in Nuclear Safety, Nuclear Security, Radiation Protection and Emergency Preparedness and Response; 2022 (Interim) Edition; International Atomic Energy Agency: Vienna, 2022. https://www-pub.iaea.org/MTCD/Publications/PDF/IAEA-NSS-GLOweb.pdf.

15. World Nuclear Association. *Emerging Nuclear Energy Countries*. https://world-nuclear.org/information-library/country-profiles/others/emerging-nuclear-energy-countries.aspx (accessed 2021).

16. World Nuclear Association. *Nuclear Power in India*. https://world-nuclear.org/information-library/country-profiles/countries-g-n/india.aspx (accessed 2021).

17. International Atomic Energy Agency. *Country Nuclear Power Profiles: Türkiye*. https://cnpp.iaea.org/ countryprofiles/Turkey/Turkey.htm (accessed 2022).

18. Kumbaroğlu, G. Turkey and Nuclear Energy. In *Turkey's Nuclear Future*; G. Perkovich, Sinan Ülgen, Eds.; Carnegie Endowment for International Peace: Washington, DC, 2015.

19. International Atomic Energy Agency. *IAEA Completes Nuclear Security Advisory Mission in Turkey*, 2021. https://www.iaea.org/newscenter/pressreleases/iaea-completes-nuclear-security-advisory-mission-in-turkey.

20. Ozfidan, B.; Burlbaw, L. M.; Aydin, H. The Minority Languages Dilemmas in Turkey: A Critical Approach to an Emerging Literature. *Journal of Educational Issues* **2018**, *4* (1). DOI: 10.5296/jei.v4i1.11498.

21. Savaşkan, I. Turkey's Place in the Rankings of The English Proficiency Index. *Journal of Teacher Education and Educators* **2016**, *5* (2), 192–208.

22. Indian Ministry of External Affairs. *Nuclear Security in India*, 2019. https://www.mea.gov.in/Images/pdf/Brochure.pdf.

23. Mishra, S.; Jacob, H. *Nuclear Security Governance in India: Institutions Instruments and Culture (2019)*; SAND2020-10916; Sandia National Laboratories: Albuquerque, New Mexico, 2020.

24. Sarkar, J. Ploughshares and Swords: India's Nuclear Program in the Global Cold War; Cornell University Press: Ithaca, New York, 2022.

25. Nuclear Threat Initiative. *Indian Nuclear Weapons Program*, 2019. https://www.nti.org/countries/india/.

26. Government of India. *2011 census of India*. https://censusindia.gov.in/nada/index.php/catalog/42458/download/46089/C-16_25062018.pdf.

27. Government of India. The Atomic Energy Act, 1962; No. 33 of 1962; Government of India: India, 1962.

28. Government of India. The Official Secrets Act, 1923; No. 19 of 1923; Government of India: India, 1923.

29. Borja, L. J.; Ramana, M. V. Command and Control of India's Nuclear Arsenal. *Journal for Peace and Nuclear Disarmament* **2020**, *3* (1), 1–20. DOI: 10.1080/25751654.2020.1760021.

30. Jordan Ministry of Energy and Mineral Resources. *Updated Master Strategy of Energy Sector in Jordan for the period 2007–2020*. https://www.memr.gov.jo/EBV4.0/Root_Storage/EN/EB_Info_Page/energystrategy.pdf.

31. World Nuclear Association. *Nuclear Power in Jordan*, 2021. https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx.

32. Global Changemakers. Interview: HE Khaled Toukan, Head of Nuclear Commission. YouTube, 2009. https://www.youtube.com/watch?v=EFepY9Czc9E&t=221s&ab_channel=GlobalChangemakers (private video).

33. Shank, M. A. Khaled Toukan reveals to Roya his salary and the salaries of the employees of the Atomic Energy Authority. *RoyaNews*, January 21, 2021. https://royanews.tv/news/235753?fbclid=IwAR0Pw8yA_axjjBj1lGi6zNKmUeWyBfpLA2B-XH23N7PFe6T4t4PtFnSo-DM.

34. Dixit, A. (2019). Safety from start to finish: A tour through Jordan's research reactor facility. *IAEA Bulletin* **2019**, *60* (4). https://www.iaea.org/bulletin/safety-from-start-to-finish.

35. World Nuclear News. *Jordan announces uranium production*, 2022. https://www.world-nuclear-news.org/Articles/Jordan-announces-uranium-production.

36. Jordanian Armed Forces. Jordan Nuclear Security Measures. Presented at the International Conference on Nuclear Security: Commitments and Actions, Vienna, Austria, 2016. https://mission-vienna-io.mfa.lt/uploads/mission-vienna/documents/Naujienu_dokumentai/Jordan%20Nuclear%20Security%20Measures.pdf.

37. Nuclear Threat Initiative. *The CNS Global Incidents and Trafficking Database Archived Reports and Graphics.* https://www.nti.org/analysis/articles/cns-global-incidents-and-trafficking-database/ (accessed 2020).

38. Suleiman, Y. The Language Ecology of the Middle East: Jordan as a Case Study. In *Encyclopedia of Language and Education*; N. H. Hornberger, Ed.; Springer: Boston, Massachusetts, 2008.

39. Jordan Ministry of Energy and Mineral Resources. *Annual Report 2016.* https://www.memr.gov.jo/ebv4.0/root_storage/en/eb_list_page/annual_report_2016.pdf.

40. Wardam, B. *The Eventual Meltdown of the Nuclear Program in Jordan*, 2014. 7iber. https://www.7iber.com/2014/01/the-eventual-meltdown-of-the-nuclear-program-in-jordan/.