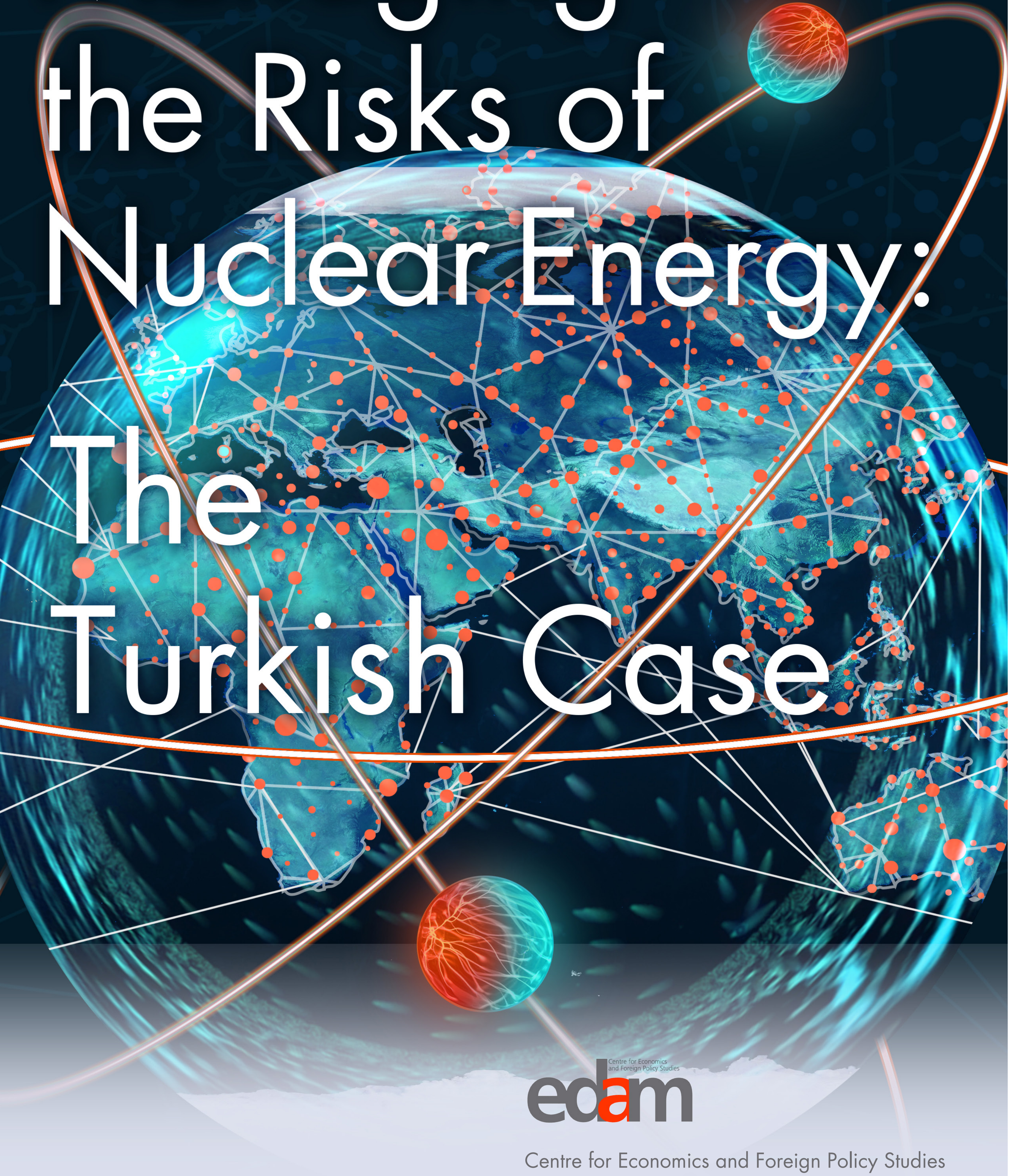
Managing the Risks of Nuclear Energy: The Turkish Case



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MANAGING THE RISKS OF NUCLEAR ENERGY: THE TURKISH CASE

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Introduction

With this set of papers, EDAM intends to make another substantive contribution to the overall knowledge on the policies that are being shaped for the transition to nuclear power in Turkey. Since the decision was made back in 2010 to switch to nuclear power with an intergovernmental agreement with Russia, EDAM has decided to deepen the knowledge available to policymakers but also to wider civil society on the different aspects of nuclear energy. Since then, EDAM has been publishing regularly on the safety, security and non-proliferation aspects of Turkey's nuclear power program. EDAM's ongoing work on nuclear energy intends to contribute to the public debate on nuclear energy by providing a thorough and impartial analysis on the state of play of Turkey's nuclear power program. This year's analysis breaks new ground by focusing on some under-explored dimensions of this program. The collection of policy papers incorporated in this book examines the policies related to the physical security of nuclear power plants, Turkey's accident and consequence management approach, the transport security of fissile materials and nuclear waste, the financial, safety and security risks inherent in the unique Build-Own-Operate investment model that is to underpin the Akkuyu nuclear power plant project. The book also explores the prospects for regional cooperation in nuclear energy against the backdrop of the rekindled interest among regional states to acquire nuclear power plants.

It is our firm belief that as a country that has decided to transition to nuclear power, Turkey should adopt best regulatory practices to mitigate the risks inherent in nuclear energy. That is the reason why our focus has been to critically analyze the current policy so as to determine existing gaps which eventually shape the set of recommendations included in our reports. We believe that such an unbiased analysis that embodies a constructive criticism of the ongoing nuclear power program is instrumental in helping to shape not only better public policies but also in focusing the public discussion on the real and critical issues faced by this burgeoning program.

Finally, I would like to express my gratitude to the Stanton Foundation whose support has been instrumental in allowing EDAM to continue its analytic work on this important topic.

Sinan Ülgen

Executive Chairman – EDAM

About EDAM

The Centre for Economics and Foreign Policy Studies (EDAM) is an Istanbul based independent think-tank. EDAM's main areas of research are:

- Foreign policy and security,
- Turkey-EU relations,
- Energy and climate change policies
- Economics and globalization,
- Arms control & Non-proliferation,
- Cyber policy.

EDAM aims to contribute to the policy making process within and outside Turkey by producing and disseminating research on the policy areas that are shaping Turkey's position within the emerging global order. In addition to conducting research in these fields, EDAM organizes conferences and roundtable meetings. Additionally, EDAM cooperates with numerous domestic and international to conduct joint-research and publications.

Organizational Structure

EDAM brings together a network of members from multiple sectors of Turkish society including academia, civil society, media and business. This diversified representation enables EDAM to create a productive and effective platform through which different visions and perspectives can interact.

EDAM's Executive and Supervisory Board consists of members from the academia, business community, civil society and media. Board members are assigned to supervise research projects in order to ensure their academic and editorial quality. While EDAM staffs a small number of permanent researchers, it also reaches out to select Turkish and international researchers to form ad hoc research teams based on the projects that it undertakes.

EDAM relies on project-based funding, matching grants and institutional donations in order to carry out its projects, and hence maintains its editorial independence. Additionally, EDAM undertakes joint projects and research with various civil society and international organizations on the basis of the principle of shared funding.

About the Authors

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Physical Security of Turkey's Prospective Nuclear Infrastructure: Outlook and Challenges

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1. INTRODUCTION

Nuclear facilities present very attractive targets for adversaries. Due to the potentially catastrophic effects on public health and psychology, economy, property and state stability and prestige, targeting nuclear facilities and nuclear material are tempting opportunities for terrorist organizations. Furthermore, as they may hold a considerable place in the overall electricity generation potential of a given country and may have severe effects on state capacity and public morale if targeted, nuclear facilities would present high-value strategic targets for adversarial states.

As Turkey is on the cusp of establishing its first nuclear power plant (NPP) in Akkuyu, it will have to give strong consideration to the potential threats to its prospective nuclear infrastructure and the security measures to overcome them. This would be a momentous task already, as Akkuyu is placed proximate to a number of state and non-state threats, including those emanating from the Syrian Civil War and the traditional areas of operation of the Kurdish terrorist movement that the country has had to deal with for over three decades. Furthermore, during their transportation, nuclear fuel and waste are likely to transit through major population and financial centers. Yet as the facility will be built, owned and operated (BOO) by the Russian state-owned company Rosatom, in a first for the global nuclear industry, Turkey has to formulate ways of making these strategic arrangements in unison with state that is a fickle partner and a traditional rival.

This paper will examine the collaboration between Turkey and Russia necessary to securely and safely operate the Akkuyu plant, and the challenges to this collaboration. It sets off by briefly introducing the core concepts in securing nuclear facilities. It then moves on to the three areas of significance, namely, sketching the design basis threat, determining on-site security arrangements and thwarting insider threats. The paper concludes by identifying overarching themes and providing recommendations.

2. AN INTRODUCTION TO NUCLEAR POWER PLANT SECURITY[1]

2.1. Radiological Sabotage

Radiological sabotage potentially represents the biggest threat to a country's civilian nuclear infrastructure. Though nuclear facilities are built with numerous safety measures in place, and have been improved throughout the decades-long history of nuclear energy generation, there remain three key vulnerabilities that may result in significant radioactive leakage. These vulnerabilities stem from systems that control the chain reaction, which if damaged could result in damage to the core, nuclear fuel cooling systems, which prevent the fuel from melting even after the chain reaction has been stopped, and storage facilities for spent nuclear fuel that is highly radioactive.[2] Such sabotage may likewise target nuclear fuel and waste in transit, and may, albeit with less adverse consequences compared to a core meltdown, inflict considerable damage by contaminating a given area and rendering it unsuitable for use until the area has been decontaminated. Adversaries may have numerous potential means, including distractions, variety of tools and firearms, access to insiders, car bombs, deliberate plane crashes, cyber-attacks, missiles, so on and so forth, necessitating a holistic approach to physical security of nuclear facilities and material. As such, whilst 4th generation nuclear facilities, such as the one that will be built in Akkuyu, have numerous passive safety and security systems to prevent or delay worst-case scenarios, a capable adversary may inflict considerable damage by employing variegated means of attack.

2.2. Theft or Diversion

It is quite unlikely for terrorist organizations to possess technical capabilities and material necessary to construct a functional nuclear warhead. Still, numerous illicit shipments of radioactive material (a considerable portion of which was uranium with different levels of enrichment) have been intercepted by states throughout the 1990s and 2000s, most of which had originated from poorly guarded ex-Soviet nuclear facilities. Furthermore terrorist organizations, including al-Qaeda[3] have sought to capture nuclear material through the black market or have reportedly targeted nuclear facilities with the potential aim of stealing warheads or material.[4] Nonetheless, the more likely threat emanating from the theft or diversion of sensitive nuclear and radiological material is that this may allow terrorists to construct radiological dispersion devices (RDD) – dirty bombs. Whilst not all radiological material used or produced in nuclear facilities are readily useable by terrorists for making such devices, it has been suggested that cobalt-60, strontium-90, iridium-192 and cesium-137 isotopes may cause great risks based on their half-life, portability and prevalence.[5] Furthermore, it should be noted that for the purposes of terrorism, even if terrorists do not succeed in capturing weapons grade or quantity material, their success in penetrating a nuclear facility or intercepting a shipment would have immense psychological impacts on the target population and erode trust towards the state and its security forces.

2.3. *Transportation Security*

Nuclear and radiological material are most vulnerable to sabotage and theft whilst being transported. During transport, the material are mostly not under the protection of static defenses as they are when within the premises of a facility. The distance travelled, terrain type and the mode of transportation used all factor into this vulnerability, as adversaries may set up traps, ambushes or gain access to secret information regarding the transit schedules and planned security measures. Furthermore, as Russia will most likely be in charge of the fuel and waste operations, the Bosporus Straits will likely be used to transit nuclear material. Thousands of vessels transit through or in between the two sides of the Straits daily.[6] Moreover, the Straits lie in the middle of the biggest city of Turkey, Istanbul, which hosts one sixth of the population and provides a quarter of the gross domestic product.[7] As such, a deliberate attack targeting the material in transit may have considerable damages to public health, the economy and the environment – as discussed in depth in the respective chapter on transportation security of this volume.

2.4. *Sensitive Information*

The acquisition of sensitive information on nuclear technology by adversaries is another risk facing nuclear facilities – though it should be noted that this is a more dire threat for nuclear weapons facilities rather than NPPs, such as Akkuyu. The bigger threat facing Akkuyu would be for the adversaries to acquire information about the physical security measures and on-site security forces of the facility or nuclear material transportation schedules, routes and precautions – as such information would significantly increase the chances of a successful sabotage or theft attempt. Another such critical information would be personal information about facility employees, from nuclear scientists to security personnel, as this information can be used to plot assassinations or "turn" such employees into insiders through coercion or bribery. These types of sensitive information can be acquired mainly through theft (infiltration or cyber-attacks), the active or passive assistance of an insider or malpractices of facility employees and officials regarding information security. As the facility will host a considerable amount of temporary and permanent contractors and employees during its construction and operation, both Turkish and Russian, the potential threats or *weakest links* will be ever changing. For Akkuyu, this number is expected to reach over 12,500 at its peak,[8] making it difficult for officials to comb through for collaborators.

3. DESIGN BASIS THREAT

Faced with the aforementioned risks, states hosting NPPs have to draw comprehensive physical protection plans based on an accurate understanding of the sources and the features of potential threats. These assessments, referred to as the Design Basis Threat (DBT) are described by the International Atomic Energy Agency (IAEA) as follows:

> "A DBT is a description of the attributes and characteristics of potential insider and outsider adversaries who might attempt a malicious act, such as unauthorized removal or sabotage against which a physical protection system for nuclear or other radioactive material or associated facilities is designed and evaluated."[9]

A DBT does not consist solely of the potential means that adversaries may have but also incorporate an exhaustive approach by factoring in motives, intentions, capabilities, assets and skills. Due to their sensitive nature, design basis threats of countries are highly classified. For example, readily available information about the DBT requirements of the U.K.'s Nuclear Directorates Office for Civil Nuclear Security are mainly limited to suggesting that terrorists may use car bombs to penetrate facilities, and may be prepared to kill themselves or risk getting discovered.[10] The U.S. Nuclear Regulatory Commission (NRC) provides a more detailed account by suggesting that adversaries may consist of multiple groups attacking through multiple locations, may be well-trained, in possession of suitable know-how, equipment and weapons, willing to kill or be killed, able to utilize land or water vehicles (rigged with explosives or for transport), may conduct cyber-attacks and have access to insiders.[11] For its own accord, the IAEA suggests that the competent authority of the state and other participants in the threat assessment process should at least consider the following for each identified internal and external threat:

" · **Motivation**: political, financial, ideological, personal;
- **Willingness** to put one's own life at risk;
- **Intention**: radiological sabotage of material or of a facility, theft, causing public panic and social disruption, instigating political instability, causing mass injuries and casualties;
- **Group size**: attack force, coordination personnel, support personnel;
- **Weapons**: types, numbers, availability;
- **Explosives**: type, quantity, availability, triggering sophistication, acquired or improvised;
- **Tools**: mechanical, thermal, manual, power, electronic, electromagnetic, communications equipment;
- **Modes of transportation**: public, private, land, sea, air, type, number, availability;
- **Technical skills**: engineering, use of explosives, chemicals, paramilitary experience, communications skills;

- **'Cyber' skills**: skills in using computer and automated control systems in direct support of physical attacks, for intelligence gathering, for computer based attacks, for money gathering, etc.
- **Knowledge**: targets, site plans and procedures, security measures, safety measures and radiation protection procedures, operations, potential use of nuclear or other radioactive material;
- **Funding**: source, amount and availability;
- **Insider threat issues**: collusion, passive or active involvement, violent or non-violent engagement, number of insider adversaries;
- **Support structure**: presence or absence of local sympathizers, support organization, logistical support;
- **Tactics**: use of stealth, deception, or force."[12]

Nonetheless, even in the absence of a DBT based assessment, both the state and the operator will need to have physical protection measures in place for the facility and sensitive materials due to the high risks involved. As such, it is important to assume that the adversary or adversaries that are willing to target the nuclear infrastructure understand the conditions of deterrence (are aware of the risks they are facing) and would not strike without a perceived chance of succeeding. In other words, with the strong assumption that there will be at least rudimentary security measures in place, it is hard to expect opportunistic individuals to cause any harm – as has happened occasionally in the context of orphan radioactive sources, which have been stolen for profit or simply to sell as scrap metal. As such, adversaries willing to target nuclear facilities or respective nuclear and non-nuclear sensitive materials are very likely to have means, tactics and assistance that could potentially enable them to wholly or partially achieve their goals.

3.1. Division of Labor in Design Basis Threat

Another main aim of the DBT is to determine the scope of the operator's role in securing the nuclear infrastructure. Overall, the main division of labor between the operator and the state and its respective authorities is that the operator is in charge of ensuring on-site security, while the state is tasked with maintaining off-site security and act as a backup in case on-site security measures are not enough to overcome the threat posed. Nonetheless, there are differences in the interpretations of what the operator's role should be. While some threats, such as missile strikes, shelling and airstrikes of adversarial nations may clearly be the role of the host state, others, such as deliberate aircraft crashes by terror organizations, may be more debatable. The interpretations depend on the host state and are clarified via their respective regulations.

Drafting the DBT requires the participation of multiple actors, including the political leadership, competent authorities, intelligence services and armed forces and other respective actors. On the top of the chain, the IAEA[13] suggests that the political leadership should ensure that the competent authority/authorities have the necessary skills, authority and access to appropriate information. Moreover the leadership is tasked with ensuring that appropriate state organizations are involved in the process, and that their roles are specified. Lastly, the state should guarantee that the operator and state institutions that are tasked with providing security against the DBT are effectively integrated. The intelligence services, or organizations that collect intelligence as part of their duties, such as the Ministry of Foreign Affairs, law enforcement and military bodies, are responsible for gathering and providing information on potential threats, and ensure the credibility of the threat assessment and data that constitutes the foundation of the DBT.

The competent authority gets the lion's share in developing the threat assessment that will form the basis of the DBT. According to the IAEA, the authority should coordinate the development of the DBT, document assumptions and decisions, and ensure that its conclusions are consistent with existing legal, legislative and regulatory requirements. In cases where existing regulations do not provide state bodies with the necessary framework for assuming their role in complementing the physical protection/mitigation arrangements, the competent authority is tasked with taking steps to improve the regulatory framework. Furthermore, the competent authority is tasked with gaining consent for the DBT from all relevant state organizations, disseminating the DBT, determining how it will be reviewed, maintained and updated, and deciding upon and upholding the confidentiality rules and security measures for the information provided for and contained in the DBT.[14] The operator, on the other hand, is tasked with providing feedback on the potential impacts of the decisions pertaining to the DBT if requested, providing additional information on insider threats or any adversarial incidents, and developing necessary protective measures against the DBT.[15]

3.2. Turkish Progress at Laying the Groundwork for its Design Basis Threat

The most definitive document in the current Turkish legislation is the Regulation on the Physical Protection of Nuclear Facilities and Nuclear Materials,[16] penned by the Turkish Atomic Energy Authority (TAEK). According to Article 9 of the law, TAEK acts as the coordinating authority to decide upon the DBT with the representatives of the organizations that have a seat in the National Security Council (MGK), and other related branches and agencies. The MGK consists of the President, Prime Minister, Chief of Staff, Deputy Prime Ministers, Minister of Justice, Minister of National Security, Minister of the Interior, Minister of Foreign Affairs and Commanders of the Land Forces, the Navy, Air Forces and Gendarmerie. Representatives from other governmental bodies, such as the National Intelligence Agency (MİT), may also be present at bi-monthly meetings but have no voting rights on the decisions that are taken on the MGK. Once the DBT is decided upon, it is reported to the (legal or actual) authorized person[17] (in this case the operator) with a "Top Secret" classification. The Top Secret document is only disclosed on a need to know basis to the persons involved in drafting it and the authorized person and respective personnel in charge of running and securing the nuclear facility. The DBT is renewed in extraordinary conditions or no later than five years in ordinary conditions.

According to Article 10, the operator is then tasked with establishing the physical security system, which includes information on the chain of command, facility plans, personnel tasked with ensuring physical security and their training, procedures on how to respond to intrusions, the physical protection emergency response plan, and all elements of the physical protection system, including those on transportation security. Until TAEK approves the Top Secret physical protection plan for both the facility and the transportation of nuclear materials, the facility may not begin its operations and no nuclear material may be transferred to the facility. The physical protection program should be submitted during the licensing process, along with the construction license application according to Article 11.

The document resembles its international equivalents in many ways, including those published by the IAEA and the NRC. Some examples include the specifics of transportation security plans, central alarm stations, classification of nuclear materials and respective protective measures, separation of the facility into different zones of protection, and the inclusion of concepts such as defense-in-depth. Furthermore, the regulation has addressed some detailed scenarios, some of which include clauses on: the security of depleted nuclear material unfit to use as fuel or in any other way in the facility, ensuring that drills, exercises and evacuations do not jeopardize the security of nuclear material, maintaining highly sensitive information that could be used in sabotage and theft, and keeping logs of alarm and intrusion detection systems for at least five years. For the purposes of this paper, the authors will not go into extensive detail about the document itself, but will rather highlight areas of the Turkish resolution that would necessitate close cooperation with the Russian operator.

First of all, the document oversees a close cooperation between Turkish law enforcement forces and the operator. In line with international norms, the operator is in charge of taking necessary precautionary measures against theft or loss of nuclear material or sabotage against nuclear facilities, reporting any incident immediately to the Turkish authority – TAEK. Furthermore, the operator is tasked with providing a detailed incident report within 15 days after the incident. Yet even before all of this is possible, the operator is tasked with reaching out to Turkish law enforcement in order to sign a written agreement on the nature of the cooperation between the sides, one that clearly defines the tasks, responsibilities, exercises and other related aspects of physical security.[18] Moreover, the operator is responsible for preparing an emergency response action plan that includes the training of on-site security forces and Turkish law enforcement that would fight against an intrusion or theft attempt, according to Article 23.5. The cooperation between the sides is to be strengthened with regular exercises, and the operator is responsible for training all facility personnel to be ready for cooperating with Turkish law enforcement and other personnel related to nuclear security. This cooperation is to continue throughout the facility's operation, such as during afterhours when the personnel responsible for on-site security or the central alarm station have to report to Turkish law enforcement in regular intervals – and if they are unarmed, on-site personnel have to facilitate the response of Turkish law enforcement in cases of armed attacks – according to Article 24.9.

Secondly, with regards to transportation security, the document outlines the inclusion of numerous stakeholders into the equation. These include the Coast Guard, which is tasked with protecting and escorting the shipments of nuclear material throughout the time it spends in Turkish waters. Once on land, the 'sender' of nuclear material, which in this case will likely be Rosatom or another Russian entity, has to collaborate with all of the local administrative officials and law enforcement agencies along the planned route of transportation.[19]

Furthermore, the 'sender' and the 'receiver' of nuclear material have to report their division of responsibility and arrangements for physical security to TAEK no less than 14 days prior to sending the nuclear material, and information about the personnel that will be involved in the transportation process to be used in background security checks no less than 21 days.[20]

The third crucial part of the document is what happens if the operator fails to comply. Representatives of TAEK have the responsibility of conducting announced and unannounced inspections and demanding access to all areas, personnel and information as part of their inspections. Furthermore, if anything is out of place, the inspectors have the authority to demand the operator to take measures directly. The operator is also tasked with conducting its own internal inspections twice a year and exercises every year, and submit reports on their results with a Top Secret classification to TAEK. According to Article 41, in case the operator fails to comply, TAEK has the right to permanently or temporarily revoke the license of the operator and withhold nuclear material in the facility.[21]

3.3. Design Basis Threat and Potential Issues with the Build-Own-Operate Model

The initial challenge that Turkey will face with regards to drafting a DBT for Akkuyu stems from the clandestine nature of the threat analysis. To compose the DBT, Turkish authorities will have to accumulate comprehensive amounts of intelligence analyses regarding potential terrorist and criminal organizations that might have the motive and means to target Akkuyu or its nuclear material. Not only will the authorities focus on operatives of terrorist organizations and criminal networks, but also they will have to compile background information pertaining to prospective facility employees and contractors – as will be discussed below in more depth. To ensure that the operator has the necessary preparations to counter design basis threats, Turkish authorities have to share this Top Secret information with its representatives. Furthermore, they have to keep sharing this information and update the DBT accordingly based on the shifting threat landscape in both Turkish territory and Syria, and to some extent, Iraq. As the operator will primarily be a Russian state-owned company, this would be akin to sharing sensitive information with Moscow directly. When Russia and Turkey signed the intergovernmental agreement on Akkuyu, the relationship between the sides was booming, and Turkey's historical rivalry with Russia, and the fact that Turkey was a member of NATO might have seemed as issues that could potentially be circumvented. Yet as tensions between Russia and NATO have incrementally built up over Russian involvement in Ukraine, Eastern Europe and NATO's Southern Flank, the possibility of sharing NATO intelligence with Moscow seems dim. This was further exacerbated by the historically high levels of tension between Turkey and Russia that stemmed from Russia's involvement in the Syrian civil war in direct opposition to Turkish interests, and the downing of the Russian warplane for its violation of Turkish airspace. Moreover, Russia is currently in close collaboration with the Syrian Kurdish Democratic Union Party (PYD), which Turkey considers as a threat due to the PYD's ties to the Kurdistan Workers' Party (PKK) that has posed the biggest existential threat to the unity of the Turkish state for the last three decades – and may be one of the usual suspects of a potential attack to the

Akkuyu site, according to the analysis of the authors.[22] Even against the backdrop of the current rapprochement between Turkey and Russia, how and how much information Turkey will share with the operator appear as considerable challenges.

As noted in the IAEA publication on Design Basis Threat, once handed the DBT, the operator may have feedback regarding its application out of operational concerns. Turkey has no experience running a nuclear operation of this magnitude, as opposed to the Russian side which has operated dozens of reactors. Hence, the feedback from the operator may be valuable in fine-tuning the measures that the Turkish side deems necessary. On the other hand, the operator may have objections arising from the financial burdens of the security measures against Turkey's threat perceptions. In this scenario, the Turkish side may be recalcitrant to take the operator's concerns into consideration. Alternatively, it may accept the operator's demands due to its own inexperience or political pressures to speed up the facility's licensing process, depending on how Turkish-Russian relations fare. In fact, before things went south and Ankara and Moscow were at the heyday of their relations, one potential source of concern was that the politicization of the Akkuyu project due to the nature of the initial deal and the ownership of a state-owned firm, could be detrimental to safety and security measures – as discussed in other chapters of this volume.

Transportation security, which is discussed in more depth at the respective chapter of this volume, also warrants close cooperation between the operator and Turkish authorities. Rosatom will have to collaborate with all of the local administrative officials and law enforcement agencies along the planned route of the nuclear material. The planned level of cooperation may once again be hampered due to political reasons. Furthermore, as TAEK, along with other Turkish authorities, will have to evaluate their intelligence and security assessments as well as the proposed physical security measures of the operator for each shipment against the actual threat of sabotage and theft, the intelligence sharing challenge may present itself yet again, unless necessary arrangements for standardizing and de-politicizing the issue are taken. Similar challenges may also present themselves when it comes to the overall cooperation between the operator and local law enforcement agencies proximate to the Akkuyu site, as the sides will have to collaborate closely on both ensuring the physical security of the facility and developing capabilities to do so. In addition to long-term collaboration, this may also entail the sharing of acute intelligence based on emerging threats. As such, the Turkish state will have to formulate ways of prompt and accurate sharing of intelligence analyses with the operator.

Ensuring effective supervision and compliance may also present challenges to the country. One major issue in this regard is the lack of experience on the Turkish side. Whilst Turkey has been dealing with a wide array of domestic and international terror organizations for decades, some of which have targeted critical energy infrastructure on numerous occasions,[23] the Akkuyu project will mark Turkey's first undertaking in this magnitude. Securing the transfer of nuclear material along high risk areas, ensuring that the facility, which will be proximate to the hotspots of major terrorist organizations such as the Kurdistan Workers' Party (PKK) and the Islamic State of Iraq and the Levant (ISIS, ISIL or Daesh), is operated securely, and conducting background checks on thousands of multinational employees will only be some of the issues that Turkish security forces and law enforcement have to deal with. Furthermore, although the Turkish Armed Forces have some dedicated CBRN units, these are primarily tasked with training other branches of the military or operating on the field against CBRN attacks, and thus are not fully suited for assisting in the physical security of the facility.[24] On the other hand, while TAEK has accumulated some experience in nuclear power through its research reactors over the decades, this will be the first time that the organization is put in charge of coordinating between Turkish security forces, intelligence community, administrative branches and a foreign company. Considering that TAEK currently does not appear to have the in-house capability of even reviewing the license applications of Rosatom – as evidenced by its reliance on outsourced technical support services[25] – it is unlikely for the organization to have sufficient expertise to fulfill all of the tasks on physical security entrusted upon it. As such, both the country's regulator and its security and intelligence community will have to jointly develop capabilities to address the existing lack of experience and strategic thinking vis-à-vis nuclear energy security. In order to ensure that it does not over-rely on the Russian side, Turkey may seek to enrich its capabilities in this regard through closer cooperation with international organizations, such as the IAEA or other nuclear countries, including its NATO allies with which Turkey already has strong military ties.

Under the current legislation, TAEK has been given the mandate to suspend or revoke the license of the operator in case of non-compliance. Yet this may not be as feasible as it appears on paper. The state-owned Russian operator will invest upwards of 20 billion USD for the facility and will continue to own this investment for six decades. With a sunk cost that high, it would be remarkable for TAEK to take any action against the operator without creating a political crisis between Moscow and Ankara. This is all the more true considering that TAEK is subordinate to the Prime Ministry, which is able to dictate the appointments and the budget of the regulator. Furthermore, if Turkish-Russian relations thaw eventually, TAEK may face considerable political pressure from the Turkish leadership to ease its criteria vis-à-vis how Akkuyu is managed and secured. As such, the authority direly needs to grasp its political autonomy, whilst complementing this with further accountability and transparency on its own end.

4. ON-SITE SECURITY

In line with the DBT, the operator is required to assemble a crew of on-site security personnel that would ensure the physical protection of the facility against any internal and external adversarial actions at all times. According to the IAEA, the primary aims of having guards that would patrol the premises are to deter adversaries, detect intrusions, visually inspect physical protection components, provide initial response, and supplement existing physical protection measures.[26] The host state is responsible for ensuring that the physical security measures, envisioned by the operator, include the presence of such guards, their training and cooperation with off-site response forces, as well as nuclear contingency response plans. These measures should also be put to test by the regulator at regular intervals through drills and force-on-force exercises – exercises during which participants split into groups of two or more as attackers and defenders in realistic contingency scenarios to test the applicability of planned response measures – to ensure that guards and response forces can respond to threats timely and effectively. The IAEA further encourages states to take similar measures when it comes to the protection of nuclear cargo, and to employ compensatory measures in cases where the host state's legislation does not allow the employment of armed guards.[27]

Physical protection measures aim to detect adversaries, delay their progress to reach their objective, and finally, to respond to the threat. As they are located within the facility, are familiar to the facility 'routine' and have access to numerous equipment, such as CCTVs and intrusion alarms, on-site guards act as integral parts of detection and delay measures. Nonetheless, a significant adversary will most likely conduct its own intelligence activities – even attempt to garner insider help – in order to assess and overcome the physical protection measures of the facility through guile, stealth and force. Thus, regardless of whether they are armed or not, on-site security forces may not necessarily have sufficient capabilities to respond to major adversarial attacks. In such scenarios, effective cooperation and coordination between on-site guards and off-site law enforcement and security forces belonging to the host government become vital.

Based on their national regulations and threat perceptions, individual states have their own preferences over how operators within their territories should structure on-site security forces. For example, until recently, Belgian nuclear power plants were only protected by unarmed private security guards, as they were not allowed to carry weapons under Belgian law.[28] On the other side of the spectrum, the United States Nuclear Regulatory Commission goes as far as detailing the varieties of weapons that guards should possess and have proficiency in using, including handguns, shotguns and semi-automatic rifles.[29] Overall, the U.S. nuclear industry employs close to 9,000 armed and trained security officers to guard its 100 reactors.[30] Yet, considering that security exercises at nuclear facilities have suggested that it "might take only three minutes for a well-trained attacker to penetrate sensitive parts of a nuclear power plant"[31] while off-site response forces could be delayed by traffic, weather or by ambushes and attacks of adversaries, it might be wise not to rely solely on off-site response forces.

4.1. On-Site Security in Turkish Legislation

According to the Akkuyu Environmental Impact Analysis Report (EIA), the project company envisions the employment of 100 personnel in charge of security and physical protection[32] in addition to an undisclosed number of guards. As the protection of the facility as well as the provision of on-site security forces and their training fall under the responsibility of the project company, the operator will be in charge of enlisting sufficient amount of qualified guards as well. Under current Turkish legislation, the operator will either have to contract an existing private security company based in Turkey or establish a company in the country in order to delegate this responsibility. According to Law no. 5188 on Private Security Services, whether foreign private security companies may operate in Turkey, whether foreign entities may establish private security firms in Turkey, and whether foreign nationals may be employed in such companies with the purposes of training new personnel, depend on the existence of reciprocal arrangements which fall under the purview of the Ministry of Foreign Affairs.[33]

Regardless of the Russian operator's ability to establish a company in the country, enlist a Russian private security company or decide to work with an existing Turkish private security company, decisions regarding the composition, training and authorities of the private security forces are taken by the local private security commission. This commission would be led by a deputy governor appointed by the governor of the given province, and consist of representatives from the provincial police headquarters, provincial gendarmerie command, provincial chamber of commerce and the provincial chamber of industry.[34] When applications to commence or terminate private security services are deliberated, the applicant is also represented at the meeting. Aside from this, the commission is responsible for determining which personnel may work at a private security company as well as the maximum quantity and attributes of arms and equipment they can possess and carry, and deciding upon alternative physical security measures and equipment when necessary. Decisions of the commission are made on the basis of the majority vote.

On the other hand, the governorship is tasked with running the background security checks on the security personnel, trainers and administrators of private security companies. The Ministry of Interior and governorships are also in charge of inspecting private security units, companies and firms that provide training to private security personnel. Furthermore, governors of provinces and districts have the authority to enlist the assistance of all public and private security personnel in order to protect public security, stipulated by the Provincial Administration Law (no. 5442). In cases where the provincial or local governor decides to evoke these authorities, private security forces have to follow the orders of the provincial (*vali*) or local governor (*kaymakam*) and the top ranking officer of the police forces in the given area.[35] Moreover, both the Ministry of Interior and governorates may conduct investigations on private security companies, units as well as private security training centers at any time to ensure that the conditions of the respective regulations are met.

According to the Bylaw on the Application of the Law on Private Security Forces, the private security company should present a copy of its security and protection plans for the area that it has been contracted to protect for approval to the respective governorship. Based on the decision of the private security commission, the governorship also has the authority to allow the private security company to acquire firearms, including long barrel rifles, upon consultation with the Turkish Armed Forces General Staff. Even though private security companies may acquire firearms, both the law and the bylaw on its application tend to be restrictive rather than permissive by limiting the amount of firearms and their cartridges, and specifying how they will be logged, stored and returned to the government. Furthermore, private security personnel that will carry weapons have to undergo at least 20 hours of firearms training in addition to the minimum 100 hours of training in order to become private security personnel.[36] Both private security personnel and administrators have to undergo renewal training every five years in order to retain their eligibility. Additionally, the private security company is responsible for ensuring that its personnel continue to meet the physical eligibility criteria throughout their service.

Increasing security concerns over the insufficiency of private security forces has compelled the Ministry of Interior to refurbish its regulations on private security.[37] The draft law on amending the Private Security Law has been submitted to respective agencies and branches for deliberation. A version of the draft law submitted for deliberation by late May 2016 envisions considerable changes.[38] For one, the draft strengthens measures against non-compliance and reinforces the requirements of private security companies to notify the governorship regarding any changes in the private security personnel they employ and their respective tasks. Moreover, the draft is expanded to include clauses on the "alarm and electronic security companies", which private security companies would collaborate for physical protection and detection measures in their area of responsibility. The draft revokes the clause on the participation of representatives of the private security company to the private security commission, whilst increasing the authorities of local governorships to mirror those of provincial governors in areas that fall under their jurisdiction. The draft also makes a specific mention to nuclear facilities to underline that security measures to be undertaken in nuclear facilities are subject to international commitments. Numerous clauses, including those on training and inspections, are to be specified in future bylaws.

Furthermore, the draft introduces "strategic locations and facilities" as "locations and facilities, that are not of military nature and that belong to public and private organizations, which if rendered inoperable even temporarily could create negative consequences for national security, economy or the public life."[39] The Ministry of Interior is put in charge of deciding upon which locations and facilities would be classified as strategic. It is noted that future bylaws would determine the special requirements for their protection by private security forces. The draft suggests that provincial private security commissions may determine additional qualifications for the private security personnel that would be employed to protect strategic locations and facilities, and private security companies should seek the commission's approval for which personnel it wants to employ in such areas. More importantly, in cases where private security personnel and law enforcement operate together, it is envisioned that private security forces operate under the orders of law enforcement. Background check requirements are also strengthened when it comes to strategic facilities and locations, necessitating such checks to be conducted for not just private security personnel, company executives and trainers, but also for shareholders and representatives of the company. In cases where these checks yield undesirable results for law enforcement, the commission is in charge of deciding upon the status of trainers and personnel, whilst the Ministry of Interior is tasked with deciding upon the company's executives, shareholders and representatives. Lastly, the execution of the law is delegated to the Turkish National Police and Gendarmerie General Command depending on their jurisdiction.

4.2. Potential Challenges Surrounding Akkuyu's On-Site Security

There are multiple uncertainties regarding prospective on-site security arrangements for the Akkuyu NPP. For one, the existing Private Security Law is likely to be amended but as the amendments are still being deliberated, it is unclear what the finalized law will entail. Even then, the final structure will depend very much on the subsequent bylaws and additional guidelines that will be produced by the Ministry of Interior, as well as the law enforcement agencies of the Turkish government. TAEK's own regulations regarding the physical security arrangements of nuclear facilities, as discussed above, will also come into play in determining how the arrangements may be shaped and reshaped in the future.

Second, even the future of the private security forces is under question. Over the years, private security forces have risen in importance as a complementary factor to the Turkish public order, with the industry amounting to over 3.5 billion USD employing hundreds of thousands personnel.[40] Various security challenges over the last years, ranging from protests in universities and hooliganism in stadiums to terror attacks, have spurred a debate on the overreliance on private security personnel and potential alternatives. President Recep Tayyip Erdogan himself joined the debate in 2015, arguing that private security forces should not be employed to protect public institutions and facilities; rather the responsibility should be delegated to a separate branch formed by the police forces instead.[41] Even before, in 2013, Muammer Güler, the Ministry of Interior at the time, had argued that private security forces would no longer be employed in stadiums and universities and the duty would be left to 'protection officers'.[42] Against the occasional news that the Ministry of Interior would start recruiting such officers in the ten thousands, some of which suggested that even refugee camps would be protected by these forces, neither protection officers nor the respective legislation that would determine their legal standing have materialized so far.[43] Even considering that such a system materializes, it might be undesirable in the Akkuyu case for the Russian operator, as the operator would likely want to have a stronger say in on-site security dynamics, which already falls under its responsibility according to international arrangements, rather than delegating this responsibility to Turkish authorities.

Third, the status of off-site security forces, with which on-site security personnel should develop a very intimate working relationship, is also in question. The 15th July 2016 coup d'état attempt in Turkey has resulted in unprecedented crackdowns on both the military and police forces over their alleged ties to the coup plotters. Moreover, it has put the structure of the military establishment in Turkey under question. One of the proposed changes to the existing structure is over the status of the Gendarmerie General Command, which is normally a branch of the Turkish Armed Forces structured to enforce law over mostly rural areas that fall outside the jurisdiction of the police – including the Akkuyu site. Though it reports to the Ministry of Interior for public order and security related duties, the Gendarmerie is nonetheless a part of the Armed Forces and, in the existing structure, is tied to the military structure for its military duties, training and education. The proposed changes to the existing architecture entail a much stricter control of the Ministry of Interior and provincial governors over the Gendarmerie General Command, limiting its military duties tied to the Armed Forces to cases of war, martial law and mobilization.[44] It is likely that structural changes will not solely be limited to the Gendarmerie General Command, but will rather encompass the entire military establishment in the country.[45] The unforeseeable future of the military structure in Turkey, as well as law enforcement, both military and civilian, render it difficult to predict the arrangements that Turkish authorities would develop on the off-site security forces.

Regardless of what arrangements Turkish authorities will eventually develop with regards to off-site security, they will have to ensure close cooperation with the on-site security forces employed by the Russian operator. This collaboration includes, but is not limited to, joint training and exercises, agreeing upon response mechanisms, tactics and procedures for a variety of adversarial action scenarios, communication methods and procedures and the determination of hierarchy and chain of command. This partnership is an integral part of ensuring that necessary measures against the threat environment, outlined in the Design Basis Threat, are planned, prepared and, if the threat materializes, undertaken. This issue is also highlighted in the Regulation on the Physical Protection of Nuclear Facilities and Nuclear Materials. The regulation necessitates the operator to conduct exercises at least once a year in order to test "the reliability and effectiveness of the physical protection system, the adequacy of planned procedures and the efficacy of the division of duties between protection guards [on-site forces] and law-enforcement [off-site forces] and their ability to respond to incidents in a timely manner"[46] and report the results of the exercises to TAEK.

The determination of on-site security personnel also necessitates close intelligence cooperation between Turkish and Russian authorities. For one, if a Russian private security company is involved or the operator decides to establish its own private security firm in Turkey, Turkish authorities will likely request access to Russian intelligence on both the guards and trainers they will employ, as well as the stakeholders, executives and representatives of the companies, according to existing Turkish legislation. Yet even if the operator opts to work with an existing Turkish private security company, it is likely that Russian authorities will request collaboration with the Turkish side in order to determine the suitability of the personnel in question for protecting such a financially and strategically significant investment. Moreover, this intelligence sharing will need to continue for the lifetime of the facility as security personnel will continue to change throughout this period.

The sharing of information and intelligence between off-site security forces and on-site first responders is also key in ensuring successful defense against potential perpetrators. As discussed above, the operator is also responsible for ensuring the safety and security of nuclear and radiological material as well as sensitive equipment in transit. As such, this collaboration will transcend the Akkuyu area and require a close collaboration between a multitude of local authorities and law enforcement forces, Turkish coast guard and military assets, as well as the operator and the security forces it contracts throughout the lifetime of the facility.

Considering the volatility of the relations between Turkey and Russia, the operator and Turkish authorities will have to come up with clear channels of communication and intelligence cooperation mechanisms that are immune to political tensions between the two countries. This will be necessary for both practical matters at the local level and strategic matters such as the DBT, private security forces and insider threats that will be discussed in depth below.

With regards to on-site security, the more important factor would be the mechanisms between the operator, law enforcement forces and provincial governorates on the local level regarding intelligence and information sharing, as well as collaboration on other practical matters. Turkey and Russia, as well as the operator and respective authorities, may create mechanisms to ensure high-level cooperation on the long-term, such as through establishing a joint commission. Yet practical and acute matters that would demand timely response and decision making may be delayed through centralized mechanisms, and hence would need to be solved through arrangements on the local level. The absence of such local mechanisms would hinder cooperation between off-site Turkish law enforcement forces and on-site security forces due to potential issues with authority and responsibility delineation, intelligence sharing and resource management and delegation.

History shows that while these arrangements are necessary to operate the facility, they are also vital requirements during the construction of the facility. One of the most disruptive attacks on a nuclear facility in history was committed by a contractor working at the Koeberg nuclear station in South Africa in 1982. The contractor placed four limpet mines on the reactor heads, containment building and electric cabling under the main control room, and detonated them before the facility had gone into operation, resulting in considerable financial damage and an 18 month delay in the plant's commissioning.[47] Hence the operator and Turkish authorities would have to formulate functioning arrangements before Akkuyu's construction begins.

Meanwhile, Turkish authorities will have to clarify their own arrangements with regards to their requirements for on-site security. Under existing arrangements and trends, it appears that the main authority in determining the components of on-site security forces, whether they are private security forces or proposed 'protection officers', in terms of training, personnel and materiel, resides in the provincial and local governorships. The same is also true for potential off-site security forces belonging to both Turkish National Police and Gendarmerie General Command. Furthermore, as argued in the chapter of this volume related to accident and consequence management, local governorships will again have the say in managing potential accidents. The concentration of this authority in the provincial administration presents a very good opportunity for avoiding issues with delegation of authority and responsibilities, and the chain of command, if the roles of respective agencies are clarified in the outset of the nuclear project. Response plans, training and exercises would serve as critical resources in ensuring this clarity.

On the other hand, the role that TAEK will play in this equation is not perspicuous. As discussed above, the Regulation on the Physical Protection of Nuclear Facilities and Nuclear Materials necessitates the operator to submit its plans regarding the physical protection of the facility, emergency response procedures, and the protection of material during transport – including the specifications of how cargo will be transported, the vehicle, protection measures and layover areas – to TAEK for approval before the operations can begin. Furthermore, the operator also has to present a written agreement on the nature of the cooperation between its on-site security forces and the off-site responders of the Turkish government to TAEK. Though TAEK is the primary responsible body granted with these authorities, the Ministry of Interior, especially provincial governorates and law enforcement forces under its roof, also have similar authorities. This duality is also present to some extent with regards to inspections of the security measures that the operator has employed. While the Ministry of Interior is in charge of inspecting private security forces and the alarm and security components, TAEK is also charged with inspecting compliance with the overall physical security requirements and plans. Hence, unless TAEK and the Ministry of Interior clarify their respective roles and collaboration over this issue, this duality might result in redundancies and confusion.

Yet this duality also presents a valuable opportunity. While the TAEK is the country's forefront agency in nuclear safety, it has no experience and very limited know-how, if any, on managing the physical security aspect of a major project such as Akkuyu, including multiple stakeholders and a convoluted threat environment. Conversely, while the Ministry of Interior and the provincial governorates and law enforcement under its purview have extensive experience in counterterrorism, perimeter security and the protection of critical infrastructure, they lack in the specific requirements of nuclear and radiological safety and security. Hence establishing a robust inter-agency collaboration early on would be essential for both sides to supplement their ability to ensure the safety and security of Turkey's nuclear operation. Clarifying their respective roles, authorities and duties would also boost the efficacy of their cooperation with on-site security forces, as well as their ability to verify and enforce the operator's compliance.

5. THE INSIDER THREAT ISSUE

Security studies literature has a broad definition for the insider threat issue. Specifically, for nuclear security, the IAEA definitions and assessments set a narrower framework as follows:

> *The term 'insider' is used to describe an adversary with authorized access to a nuclear facility, a transport operation or sensitive information. Insider threats present a unique problem. Insiders could take advantage of their access (i.e. right or opportunity to gain admittance), complemented by their authority (i.e. power or right to enforce obedience) and knowledge of the facility (i.e. awareness or familiarity gained by training or experience), to bypass dedicated physical protection elements or other provisions such as safety, nuclear material control and accountancy (MC&A), and operating measures and procedures.*[48]

Categorically, insider threats could be assessed in five dimensions, namely, espionage, fraud, sabotage, theft, and unintentional insiders.[49] Insiders can act on their own volition or may cooperate with external actors. Furthermore, they have unique advantages compared to outsiders, including but not limited to access to information, physical devices, materials and areas and personal knowledge of the facility routine, security measures, vulnerabilities and personnel. Whilst a number of motives may push insiders to conduct malicious acts – personal disgruntlement, financial gain, political agendas, among others – the personnel, management and contractors of the operator may also inadvertently enable malicious actors and thus become unintentional insiders. A likely scenario is with regards to information security, where personnel may share sensitive or seemingly insignificant information with outsiders or where contractors may create vulnerabilities in IT systems through their flawed cyber security practices. Therefore mitigating the insider threat is not only about confronting hostile activities, but also about building a significant security notion to protect critical national infrastructure.

5.1. Nuclear Security and Insider Threat

Insider threats pose menacing challenges to nuclear security. In this respect, evidence suggests that in many critical nuclear material theft cases, the crime was committed through either the direct participation or the assistance of insiders. This is also the case for thefts of large quantity nuclear material. Furthermore and perhaps more importantly, in all cases where radioactive material that could be used in the making of weapons were diverted, the insiders were low level employees.[50]

Nuclear sabotage perpetrated by workers also remains a grave threat, one example of which is the San Onofre nuclear plant incident in 2012.[51] In the incident, a back-up generator, which would be essential in cooling the reactor in case of a power failure, had been tempered with by pouring engine coolant in its oil reservoir, likely by an insider.[52]

In the literature, experts point out two key reasons that make insider threats extremely challenging. Firstly, there is a tendency of downplaying the insider threat among many nuclear plant managements. Secondly, although the field of nuclear safety enjoys procedural regulations of sharing lessons-learned – through the World Association of Nuclear Operators (WANO) and International Atomic Energy Agency (IAEA) regulations – the field of nuclear security lacks a standardized advantage.[53]

As a result, the insider threat to nuclear facilities has a menacing record. Given the current problematic security landscape in Turkey's neighborhood, such threats could be coupled with terrorism, which would have catastrophic results. In this regard, the case of Ilyas Boughalab is noteworthy. Between 2009 and 2012, Boughalab worked in Belgium's nuclear industry and "had security clearances to inspect welds in sensitive areas of the Doel 4 nuclear reactor."[54] He then left for Syria to partake in the Syrian Civil War, where he died in 2014 as a member of a radical extremist group. Moreover, a nuclear sabotage has occurred in the very same reactor in August 2014, where another insider opened a locked valve and rigged it so that the valve appeared to be untampered with. This allowed all of the lubricant of the plant's turbine to leak out, overheating and destroying the turbine as a result. Whilst there were no risks of radiological release, the financial costs of the incident amounted to 100-200 million USD, making it one of the most significant incidents of economic sabotage in history.[55] Both cases serve to highlight the importance of conducting background checks in nuclear industry staffing and the need for continuous assessment of facility employees and contractors.

Notably, in nuclear security affairs, the insider threat remains the critical weak link in the chain. Challenges that insiders could potentially pose range from the theft of mildly radioactive, low enriched uranium dioxide powder, which would be relatively 'inconsequential', to the destruction of fresh fuel assemblies, as well as extremely dangerous cases such as intentionally disabling power reactors' emergency core cooling systems.[56] Sabotages that target the key vulnerabilities of nuclear reactors, including systems responsible for the chain reaction and cooling, as well as storage facilities could bring about catastrophic results.[57] Insiders may also serve to tamper with existing physical security systems – e.g. unlock doors, disable ID scanners and CCTV camera systems – which could greatly improve the chances of an external attack of succeeding.

5.2. Mitigating Insider Threat

In order to counter insider threats, especially with regards to the threat of nuclear material theft, a good strategy should be based on two key pillars. Firstly, an effective and continuous mechanism of checks on the personnel should be initiated. Secondly, efficient accounting and material control systems should be in place.[58] Perhaps more importantly, in their 'worst practices guide' for insider threats, Bunn and Sagan argue that "complacency – the belief that the threat is modest and the measures already in place are adequate – is the principle enemy of action."[59] Hence they underscore that it is vital to not make any assumptions about the threat and the adequacy of countermeasures, but instead to always assess and test as realistically as possible.

In both theory and practice, confronting insider threats depends on closely monitoring social behavioral indicators of malicious threat activity. As indicated by the US Department of Homeland Security, some indicators suggesting malicious activity are as follows:[60]

- Remotely accessing the networks during sick leave or vacation
- Working at unusual hours without authorization
- Overtime work enthusiasm
- Copying classified material when unnecessary or unauthorized
- Unusual interest in out of scope materials and information
- Signs of vulnerability (i.e. drug abuse, illegal activities, etc.)
- Acquisition of unexpected wealth

According to the insider threat booklet of the US Department of Defense – Defense Security Service, other indicators of the insider threat are as follows:[61]

- Failure to report contact with foreign nationals and overseas travels
- Attempts to gain higher clearance
- Engaging in no-need-to-know, classified conversations
- Insistence on working in private and inconsistent working hours with official job assignments
- Exploitable traits
- Repeated security violations
- Attempts of entering no-access areas

In the light of the abovementioned key parameters, it is seen that a viable and reliable strategy against the insider threat should depend on a carefully-tailored strategy. Furthermore, such a strategy, by its very nature, depends on operating in pure human terrain which makes the task even more complicated and challenging. In addition, legal aspects of such monitoring, especially under democratic rules, necessitates a delicate balance between security and individual liberties.

As seen in the contemporary security literature, an efficient roadmap of mitigating insider threats has to depend on an effective insider threat program and conceptualizing an insider threat framework.[62] Turkey's nuclear energy perspective and the Akkuyu plant are no exceptions to this context. So far, no open-source Insider Threat Framework has been published in the country.

A viable insider threat program should ideally incorporate technical measures along with a suitable mindset. With regards to technical issues, retina scans, fingerprint and hand geometry scans for accessing to restricted areas are vitally important measures. These should be supported with state-of-art video surveillance and explosive – metal detection devices. [63]

As insiders may turn into threats over time by being co-opted or coerced by external malicious actors, or as a result of their own disgruntlement, relying solely on technological tools would not be enough to overcome the threat. As such, the IAEA notes that good relations among facility personnel and between personnel and management should be a part of the security culture.[64] It also suggests that "managers should be trained to identify and raise any concerns about an employee's behaviour with an appropriate person"[65], and thus underlines the importance of input from facility personnel as an integral part of preventing insider threats. Moreover, external adversaries may attempt to gain access to the nuclear facility by portraying themselves as contractors or facility employees – one recent eye opener was in Belgium where a security guard working at a nuclear facility was found dead with his security badge stolen[66] – making the human element in personally recognizing facility employees and others with legitimate access a vital element of facility security. Therefore the 'suitable mindset' that this study underlines should incorporate a behavior observation program in order to detect potential insider threats.

5.3. The BOO Model and Insider Threat

At this point, the Build-Own-Operate model could bring about some problems for mitigating insider threats. Firstly, the internal security regulations of the nuclear plant should be subject to background checks by the Turkish authorities. In case the Russian partner, Rosatom, opts for establishing its own security services, personnel information has to be monitored very closely, and security checks have to be renewed on a regular basis. It has been reported by Turkish media that the Turkish National Intelligence Agency (MİT) and Turkish National Police will perform background checks on all facility employees, including interns and contractors.[67] As such, on the Turkish end, Ankara will need to establish a working relationship with Moscow at the outset of the Akkuyu project for cooperating on the vetting of Russian employees of the facility.

Secondly, as indicated above, mitigating insider threat is a process rather than a one-time counter-intelligence operation. It necessitates a continuous check of behavioral patterns, travels, contacts, clearance of the employed personnel. Thus, in case Turkish and Russian authorities cannot manage to run a cooperative security approach, insider threat could surface sooner or later. Furthermore, all the aforementioned technical issues, such as fingerprint and hand geometry scans, have to be discussed and agreed between Turkish and Russian authorities in order to run an effective insider threat risk mitigation strategy and program. The operator, Russian authorities and Turkish authorities would all stand to benefit from an intelligence cooperation mechanism, as the operator would need information on suspicious actions of its personnel (e.g. contacts with outsiders, suspicious online activity etc.), and Turkish authorities would need tips and information from the operator regarding suspicious behaviors of its employees. The continuity of this cooperation becomes more important when considering the vast number and variety of personnel that will be involved in the project – for the construction and operation of the facility as well as the transportation of sensitive radiological materials – and the likelihood that these personnel will be replaced by others over the years.

Thirdly and finally, the insider threat issue becomes most destructive when it is combined with outsider malicious activities. One looming threat at Turkey's doorstep is ISIS, which is notorious for its interest in radioactive material and dirty bombs. In 2014, the extremist terrorist network seized nuclear material – despite low-grade – from the Mosul University, which ignited concerns at the International Atomic Energy Agency,[68] and international policy community. Therefore, insider threat should also be considered within the broader threat environment, through analyzing which networks would have the motivation and means to infiltrate the facility or co-opt or coerce its employees.

All of these factors make intelligence cooperation a vital part of Akkuyu's internal security. Intelligence cooperation between Russian and Turkish agencies in this regard could potentially be limited to employees of Russian origin and intermittent – before the facility goes online and depending on changes in personnel. Yet the cooperation between the Russian operator and the Turkish side has to be continuous due to the aforementioned issues. Hence, the Turkish side will have to formulate an official structure of collaboration with the operator, which may entail sharing personal information of its citizens due to security concerns.

6. CONCLUSION AND RECOMMENDATIONS

The security of its nuclear facilities will be a foremost concern for Turkey, a newcomer to the nuclear scene with a convoluted threat environment. The Build Own Operate model agreed upon with Russia is a first for the nuclear industry and foresees close cooperation between Ankara and Moscow for the duration of the facility's six decade long lifetime. Ankara has time to institutionally prepare itself for such an undertaking as the operator has yet to receive its construction license. Nonetheless, after inspecting the three major components of nuclear security – the design basis threat, on-site security arrangements and insider threats – this paper has identified three overarching themes that would warrant meticulous forethought before the nuclear project materializes.

First and foremost is the necessity of sharing both long-term and acute intelligence between Turkey and the state-owned operator. Both in drafting threat estimates that would form the basis of the DBT and readings about incipient attacks to the Akkuyu site and its cargo, Turkish authorities will need to develop measures on sharing sensitive information with a 'frenemy' without jeopardizing its national security and commitments to NATO. Additionally, Russian and Turkish intelligence agencies will have to develop mechanisms of cooperation in order to overcome insider threat, as the Russian owned facility will host both Russian and Turkish personnel.

In this regard, Turkey will have to augment its domestic capabilities in order to be able to remain one step ahead of the security challenges to its prospective nuclear infrastructure. The July 15th coup attempt has laid bare the deficiencies of Turkish intelligence services. At a first glance, it is seen that MİT and other actors of national intelligence have been unable to predict the coup and prevent the infiltration of the armed forces and other governmental agencies. Hence, as the primary agency that will collect intelligence concerning the DBT, assess potential threats, and vet the personnel involved in the nuclear undertaking, MİT will have to refurbish its capabilities considerably. Furthermore, the country's intelligence-security nexus will be subject to change in the face of the coup attempt and the vulnerabilities that it has unearthed. Initial signs suggest that this transformation will not solely be limited to changes in personnel, but may also include structural changes, such as focusing MİT's role to foreign intelligence gathering while leaving domestic intelligence gathering to the police and the gendarmerie.[69] While these overhauls may ensure that Turkey is at a better position when it comes to intelligence collection and assessment in the long run, the interim period during this transformation may yield vulnerabilities that the authorities should be vigilant about.

The second overarching theme is the inherent political nature of the Akkuyu deal and the Russian ownership of the NPP. Signed as an intergovernmental agreement between Turkey and Russia, where the Russian state has agreed to accept all the costs and financial risks of the project, Akkuyu is very much reliant upon the relationship between the two countries. During times of unity, governments of both countries may pressure their respective agencies to expedite potential hurdles at the expense of overseeing safety and security concerns. At times of discord, the sides may disrupt the cooperation mechanisms necessary for operating the facility safely and securely.

The additional, and last, overarching theme is the structure of the Turkish agencies that are tasked with securing the nuclear project. The obvious political nature of the Ministry of Interior aside, at its current state, Turkish Atomic Energy Agency is also very much vulnerable to political pressures. As it stands, the regulator is tied to the Prime Ministry for its appointments and budget. As such, neither TAEK nor the provincial governors and law enforcement tied to the Ministry of Interior have immunity against undue political influence. Furthermore, both organizations are in need of developing capabilities and an overall strategic culture on nuclear security.

Against the backdrop of these challenges, the authors of this study recommend additional deliberation, study and policy actions on the following issues:

- The development of a holistic approach to the country's prospective nuclear security and the respective threats to it will be indispensable for the DBT. Turkish authorities should ensure that they incorporate low probability/high impact scenarios into their consideration in order to avoid failures of imagination, and develop plans that are sensitive to the specific needs of the nuclear project.
- Turkish and Russian authorities both on the governmental and the bureaucratic/local levels should try to formulate ways of depoliticizing cooperation. This collaboration should be based on mechanisms that would standardize and expedite decision making and information sharing practices, without the interference of the political agendas of the two countries.
- Turkish agencies that will be part of the nuclear security ecosystem, most notably TAEK, will be in dire need of protection from undue political influence. This is also true for law enforcement and governorships that will need to have a working relationship with the operator. One possible route would be to make TAEK, and potentially the representatives of other agencies that will be tasked with nuclear security, accountable to the parliament instead of the office of the Prime Ministry.
- On the other hand, the agencies that will make up the nuclear security ecosystem (e.g. TAEK, Turkish law enforcement, armed forces and intelligence services) will be in dire need of functional inter and intra-agency cooperation as each have different and complementing competencies. The Turkish government should also prioritize enhancing the existing capabilities of these agencies, and foment the development of a strategic culture on nuclear security. Collaborating with Turkey's NATO allies, European Union partners and other nuclear energy generating countries may be valuable means of achieving this goal.
- Regulations and practices, such as training and exercises, that TAEK and other Turkish actors demand should not remain on paper. TAEK should work to develop its inspection and verification capabilities, as well as its means of

ensuring compliance.

- Turkish authorities and the operator should work towards laying the groundwork for future collaboration regarding the issue of insider threat, which should include the promotion of a security culture amongst facility personnel as well as the means of monitoring and alleviating employee dissatisfaction.
- Turkey should develop a nuclear-specific approach to on-site and off-site security arrangements, as well as transportation security. Considering the threat environment that Turkey faces today, which may still be present once the facility goes online, Turkey may need to adopt relatively strict measures, such as leaving the protection of the facility grounds and perimeter to the operator but taking its own defensive measures right outside this area, instead of limiting its contribution to being an off-site back up.

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The "Build Own Operate" Model in Nuclear Energy: An Analysis with Emphasis on Turkey's Akkuyu Project

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1. INTRODUCTION

During the 1960s and 1970s, when nuclear energy was on the rise for the first time, the organization of the electricity industry was very different from the way it looks today. In most countries, electricity was provided by vertically integrated public monopolies. In a few countries private ownership existed, but even then the form of organization was a vertically integrated regulated utility. In either type of organization most risks associated with construction costs, changes in fuel prices, costs of alternative energy sources and other factors were born either by the government or by the consuming public. In the case of public ownership, these costs were financed ultimately through taxes. Under the regulated utility model, the nature of regulation (often called "cost of service" or "rate of return" regulation) allowed the regulated utility to request adjustments in its prices according to realizations of costs. Even with secure sources of financing, however, the expansion of nuclear energy was not without problems. In the US, for example: "Many nuclear plants experienced significant construction delays and cost overruns. Many plants planned during the 1970s were abandoned before construction started; some were abandoned after construction began but before completion".[12] Costs, increased regulatory scrutiny, cheapening of alternative sources of electricity followed by accidents at the Three Mile Island plant in 1979 and Chernobyl in 1986 all added to a virtual halt in the construction of new nuclear plants worldwide.

By the 1990s and especially 2000s there was renewed interest in nuclear energy (the so-called "nuclear renaissance"). There are various reasons for this but a few stand out. The first was an increase in the prices of fossil fuels that occurred in the 2000s. The second possibly more important reason is that nuclear energy is seen as cleaner than energy produced by fossil fuels such as coal and gas. Thirdly, many countries that imported oil and gas saw nuclear energy as a means towards increasing energy independence. Hence, at least until the Fukushima accident in 2011, there was an increase in the interest towards nuclear energy. While the Fukushima accident did produce a setback, nuclear energy is still seen by many countries as a viable source of clean and reliable energy.

However, by that time in many countries the structure of the electricity industry had changed significantly. Many countries embarked on the liberalization and privatization of their electricity markets. In particular, wholesale prices were liberalized in almost all countries that embarked in deregulation. New investments in electricity plants were mostly undertaken by private firms. Wholesale prices were liberalized which meant generators would sell their electricity at market prices established in wholesale markets, or at best, against long term contracts which would freely be negotiated between buyers and sellers. In many countries retail markets have been liberalized as well, which meant that suppliers no longer would have captive consumers. Moreover, many countries also introduced "unbundling" policies which means that natural monopoly segments (transmission and distribution) would be separated from potentially competitive segments (generation and retail supply). This meant that various types of risks that were previously borne by governments and consumers would now need to be borne by private generation firms. At the very least, these developments meant that private firms now needed to devise mechanisms to manage these risks or that how risks would be shared between firms, the government and consumers became an issue.

These changes in market structure have significant implications for nuclear energy. As will be discussed below, nuclear energy investments are characterized by very high fixed costs and relatively lower variable costs. It faces certain types of risks which are either not faced by other types of electricity investments or are faced to a much lesser degree. In nuclear new build, the cost of up-front investment is very high and nuclear plants take longer time to build. Together these mean that returns to investment start to be generated with a significant delay. High irreversible up-front costs amplify the cost of various risks. Hence the issue of how to distribute these risks is especially critical for investments in nuclear plants. Indeed, whether nuclear plants are viable in completely liberalized electricity without any government support is still heavily debated (OECD 2015).[3]

This concern about how to distribute risks associated with the construction and operation of nuclear plant, and the question of whether nuclear plants are economically and financially viable have generated a search for various ownership and financing models. In this context, the Build Operate Own (BOO) model has recently been proposed as one model that is likely to be attractive to host countries. It is a model where a company (in theory could be a private company but in practice so far it is a state owned company active in export markets) takes responsibility for the construction, operation, maintenance and possibly the decommissioning of a nuclear facility as well as the associated risks. More generally, the BOO model is discussed as a form of Private Public Partnership (PPP), which refers to various modalities through which the private sector participates in the provision of public assets and/or services, including infrastructure and health. As will be discussed below, PPPs have been proposed both as a way to provide incentives to improve efficiency and reduce costs as well as a means to reduce expenditure burden on the public budget.

In the context of nuclear energy the emergence of the BOO model is relatively recent. The Akkuyu project is the first power nuclear plant (NPP) to be built through the BOO model. While the model is still not used in a widespread manner, it has been mentioned in recent commentary about alternative models that can be used to finance nuclear new build.

The purpose of this paper is to evaluate the BOO model in the context of nuclear new build. The paper is organized as follows: The next section summarizes the main characteristics of and main risks associated with investments in nuclear energy. The next section reviews private public partnerships and incentives associated with public versus private investments in infrastructure facilities. The paper then discusses recent financing models for the construction and operation of nuclear plants. The BOO model and the specific case of the Akkuyu project is discussed next. A discussion of the BOO model in the context of Russia's competitive strategy in international markets follows. The last section concludes.

2. THE CHARACTERISTICS OF NUCLEAR INVESTMENTS AND THE MAIN RISKS

This section reviews the main characteristics of and risks associated with nuclear energy. The discussion is not meant to be exhaustive, and emphasis will be on dimensions that are particularly important for the evaluation of the BOO model.

2.1. *High fixed cost and low variable cost*

One of the most important characteristics of nuclear energy is high capital costs and low operating and fuel costs. According to Joskow and Parsons[4] capital cost makes up 80 percent of total cost of electricity produced by nuclear power, whereas this ratio is about 15 percent for electricity produced by gas, and somewhere in between the two for coal. Typically nuclear plants take longer time to build (Finon and Roques[56] estimate 3 years for project preparation, 5 to 6 years for construction). The implication is that there is a significant amount of cash expenditure before the project starts earning revenues.

Another implication is that any delays in construction has a much larger impact on costs compared to investments based on other sources such as coal and gas. For example, Finon et. al[7] calculate that a 24-month delay (at 6.7 percent weighted average of capital) increases levelized costs of a nuclear plant by about 9.6 percent and that of a CCGT plant by only 2.6 percent.[8]

2.2. *Construction risk*

Compared to other infrastructure projects, construction risk of nuclear plants is very high. Construction risk encompasses two important (and interrelated) elements: uncertainty related to the cost of "overnight costs" and those associated with the duration of construction. (Overnight costs refer to the cost of construction under the assumption that it is built overnight; in other words, it excludes interest and other costs of financing). Experience shows that construction risk is also closely related to the how rigorous safety regulations are. For example, for the French case, Escobar Rangel and Leveque[9] find that in the French case reactors with higher safety characteristic cost more.

There is some discussion about whether the cost of nuclear energy has increased over time. This seems to be definitely the case for the US and France.[10] [11] Lovering et al[12] argue that overnight costs have declined in some countries over certain periods. Koomey[13] point out that the right measure is not overnight but levelized costs, which does take account of interest costs. There are fewer disputes over the fact that construction risk in nuclear new build is very high.

2.3. Market or price risk

Fluctuations in overall demand, and in the prices of competing electricity supply, as well as of carbon prices create risks for electricity produced by all technologies. However, the fact that fixed costs make up a high share of total costs make nuclear energy especially vulnerable to long periods of low prices. When prices are low, a gas plant can cut losses by shutting down temporarily or by leaving the market. Thereby it saves on variable costs. A nuclear plant does not have this option. Variable costs are low, and through fixed/sunk costs, about 80 percent of total costs have already been committed. This makes nuclear plants especially vulnerable to long term electricity price risk. [14][15][16]

2.4. Externalities, social costs and the need for safety regulation

This term refers to costs and risks not directly borne by the providers of electricity based on nuclear energy.[17] Primary among these are costs that would be borne by society in case of a nuclear accident. Since they are not directly borne by the providers of electricity, decisions taken by private parties based on private costs will not be socially optimal. It is of course this divergence between private and social costs that makes the establishment of a regulatory framework for safety under nuclear energy a critical condition for countries that embark on developing nuclear energy.

3. INCENTIVES AND THE PRIVATE-PUBLIC DECISION

The BOO model has emerged as a form of public-private partnership (PPP).[18] [19] Grimsey and Lewis[20] define PPPs as "arrangements whereby private parties participate in, or provide support for, the provision of infrastructure, and a PPP project results in a contract for a private entity to deliver public infrastructure-based services." In particular, they emphasize that PPP is more than a financing arrangement. Under a PPP the government does not simply buy an asset construction of an asset. This would public procurement. Under a PPP it purchases a stream of services associated with the asset. Indeed, it is the *bundling* of design, construction and operation of the asset that distinguishes PPP from standard public procurement. Since PPP has emerged as an alternative to standard public procurement, it will be helpful to summarize here traditional arguments about the advantages of public procurement, PPP and private provision.

There are three main methods that a government can use to provide infrastructure services to its citizens. The first is public provision, in which the government either builds the infrastructure itself or contracts the construction of the facility out to a private firm. Once the facility is built, the business of the firm with the government is concluded. The government may then design another contract to transfer the management of the facility to another private entity, for example under a management contract, or a contract that transfers to a private entity the operating rights of the facility. The important point for our discussion is that the construction (and design) phase is separated from the operation and maintenance phase. The second method is a PPP contract. For example, under one popular form of PPP, namely the Build Operate and Transfer (BOT) scheme, the private party constructs the facility (or improves an existing facility) and operates it in exchange for an income stream for a long period of time (say 20 or 30 years). At the end of the period the ownership of the facility is transferred to the government. The stream of income may consist of user fees, government transfers or both. The third method consists of privatization, a scheme where the ownership of the facility is transferred to private firms, or remains there from the beginning. In a Build Operate Own (BOO) contract, the private sector entity finances, builds, owns and operates an infrastructure facility and the facility is not transferred back to the government. As indicated above, many sources classify BOO as a form of PPP, but in essence and as far as cost reduction incentives are concerned, it is a PPP with much more extensive private participation, as discussed below.

Each scheme in theory (or in the default arrangement) implies a distribution of various risks associated with the construction of the facility and provision of the service. For example, under privatization the risks would be borne by the private sector. But in reality contracts are more complicated and may distribute different risks in a variety of ways between the private party, the government and the consumers (as will be seen below, stakeholders will often include other parties as well, such as banks). Hence even under private ownership, revenue risks may be borne by the government if the output or service of the private firm is sold to a government under a take-or-pay contract, whereby the government promises to buy the output or service irrespective of whether there is demand for it.

The literature identifies a number of factors and conditions that may make one scheme preferable to others. For example, the following are often cited as weaknesses of public provision:[21]

- Project selection may be poor. In particular projects that benefit specific lobbies or constituencies may be chosen over those that benefit the general public. In other words, public provision may be ineffective in preventing "white elephant" projects, i.e. projects whose social value are lower than costs.
- Poor maintenance. Politicians have incentives to allocate resources to new projects rather than to the maintenance of existing ones, until the condition of the facility in question is seriously impaired. This raises costs and, for example, in the case of roads, may lead to accidents.
- Services may be priced inefficiently low for political reasons.
- Frequent renegotiation of contracts creates opportunities for manipulation and abuse. As a result, efficient firms may be discouraged from participating, whereas those with political connections or lobbying power will participate even if they are relatively inefficient. That is because they are confident that thanks to political connections, they will be able to renegotiate contracts to their favor.

By contrast, the following are often cited as factors that may favor PPPs.

3.1. Efficiency gains

The first is prospects for efficiency gains, especially gains in terms of cost reductions. PPPs may entail efficiency gains over public provision for various reasons. First, under a PPP financing, construction and the operation of the facility are bundled together. Second, during the duration of the contract, the firm has control rights over the facility; in particular, it has control over the choice of inputs and overall costs of the project. These two characteristics provide strong incentives for the minimization of costs over the duration of the project. In particular, if there are interdependencies between cost of construction and cost of operation and maintenance, the firm will have strong incentives to make choices that will take these interdependencies into account. To the extent that what is done during construction may affect the cost of operations or maintenance, the private firm will have incentives to minimize total costs of the bundle, an incentive which is absent when the activities are not bundled. Also, under a PPP the firm may have higher incentives to finish the project early so that it can start earning revenues from the provision of the service associated with the facility.

However, strong incentives for cost cutting may also encourage the firm to reduce quality, since under most circumstances increases in quality is likely to increase costs. So PPP is preferable to public provision only if the government can ensure that quality will not be reduced. This is only possible if quality is observable and more importantly, contractible, that is, if the government can hold the firm accountable for reaching quality targets and penalize the firm when they are not reached. We will see that this is an important dimension in the discussion of nuclear energy.

3.2. *Eliminating bad projects*

Typically, a PPP project is financed by private parties. The need for private finance in principle may introduce a reality/financial viability check to the process. However, it is not always true that a PPP will be successful in eliminating projects whose net social value is negative. Consider two alternative revenue mechanisms, user fees and government purchase guarantees. When the project revenues take the form of user fees, Engel et. al[22] argue that it is more likely that bad projects will be eliminated. The assumption here is that very likely there will be an upper limit to user fees making revenue forecasts more realistic. By contrast, when revenues take the form or purchase guarantees, services may be sold even if society is not really willing to pay for them. The presence of guaranteed income will make providers of finance more willing to support the project even if the social usefulness of the project is below its cost.

3.3. *Public budget considerations*

Public budget constraints are often presented as an important reason for choosing PPP or private ownership. The argument is that because the latter are financed by resources outside the budget and often through private parties including the financial markets, public resources are saved and may be used for other purposes such as health and education. However, this argument is somewhat deceptive. Consider a situation where the cost of the project is covered by user fees, or through market operations.[23] The resources that the government saves by not committing funds to the construction of the project are matched by the future revenues that the government foregoes to the private firm. In other words, in principle the government could have borrowed against those future revenues and build the project, and in intertemporal terms the budget constraint of the government would not change. In present value terms, the cost of the project and the future revenues should be equal. Hence compared to arguments regarding efficiency gains, the "government budget constraint" argument is much weaker.

If the government is already highly indebted, however, one can imagine scenarios under which government may prefer the PPP model to public procurement because the latter would further increase public debt whereas the former would not.

The literature also identifies a number of weaknesses with PPPs. The first is that it does not offer an effective response to the problem of renegotiation. In fact, contracts of 20-30 year duration are highly prone to renegotiation because it is difficult to write contracts that will be contingent on events in a distant future. Second, the fact that PPPs may allow the governments to move the cost of public projects off their balance sheet may in fact be a curse as well as blessing. PPP projects may entail a variety of contingent liabilities that are not immediately recognized in official statistics so PPPs may be a vehicle through which current politicians may impose debt over future generations.

One should also discuss the allocation of risks. The general agreement in the literature on contracts is that risks should be allocated to those who can best control them. Risks that that cannot be controlled should be allocated to those who have the best ability to diversify them.[24] In the specific case of PPPs, one can focus on construction risk, operations risk and management risk. The general agreement is that these risks are best controlled by the private firm.[25] This must be certainly true for roads, and possibly for power plants. In the case of nuclear it is a bit more complicated since construction risk may increase and delays may occur due to regulatory oversight. However, if standards are clear, than the regulatory portion of construction risk is smaller. So the extent to which construction risk is controlled by the firm depends on the clarity and contractibility of construction standards.

The question of market or demand risk may deserve special focus. Under many circumstances, market risk may be high and uncontrollable. Demand forecast for roads, for example, have been proven unreliable even in developed countries. Shifting demand risks to the private firm under these circumstances may be too costly, because the firm will require a high risk premium and that will increase the cost of the project. One solution proposed under these circumstances is to make the duration of the PPP contract variable. The government would impose a user fee, as well as a discount rate and the firm would continue to collect user fees until the cost of the project (plus a return) would be covered. That way if demand turns out to be lower than anticipated, the private firm would still be allowed to recover costs, albeit in a longer time period. If demand turns out to be high, the PPP contract would be terminated early. Effectively the demand risk is eliminated. Such a "present value of revenues" (PVR) contract has been proposed by Engel et. al.[26] as a way to reduce the risk premium in highway contracts. When the project is tendered, firms would complete on the least present value of revenues that they would claim.

To summarize, then, the main argument in favor of PPP against public procurement is the possibility of bundling and high incentives to reduce total costs of construction, operation and maintenance. The critical condition for success is that the quality of the output or service needs to be contractible. What is the difference of a typical PPP (such as a Build Operate Transfer project) and BOO in this context? The main difference is that under a BOO the contract period is essentially infinite (or it lasts until the asset in question is depleted and stops generating revenues). Incentives for cost reduction (vs quality) are similar under the two methods, except for the following: Under a typical PPP, towards the end of the contract period, the firms' incentives for investment will be muted because the ownership of the facility will be transferred to the government. This may especially be important in industries where continuous network expansion and/or investments for maintenance are important. No such disincentives for investment exit under a BOO. Second, the fixed-term nature of most PPPs creates risk that costs may not be recovered during the duration of the contract (unless the contract has variable terms such as the PVR contract mentioned above). Having no fixed term after which the ownership of the facility will be transferred, such a risk does not exist for a BOO. Viewed from the perspectives of incentives, the BOO model is more like private entry.

4. MODELS OF FINANCE FOR NUCLEAR ENERGY

As indicated above, before deregulation the primary form of organization of nuclear energy was either public ownership or private regulated and vertically integrated utility. In principle, financing was not a major problem under those forms of organization. Under both models, and the prevailing approach to regulate prices, risks were born by the government and consumers. Government ownership and financing from the budget are still options available for nuclear new build. However, with liberalization and movement away from government ownership, the search for alternative forms of financing has intensified. Today, aside from government ownership and direct government funding, the following are often listed as the main financing models for new NPPs:[27]

4.1. Corporate balance sheet financing

Under corporate balance sheet financing, the construction of the NPP is financed through debt and equity issued by the company. The asset that is built becomes an integral part of the company's balance sheet. Hence, from a financial perspective, the asset or the debt and/or equity that has been used to finance it is not separated from the rest of the balance sheet of the company that built the project. Financing risk is born by all the shareholders and lenders of the company. This was a method that has been used in the 1980s, especially in the US. Cost overruns or construction delays have caused difficulties for the financial performance of the companies.[28] It is now generally accepted that this is an option that can be used, if at all, only by very large utilities. Since typically construction takes at least 5 to 7 years, given that pay-back period starts at the end of the construction period, and given a typical cost of, say, 20 billion USD, this is typically a very large commitment of funds before any revenues are collected. Indeed, one could say that the simple balance sheet financing model has evolved into more complicated and complex arrangements, as discussed below.

4.2. The French Exeltium model

This was an initiative in France that involved industries such as aluminum, chemistry, industrial gas, paper and steel. Because after liberalization electricity prices in France increased both in level and variability, and because electricity holds a large share in total inputs of these industries, firms formed a joint company, Exeltium, which would negotiate an electricity supply contract with the state owned Electricite de France (EDF) and finance it, and in turn, sell electricity to its clients which are also its shareholders. It has take-or-pay contracts with both EDF and its clients, as well as an initial upfront payment to EDF. The objective for EDF was to secure long term power purchase from large customers, and, for members of Exeltium, to secure electricity prices at a fixed price, based on nuclear power generation costs rather than market prices The company has 27 shareholders and will run until 2034.[29] Negotiations started in 2006 and a contract was signed in 2008.[30]

As discussed in Pehuet Lucet[31], such a take-or-pay contract provides a hedging mechanism against fluctuations in price but renders the parties vulnerable to sustained changes in market prices. Due to the global financial crisis, and the consequent fall in electricity prices, competitors of members of Exeltium became able to procure electricity at much lower prices.[32] This created pressures to renegotiate the contract, which was done in 2014.[33] In any case, supply of energy started in 2010. Exeltium provides about a third of the energy consumed by these sites.[34]

4.3. *The Finnish Mankala model*

In this model industrial firms and/or utilities take a share in a company building the NPP. The model dates back to 1930s and was initially launched by firms in the wood product industries such as paper and pulp, which, again, are heavy users of electricity. The model is used for energy in general and OECD (2015) reports that in 2010, 42 percent of all electricity production in Finland was generated by Mankala Companies. Currently the Olkiluoto 3 power plant in Finland is being constructed by a consortium led by AREVA and Siemens through a Mankala scheme. The Mankala company involved in the project is Teollisuuden Voima Oyi (TVO), a consortium of local utilities, an electric company, the chemical industry, the city of Helsinki and other municipalities and utilities.[35]

The construction of the plant is governed by a fixed price turnkey contract between the TVO and the consortium. Hence construction risk is carried by vendors. The TVO is expected to sell electricity to its shareholders at cost, and they in turn can either use the electricity or sell it to the market. Since its electricity is to be sold under a contract under a cost based scheme, the TVO is protected from price risk, so are the shareholders/uses of electricity. Since pricing is cost based, TVO is protected from operational risk as well, which is borne by the users of electricity who are also the shareholders of TVO. Of course, for users there is again a price risk in the sense of opportunity cost, since it may be possible that TVO cost-based price may be higher than market prices that will emerge in the future. Also, the Olkiluoto 3 NPP project has been seriously delayed. Clearly, shifting the construction risk to the vendor has not prevented delays.

4.4. *Vendor Equity*

Vendors of nuclear technology may be interested in providing finance into projects that use the vendor's technology. As stated by WNN[36] since vendors do not have unlimited balance sheets, they will likely invest only in key strategic projects "in the most advanced projects that are likely to succeed, that will allow them a return on their investment in the shortest time and allow them to exit the project at the earliest opportunity."

4.5. Export Credit Agencies (ECA) debt and financing

Under this model ECA of the country exporting the project provides financing as a means of support for exports from the home country. In this model often a group of syndicated banks lends to the owner of the plant. The exporter delivers the goods and services to the client (owner of the plant) according to the project schedule, but is paid by the lending banks. What the ECA brings to the scheme is a repayment guarantee to the banks. The OECD has adopted an "Arrangement on Officially Supported Export Credits" which provides some guidelines and ensures that ECAs from countries that are members of the OECD provide similar support to their domestic industries. A specific agreement has been drawn for the nuclear industry and revised in 2009 providing a maximum of eighteen years for the duration of the loans. Non-OECD countries such as Russia often offer terms that are more attractive and longer durations (such as 25 years) and access to government loans as well.

4.6. Government support for private financing schemes

This can take the form of guarantees for private debt (such as a sovereign guarantee), power purchase agreements (PPAs) of contract for difference (CFDs). An example is the agreement between the UK government and Electricite de France (EDF) for building a nuclear plant at Hinkey Point. The agreement includes a 35 year contract for difference. A contract for difference is a hedge against price fluctuations. If the monthly electricity price is lower than the strike price the UK government compensates the EDF for the difference. If the price is above the strike price EDF will repay the government.[37]

4.7. Build Own Operate (BOO)

This scheme is mostly used by Russia whereby a consortium takes responsibility for developing, constructing and then operating the plant over its lifetime. As of September 2016, the only BOO project seems to be the Akkuyu project in Turkey.[38] The BOO model in nuclear energy is discussed in detail below.

5. THE BOO MODEL FOR NUCLEAR POWER PLANTS AND THE AKKUYU PROJECT

The BOO model for nuclear power plants transfers all the different types of risks associated with the construction and operation of a nuclear power plant to the project company that owns and operates the plant. In the case of Akkuyu, management of nuclear waste and spent fuel, as well as the decommissioning of the plant are also the responsibilities of the project company. As such, the BOO model provides very strong incentives to minimize costs, and to take advantage of any cost synergies between construction, operation and maintenance. In an era where parties are looking for innovative ways to share risks associated with the construction and operation of nuclear plants, an opportunity to transfer all major risks to the project company looks like a good deal.

The problem is that the tradeoff between minimizing costs and reducing quality is very large. From the perspective of the host country, private construction and operation is optimal only if quality is contractible. In the context of nuclear energy, contractibility is closely associated with having a credible and competent framework for safety regulation.

The Akkuyu project was launched through an intergovernmental agreement (IGA) between the governments of Turkey and Russia signed in 2010 and ratified in the same year in both countries. According to the agreement the responsibilities of the Russian side include engineering design, obtaining the necessary licenses and permits, financing, construction, commissioning, operation, maintenance, waste management and decommissioning, as well as the training of Turkish staff. The Akkuyu NPP will have four VVER-1200 reactors with a total capacity of 4800 MW. The first reactor is expected to start operations in 2020. The expected lifetime of the reactors is about 60 years.

The capital expenditure is expected to be about $20 billion. In line with the IGA, the Akkuyu Nükleer AŞ (Akkuyu Nuclear JSC) has been established as the project company, that is, as the owner and operator of the NPP with 100 percent Russian capital. The largest shareholder is Rusatom Overseas with 75 percent of shares. Atomstroyexport JSC is the general contractor for construction, engineering and procurement of the plant has 2.3 percent share and Rosenergoatom Concern OJSC, which is the operation and maintenance contractor, has about 22 percent share. Minority shares of Akkuyu Nuclear JSC can be sold at the market but the share of Russian party cannot be less than 51 percent.

The IGA envisages that a power purchase agreement will be signed between Akkuyu Nuclear and TETAŞ, the government owned wholesale company. According to the PPA, TETAŞ will purchase 70 percent of the electricity generated by the first two reactors and 30 percent of the electricity generated by the third and fourth reactors, once these reactors start operations for a period of fifteen years. The rest of the electricity, and once the PPA is concluded, all of the electricity produced will be sold in the market. Once the PPA expires, 20 percent of the net profits of the company will be given to the Turkish government.

The IGA indicates USD 123.5 per MWh as the average electricity purchase price to be paid by TETAŞ. The IGA also indicates that, to ensure the pay back of the project, Akkuyu Nuclear JSC may adjust the annual variations of the electricity price, within an upper limit of USD 153.3 per MWh. The details about how this adjustment will be made are not made public and is not clear from the IGA. Even though the details are not clear, we can state that the PPA will provide only partial relief from market risk that the Akkuyu company will face.

In short, then, all of construction risk as well as an important portion of market risk on the project company. The peculiarity of the Akkuyu BOO model is, of course, that Rosatom Overseas is not a regular private company, it is owned by the Russian state. It is well understood by all parties that the in last resort the responsibility for ensuring the successful implementation of the project lies with the Russian government.

The presence of the Russian government as a player of last resort may require a re-evaluation of cost reduction incentives of the project company. Information on the nature of the relation between the Russian government and Rosatom, and on what type of conflicts of interest this relation may entail is scarce. One might expect that government ownership of Rosatom is likely to generate soft budget constraints, that is, if for one reason another Rosatom loses money, it will be compensated from the Russian budget. This is likely to moderate the cost reduction incentives of Rosatom. However, it may also dim reputational incentives to maintain quality.

But ultimately, what is missing from in Akkuyu equation is the dimension of a credible and competent regulatory framework for nuclear safety. Cost reduction incentives are in conflict with the need to reach internationally accepted safety standards. Hence the regulatory framework for nuclear safety requires that such standards are enforced. International standards regarding conditions that need to be met for the effectiveness of such a regulatory framework are well established. As discussed elsewhere[39] currently Turkey does not meet these standards. First of all, Turkey does not yet have a comprehensive nuclear law or a regulatory authority that is independent. The legal framework is governed by two laws: the Law on the Construction and Operation of Nuclear Power Plants and Energy Sale (Law No. 5710, known as the "Nuclear Law"), which was enacted in 2007, and the Law on the Turkish Atomic Energy Authority (TAEK, Law No. 2690), enacted in 1982. As discussed in Atiyas[40] the Nuclear Law does not assign responsibilities for nuclear safety, it is mainly about competitive selection of companies to build nuclear plants. Law No. 2690 authorizes TAEK to secure nuclear safety by licensing and inspecting nuclear facilities. The gap in the legal and regulatory framework is compensated by Turkey's adoption of a number of international agreements.[41] Currently TAEK acts as the regulatory authority on nuclear energy.

One of the important elements of an effective legal and regulatory framework for nuclear safety is the independence of the regulatory authority overseeing safety issues. There are a number of important conditions for independence which are not met by TAEK. For example, the TAEK law gives TAEK the task of coordinating research and development activities which violates the condition that the regulatory authority should not be involved in promotional activities. Another condition for independence is that the decision makers in the regulatory authority should be protected from arbitrary dismissal from duty by the political authority; this condition is not met in the case of TAEK. The prime minister has undue influence on the decision making process, especially on licensing, which again violates independence. Also, TAEK does not have financial independence. Finally, transparency requirements of TAEK operations are highly deficient.

Another important concern regarding the competence of the regulatory authority is the question of human capital. The workload of TAEK will increase substantially in the near future, among other things, because of the licensing requirements of the Akkuyu and Sinop NPP projects, as well as the planned third NPP project.[42] The fact that the planned NPPs entail different models and different suppliers is going to make the licensing process even more challenging. According to the most recent report prepared by the International Energy Agency[43], in 2015, the Nuclear Safety Department of TAEK had 76 staff and an additional 20 to 40 people were expected to be recruited for the Akkuyu NPP licensing process, and 40 to 60 more depending on the developments for the Sinop NPP. Expanding the pool of competent staff will remain as a key challenge facing the TAEK in the near future.

6. THE BOO MODEL IN INTERNATIONAL PERSPECTIVE

Given that the BOO model places a significant amount of risk to the project company, how can one explain its emergence? The answer seems to be that it was a strategic choice by the Russian state to become a major player in the international market of nuclear plants.

Clearly the BOO model has many advantages for host countries, especially if the safety/quality issues mentioned above are somewhat discounted or at least are viewed with some level of procrastination, i.e. if the host country believes that the gap in regulatory oversight can be met over time. Besides the financial advantages, the BOO model absolves the host government of huge responsibilities such as the management of spent fuel and radioactive waste.

Form Russia's perspective, it seems that Russia had a clearly defined strategy to become a global supplier of nuclear plants.[44] The "one-stop nuclear shop" is an important component of that strategy, whereby "It will provide fuel and will permanently take back the spent fuel from its reactors—eliminating the need for some countries to build geologic waste repositories."[45] Training of future workers in nuclear plants is also part of the package.

Being the first project developed in a BOO framework, the Akkuyu project has already been presented as a "model" in various reviews of recent market developments.[46] It seems the BOO model will also be used in a project in Jordan.[47][48] In any case, the BOO model seems to be only one of the options available to Rosatom, or its export subsidiary Atomstroyexport, that is used to finance new projects, along with loans and joint ventures. [49] In effect, Rosatom is relying on government subsidies to become an international player in the market for nuclear plants. Rosatom's main source of finance is reportedly a National Wealth Fund (in other words, the state pension program).[50]

Russia's aggressive entry into international markets has attracted much attention. In 2014 it was reported that "According to the World Nuclear Association, Moscow is building 37 percent of the new atomic facilities currently under construction worldwide".[51] The following quotation gives a flavor of the coverage:

> "Bolivia is the latest in an increasingly long list of international reactor commitments for Rosatom, a massive state-owned corporation with some 250 subsidiaries and over 200,000 employees. Countries such as Hungary, Iran, Turkey and India have contracted, or are about to contract, massive multi-reactor projects from Rosatom, whose order book for the next 10 years is now a staggering $110 billion. No competing vendor -- France's Areva, US-based Westinghouse, South Korea's Korea Electric Power Corp., General Electric, Hitachi -- even comes close. Granted, many senior

> industry officials in the West doubt that many of the plants will ever see the light of day, arguing that the real purpose here is to plant the Russian flag in countries where Moscow craves more geopolitical influence. Still, Moscow emphasizes that a duo contract for building a nuclear plant and providing the uranium fuel can wed Russia to the client state for the lifetime of the plant, which nowadays can last a century if one includes one decade of construction works and two for decommissioning at the back end. As Rosatom's chief executive, Sergei Kiriyenko, recently said, "It is a question of geopolitical influence and relations with countries."[52]

That Russian nuclear exports may also serve geopolitical ambitions is a theme that appears frequently in international commentary. It is argued that long term Russian nuclear presence will afford the Russian government influence in countries crucial to regional geopolitics. [53]

Clearly this is a strategy that has financial risks. In 2015 concerns were raised that the Wealth Fund may not be sufficient to meet the financial support Russia has pledged for nuclear projects launched recently.[54] It has been emphasized, for example, that the Akkuyu project has been delayed and delays may feed into higher tariffs "The fear is that under Rosatom's vendor financing model, delays and unforeseen costs are recovered through electricity tariff hikes, effectively shifting the financial risk onto their cash-strapped local consumers."[55] This is probably exaggerated since in the Akkuyu project the maximum PPA price has been fixed and the rest of power will be sold in a competitive market. The same article mentions the concern that "cushy" deals proposed by Rosatom may discourage host countries to sufficiently invest in regulatory capacity, especially in human capital, which is probably correct.

To summarize, then, it seems best to see the BOO model as part of a more extensive strategy on the part of Russia to capture and increase market share in the field of nuclear exports. This is a strategy that is not confined to developing countries, but includes countries such as Hungary and Finland. It is a risky strategy, possibly laden with geopolitical ambitions, but is also increasingly seen as a highly competitive business model.

7. CONCLUSION

The utilization of the BOO model for new investments in nuclear energy is relatively recent and Akkuyu seems to remain as the prime example of the new model. From the perspective of incentives, the BOO model provides strong incentives for reducing overall costs of construction, operation and maintenance. It also allows the host country to bear minimum risks as most of the construction and operation, and, depending on the arrangements regarding pricing and sale of output, market risk is shifted to the project company. In the case of the Akkuyu project, the project company also takes on responsibilities for the management of spent fuel and nuclear waste, as well as decommissioning.

At the moment the BOO model is best seen as part of Russia's overall strategy to increase its share in international market for nuclear new build. It is a strategy that carries considerable risks and seems viable only because ultimately it is backed by the Russian government and financial resources. Still, it is being discussed as a new competitive business model.

The strong incentives for cost reduction and the opportunity it provides host government to transfer substantial risks to the project company makes the model attractive for countries especially for those which are new in the process of developing nuclear energy. However, strong incentives for cost reduction also entail strong incentives to save on quality, a tradeoff that has significant implications for nuclear safety. From the perspective of the host country, the BOO model makes sense only if there is a considerable apparatus that can monitor quality (in this case nuclear safety) and impose sanctions when quality standards are not met. This requires an independent and competent regulatory authority.

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41. IEA, (2016). *Turkey 2016 Review*. Energy Policies of IEA Countries. [online] Paris: International Energy Agency. Available at: http://www.iea.org/publications/freepublications/publication/EnergyPoliciesofIEACountriesTurkey.pdf. mentions that a new, more comprehensive draft nuclear law has been prepared. The details of this law have not yet been made public.
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Preventing the Worst Case: Accident and Consequence Management for Nuclear Power Plants and the Case of Akkuyu

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1. INTRODUCTION

In the list of mortality rates caused by the generation and use of various energy sources, nuclear energy ranks the lowest globally.[1] Furthermore with each accident the nuclear industry has updated its safety measures and the national and international regulatory agencies have upgraded their standards. Therefore, from a statistical standpoint, it is possible to argue that nuclear energy is one of the safest options. Yet, the catastrophic and long-lasting damage caused by severe accidents in nuclear power plants (NPP) - as exemplified by the Chernobyl disaster of 1986 and, more recently, of the Fukushima disaster of 2011 - suggest otherwise and highlight the importance of preparing for accidents and alleviating their consequences.

As Turkey inches towards becoming a nuclear energy-generating country with the establishment of Akkuyu NPP, it will need to reconsider its accident and consequence management structure in order to be able to take on the responsibility of managing a risky (low-probability but high-impact) operation. Yet, the Akkuyu plant will be built under the Build Own Operate (BOO) financial model by the Russian state-owned Rosatom, which will own the facility for the duration of its lifetime. Due to this financial arrangement unprecedented in the nuclear industry, the level of cooperation between the Turkish authorities and the Russian operator, as well as Turkey's ability to influence the decision-making on how the facility will be managed, may be problematic. This paper will start by briefly introducing the pillars of accident and consequence management for nuclear power plants. It will then look into Turkey's existing arrangements and plans for managing accidents, their consequences, and the organizational architecture in charge of them. Finally, the paper will analyze the potential shortcomings of the current Turkish emergency structure, especially in light of the challenges brought forth by the BOO model, and give recommendations.

2. THE ESSENTIALS OF ACCIDENT AND CONSEQUENCE MANAGEMENT

The International Atomic Energy Agency (IAEA), which serves as the key international organization in developing standards and guidelines for nuclear safety and security, lists the main goals of emergency response as follows:[2]

- Regaining control of the situation and mitigating consequences.
- Saving lives, and avoiding or minimizing the severe deterministic effects (detrimental health effects that occur in direct relationship to the absorbed dose of radiation).
- Providing first aid, critical medical treatment and treating radiation injuries.
- Reducing the risk of stochastic effects (detrimental health effects that occur by chance irrespective of the level of radiation absorption).
- Keeping the public informed and maintaining public trust.
- To the extent possible, mitigating non-radiological consequences, protecting property and the environment and preparing for the resumption of normal social and economic activity.

Successfully alleviating the effects of any given contingency rests on meticulous planning beforehand. Both for practical and operational purposes, it is possible to categorize the planning processes for three timeframes pertaining to an incident. The first is preparedness, which covers the timeframe before the actual incident and entails, among others, accident prevention, risk mitigation, facility and personnel protection, authority and responsibility delegation, and planning. The second is response, which begins the moment an incident occurs and envelops the immediate, short- and medium-term actions aimed towards minimizing and containing the effects of the incident. The last category is recovery, which encompasses long-term actions aimed towards returning to the 'normal' state of affairs, such as lowering radioactivity to acceptable levels and recuperating from the long-term effects of radioactivity to public health (physical and psychological) and agriculture.

2.1. *Preparedness*

Actions taken in the preparatory phase are decisive in how successful the response and recovery mechanisms will be. Once again, it is possible to break down preparatory actions into three categories: the preparation of the institutional and organizational framework, formulating response plans and testing these arrangements intermittently, and bolstering infrastructure and human capital capabilities.

2.1.1. Institutional and Organizational Framework

The IAEA's initial requirement in this regard is the establishment and maintenance of an "integrated and coordinated emergency management system"[3] to plan for and respond to radiological and nuclear emergencies. Tied to this is the allocation of resources to and development of the capabilities of the regulatory body and response organizations that would be in charge of the planning and response to a potential emergency. In this regard, it is vitally important for there to be a clear allocation of responsibilities amongst the response and management ecosystem, from regulators to emergency response teams on the ground. One such allocation is between on-site and off-site response, where the former falls upon the shoulders of the facility operator and the latter to governmental, local administrative, and non-governmental organizations. Still, the government cannot simply abandon all responsibility with regards to on-site preparedness and emergency response and should determine safety and security principles and requirements, as well as ensuring compliance, through the regulator.

As responding to an emergency requires a variety of complementary measures to be taken both simultaneously and sequentially, the lack of clearly defined roles, duties, responsibilities, and authorities for organizations would inevitably result in redundant or incompatible measures, if not outright chaos. Therefore, the IAEA also highlights the need for a "national coordinating mechanism"[4] to coordinate hazard assessments, ensure roles and authorities are clearly specified, and ensure consistency among emergency arrangements. Furthermore, the response and preparedness mechanisms designed for responding to radiological and nuclear incidents should also be coordinated with the wider emergency response architecture, including for conventional emergencies, both at the national and local level.

Evaluating the precedents of response to radiation emergencies within the 1945-2010 timeframe, the IAEA has compiled a comprehensive list of learned lessons.[5] While it is vital to have a clear understanding of the situation in an emergency, the IAEA notes that the gravity of the situation as well as which personnel, material, and expertise are required to respond to it are not readily available and clearly discernable as the situation unfolds. As the Three Mile Island (TMI - 1979) incident showed, in the absence of a clear allocation of tasks, multiple actors attempt to play the same role and are ineffective in doing so. The IAEA notes that the discrepancies in identifying and communicating information across response organizations "meant that critical emergency response functions were neglected."[6] In both the TMI and the Chernobyl disaster (1986), the severity of the emergencies was not clearly identified and the operator's confusion made matters worse. When the operators encounter a problem, they are tasked with providing first warnings and information immediately to off-site responders, both at the national and local level. However, in some instances, the operator personnel delayed relaying such information as they tried to solve the issue on their own or waited to report to their superiors.

Ambiguities surrounding the distribution of authority has caused problems at a wider level. Again, at the TMI incident, the IAEA reports that the regulatory body was asked for its assessment of the situation right away but, as the regulatory body, the Nuclear Regulatory Commission (NRC) did not have a clear role in the emergency plan. Thus, it was "unable to react on an appropriate timescale, or with an appropriate understanding of the situation to any requests that it received."[7] As such, after the incident, the NRC clarified its role by retaining responsibility for on-site activities and relegating off-site response duties to the Federal Emergency Management Agency (FEMA).[8] NRC's decision-making process during the TMI was also delayed because the decisions had to be approved by a majority vote of the five-member commission. As a result, the NRC's decision-making was streamlined by the appointment of a single decision-maker during emergencies.[9]

The streamlining of both decision-making processes and response mechanisms is a repeated call in the IAEA's publication regarding lessons learned. For one, the IAEA calls for the establishment of a command and control system to coordinate the responses of all off-site organizations with the on-site response, develop strategies, resolve disputes, and collect and assess information. The response management mechanisms of the national authorities and other response organizations should be integrated expeditiously, ideally at a single location in close proximity to the site of the emergency. The IAEA notes that some countries have established local coordination committees in addition to the one at the national level, which have worked to build up coordination, awareness, and mutual trust. It is noted that the effectiveness of such committees increases when they meet regularly and a full-time coordinator is tasked with administrative and logistical activities.[10]

The IAEA notes that arrangements that apply to normal situations may not apply to emergencies. With regards to streamlining, the Agency notes that while local agencies such as the police force and firefighters tune their radios to different frequencies to avoid overloading communications and interfering with one another, this may pose problems in emergencies as inter-agency communication becomes vital. Some countries (e.g. Canada, U.S. and Mexico) have also implemented an "Incident Command System which provides standardized terminology and concepts of operation and process for response at all levels of an emergency (local to national)."[11] The system has a clear chain of command led by the Incident Commander, and the system has "enhanced the effectiveness of multiagency responses by allowing an element from any response organization to be promptly integrated into the overall emergency organization."[12]

2.1.2. Planning for Emergencies

Drafting emergency plans and allowing the responsible authorities and responders to familiarize themselves with these plans forms an integral part of emergency preparedness. Both the operator and all the responding organizations should make comprehensive plans based on the assessment of risks and threats, which should be regularly reviewed and updated. Furthermore, there should be consonance amongst these plans, and they should be coordinated with other plans for responding to conventional emergencies. As is the case with the organizational structure, these plans should offer clear divisions of responsibility, authority, and tasks for the stakeholders. Moreover, in order to account for their actual capabilities and coordinate plans accordingly, the response agencies' and operators' plans should be drafted with the active involvement of all stakeholders involved in emergency response operations.[13]

The lessons learned that the IAEA has gathered suggest that the facility operators and response organizations failed in drafting emergency response arrangements for low probability, high impact incidents as they were considered very unlikely to happen. According to the Fukushima Nuclear Accident Independent Investigation Commission of the Japanese National Diet, this was also the case in the Fukushima nuclear disaster of 2011. According to the report, although both the regulator and the operator were aware of the risks posed by tsunamis, they were negligent in taking necessary precautions.[14] The regulator, Nuclear Safety Commission, even "informed the operators that they did not need to consider a possible station blackout (SBO) because the probability was small."[15] For a multitude of reasons, including the lack of regulatory capability and response mechanisms, the Japanese Independent Investigation called the Fukushima nuclear disaster a "profoundly manmade disaster".[16]

Some other such low-probability incidents are terror attacks, sabotage, and theft, which will be covered in more depth in the subsequent papers of this volume. Emergency response plans should account for malicious activity that may be conducted by outsiders and insiders. These malicious actors may both be the cause of the respective emergency or may act opportunistically and exploit vulnerabilities during an emergency.

While response measures to safety related incidents and security related incidents may entail differing procedures, they should not be contradictory.In a separate incident at the Three Mile Island facility in 1993, the response mechanism to an intruder resulted in the locking of all doors in Unit 1, "which interfered with the activation of emergency centers, off-site communications and notifications."[17] The IAEA concluded that in such conditions, the objectives of safety, such as minimizing detrimental health-related, environmental effects may conflict with those of security (e.g. responding to threats, collecting evidence). Alternatively, other blunders may be caused by the lack of coordination among the response plans of different actors. For example, when drafting evacuation plans during the TMI accident, two counties in the vicinity of the plant decided to reverse the flow of a freeway, with the southerly country deciding to direct all traffic north and the northerly country decided to direct all traffic south.[18] Luckily, a traffic gridlock was avoided because a limited evacuation order was issued.

The plans should incorporate predetermined criteria for classifying incidents, assessing on-site and off-site radiological conditions, and a clear definition of the transition from normal to emergency operations, including appropriate response measures and allocation of responsibilities for all respective conditions. The lack of such properly defined criteria may result in confusion, which may end up in delayed, erroneous, and conflicting decision making. The IAEA notes that such cases have eroded public confidence in the competence of the authorities and made the public less willing to follow authorities' emergency action recommendations.

A common theme encountered in both the IAEA's and the Japanese Diet's reports is the reluctance of the nuclear industry or pro-nuclear government authorities to acknowledge the risks associated with nuclear power plants. This is done primarily out of economic concerns, such as reducing public concern about nuclear safety and quelling anti-nuclear movements. In some cases, local officials hesitated in ordering evacuations on the assumption that this would increase fatalities by causing panic and traffic jams – though decades of precedents have shown that evacuations are quite common can be handled smoothly with proper management.[19] Whilst the operator cannot be expected to be concerned inherently and primarily about public health, the regulator has to be. Aside from the responsibility of the regulator to ensure that safety is the utmost concern when nuclear facilities are operated and during emergency conditions, it is also beneficial for the public to be informed about what may be expected of them in the case of an emergency. It has been noted in other contexts –such as the Israeli approach to protection against CBRN terrorism[20] – that pre-education of the public may be a critical element of preparedness and work in reducing panic and ensuring cooperation with authorities. The lack of pre-education may result in instances such as the hazardous material release in Bhopal, India, where the warning siren attracted the local population to the site out of curiosity, instead of the desired effect of causing them to move away and take precautions.[21]

2.1.3. Training and Capacity Building

The third pillar of emergency response, after institutionalization and planning, is execution. To be able to fulfill their designated roles according to emergency plans, all actors involved in on-site and off-site emergency response activities should have sufficient capabilities. Allocation of tools, equipment, and funds, and the preparation of logistical and communication arrangements for emergency responses are necessary before the facility begins its operations. These arrangements and tools should have alternatives according to the IAEA, as the emergency may render the primary ones inoperable.[22] As with all steps of emergency preparedness, states may collaborate with the IAEA and other international and state actors to expand their capabilities.

The human factor plays a major role in the capacity to respond to emergencies adequately. As such, the IAEA requires that both the operator and organizations tasked with emergency management should employ sufficient amounts of qualified personnel to fulfill the requirements of emergency response. Qualified personnel should be available 24/7 as emergencies occur regardless of office hours, and their fitness for duty should be assessed routinely. Furthermore, personnel should be familiar with both the emergency response plans and the equipment they will use during the actual response through training and regular exercises.

Experience from decades of radiation emergencies suggests that training should cover more than just emergency plans and equipment. One such case relates to medical personnel in the vicinity of nuclear facilities, especially those that work in hospitals designated under emergency response plans. For one, medical personnel should be trained to notice and diagnose the symptoms of radiation exposure correctly. Specialization would be vital for the immediate term, as it would increase the capabilities of medical personnel to assist overexposed workers and emergency responders, especially first-responders, after an emergency. Proper training and specialization are also a vital for the long term following a radiation emergency, as early identification of exposure and long-term follow-up are necessary in reducing the effects of thyroid cancer, among others.[23] Furthermore, medical personnel should be well-versed in how to protect themselves against exposure when treating exposed personnel after an emergency.

In cases of major exposure, triage – separation of patients into different categories based on the severity of their condition – may come as a necessary response. Yet, the lack of preparedness for such measures may significantly hamper the process. According to the IAEA, during the Goiânia accident, triage entailed establishing multiple medical facilities and staffing them with health personnel experienced in treating contamination. Yet this strategy also entailed separation of families, which caused distress among patients. Additionally, there were shortages in experienced staff, some medical staff that were afraid of radiation exposure and contamination from patients, and the authorities were inable to control contamination and contaminated waste in the facilities.[24] As such, it would be wise to develop a worst-case scenario emergency medical response plan, which would ensure that adequate equipment, trained medical personnel, and logistical arrangements are in order.

Similar to medical personnel, facility personnel, first-responders, local authorities and actors responsible for emergency response should also be knowledgeable and trained. Facility personnel should have the ability to detect dangerous conditions and act immediately to contain and report them. First-responders and local officials should be trained in recognizing the radiation warning symbol and other danger indicators. Unless they are educated and trained, both employees and responders may not respond to emergencies adequately and endure more harm themselves.

The following excerpt from IAEA's compilation of lessons learned, highlights the importance of training and exercises:

> "Many managers directing initial response were ineffective because they had not been trained under realistic emergency conditions and the response system was not designed for severe emergencies (e.g. TMI, Chernobyl). These managers were overwhelmed and confused by the stressful environment, performed their subordinates' tasks rather than their own managerial roles, had to move to new locations at crucial times, lacked telephone access because of jammed lines, and failed to develop an understanding of the true nature and severity of the emergencies. During the response to emergencies, senior officials/managers caused confusion by developing ad hoc plans because they were unaware of the plans and procedures that their organizations had established. Quite often, senior managers and decision makers failed to recognize the need for their participation in training and for identifying their roles in emergency situations."[25]

Finally, while the decision making should be streamlined, which means that it will likely be centralized, local actors are in the best position to respond to emergencies and read early warning signs, but local actors often lack the necessary personnel, training, and equipment to do so effectively. If their conditions are not improved to meet the standards set by emergency response plans and unless all actors become familiar with the response plans through extensive training and exercises, they will unlikely produce timely and adequate responses. However, the IAEA notes that "local emergency local emergency planners have difficulty getting other local agencies such as police, fire, and emergency medical services to commit staff time to developing emergency plans and procedures and to participating in training, drills and exercises."[26] Even if this is overcome, the emergency drills still need to be tailored to reflect the necessities of an actual emergency response. In its evaluation of the Fukushima disaster, the Japanese Independent Investigation Commission noted that even though there were comprehensive nuclear disaster drills sketched by the government, it failed to consider severe accident or complex disaster scenarios. Furthermore, "as the scope of the drills expanded, they lost substance, and were performed for cosmetic purposes … the irrelevant drills were lacking instruction in the necessity of using tools"[27] and as a result "participants found the drills useless at the time of the accident."[28]

2.2. *Response*

The main functional goals of emergency response are regaining control of the situation, avoiding additional detrimental consequences, rendering first aid to those affected from the incident, and taking protectionary measures to mitigate effects on the economy, environment, agriculture, and public health. As the severity of nuclear and radiological accidents may range from minor accidents with limited economic consequences to catastrophes that affect millions of people in multiple countries, first-responders, response agencies and local affiliates must possess a breadth of capabilities.

2.2.1. On-site Response

For the facility operators, the initial challenge is to correctly identify an emergency, swiftly take appropriate measures, and promptly notify off-site emergency response authorities. As the first people to arrive at the scene and therefore the most susceptible to radiation, the response structure should be shaped to ensure the safety and well-being of first-responders by properly educating emergency workers about the risks and precautions and providing sufficient, up-to-date, and operational protective equipment and monitoring instruments. The 2014 Soma disaster that claimed the lives of 301 miners, many of which died because they were unable to use their obsolete and moldy gas masks, should serve as a fresh reminder to Turkish policymakers of the indispensability of protective equipment.[29]

Prompt communication of on-site responders and facility operators with off-site response personnel and agencies is also key in determining which response mechanism will be employed. The continuity of this communication – and the availability of diverse and redundant systems for ensuring it – are also vital for the continuity of emergency response operations, as the consequences of the accident may worsen considerably over time and may require operations to be carried out over many weeks. The TMI incident highlighted this issue when over 4,000 calls within the first days of the accident jammed the telephone lines of the control room and prevented receipt of important information.[30] The situation worsened when the public telephone systems in the vicinity broke down as it was overloaded by the public, which prevented the regulatory body from maintaining communications with the site.

2.2.2. Off-site Response

The main aim of mitigatory actions aimed at reducing radiation exposure are fourfold: to "decrease *time* of exposure, increase *distance* from source, provide *shielding* from plume, or limit *ingestion* of contaminated foodstuffs."[31] FEMA divides radiological incidents into three phases.[32] The early phase, also referred to as the emergency or plume phase, is the period that lasts from the initial release of radiation to the end of radiation release and may last hours or several days. This phase is the most vital for limiting radioactive release and exposure and requires immediate decisions and actions to be undertaken. Furthermore, projecting dose radiation takes time and initial readings after an incident may likely yield uncertain results, which will force responders to make decisions based on their understanding of the situation of the NPP and projections for worsening conditions.[33] The IAEA notes that due to these reasons the initial step in any incident involving damage to the core or fuel in the spent fuel pool should be to immediately take precautionary protective action in the 3-5 km vicinity of the facility.[34] Stressful environment, complexity, multiplicity and uncertainty of information, as well as internal and external pressure, would likely characterize the initial phase. Furthermore, as the radiological incident may have been caused by an initial natural disaster, such as the Fukushima case, or by a deliberate attack of an adversarial group with or without the aid of insiders, further logistical issues may ensue and complicate the picture. All this, highlight the importance of preparedness as a precondition for successful emergency response.

Another protective action is evacuating all people in a predetermined radius to prevent or limit exposure to radioactive plume. Referred to as the Urgent Protective Action Planning Zone (UPZ) in the IAEA publications (approximately 30 km radius for large reactors), and as Plume Exposure Pathway Emergency Planning Zone (PEP-EPZ) in FEMA publications (approximately 10 mile radius), this evacuation zone aims to avoid acute health effects and lower the risk of delayed health effects in cases of radiation dispersion due to design basis incidents or most core damage scenarios, and in worst-case core damage scenarios, prevent exposure to immediate-life threatening doses.[35] In cases where residents cannot be evacuated, sheltering may provide a temporary solution. Distribution of potassium iodide tablets to prevent radioactive iodine buildup in the thyroid gland is another mean of mitigating risks, but as the pills only serve to block radioactive iodine and do not repair the damage already done, they should be distributed rapidly and with care.[36] As such, provisions should be in place for a worst-case scenario.

Another vital part of preventing the effects of radioactive release is promptly cutting off ingestion of potentially contaminated water, dairy, meat, and crops since their consumption may increase the risks of cancer in the thyroid, bone marrow, and other organs.[37] As contamination can last months or even years and may spread through rainwater and wind, the radius of the Ingestion Exposure Pathway EPZ (IEP-EPZ) as recommended by FEMA is 50 miles, whereas the IAEA's *food restriction planning radius* is 300 kilometers, and the precautionary measures stay in effect until the soil and water sources are analyzed and proven to be safe. These actions mostly take place in the intermediate phase of radiological release according to FEMA. This phase, which begins after the release of radioactive material is terminated and ends when the protective measures are no longer necessary, may last many months and allows for calmer decision-making as reliable environmental measurements may be used as a basis. Another action that largely falls under this period is the long-term relocation of the population based on values of ground deposition and may cover an area of 250-300 km according to the IAEA.[38]

In its collection of lessons learned, the IAEA further underlines the vitality of precautionary measures:

> "Studies and experience also show that releases into the atmosphere during severe emergencies … are unpredictable. They can occur via an unmonitored release route and can begin within minutes after core damage. Consequently, facility operators cannot predict with certainty the occurrence of a major radioactive material release, the magnitude and duration of any such release, or its radiological consequences However, studies also show that taking precautionary protective actions (such as evacuation, substantial shelter, iodine thyroid blocking and restricting consumption of food and water that may be contaminated) promptly upon the detection of conditions in the facility that might lead to fuel being damaged (uncovered) will greatly reduce the off-site consequences."[39]

As the Chernobyl disaster highlighted, the realization of worst-case scenarios may lead to cross-border incidents and require multiple countries to take precautionary action. In fact, Turkish authorities have been criticized for favoring economic considerations over public health in the Chernobyl issue and for allowing crops, especially tea, to circulate in the market after the disaster. One notorious example was when the Minister of Industry and Trade at the time drank tea on live television to prove there it was not contaminated with radiation. Still, the Chernobyl disaster and the lack of effort on the part of the Turkish government to ease the public's worries form the foundation of the anti-nuclear movement in Turkey, and cancer rates in the Black Sea coast are widely attributed to the Turkish government's mishandling of the incident – even against the lack of evidence to back this claim.[40]

2.2.3. Public and Media Outreach as an Essential Element of Emergency Response

As a matter of fact, addressing concerns of the public and media is a vital part of emergency management. For one, informing the public reinforces the opinion that the government or respective authorities have the best interest of the people at heart, which in turn makes the public more compliant with emergency response measures and recommendations and eases the psychological effects in the aftermath of an incident. While officials and facility operators may be inclined to downplay problems for a variety of reasons, be it avoiding mass panic or economic concerns, this type of behavior is mostly self-defeating as the lack of trust that arises out of lack of information tends to exacerbate these concerns. For example, the IAEA notes that the 1999 criticality incident at the Tokaimura fuel conversion plant in Japan, resulted in the deaths of two workers but did not cause any significant radiation release or exposure. Still, as public concerns were not addressed, the incident resulted in "severe economic and psychological damage."[41]

The 2011 Fukushima disaster also provides an eye-opening example of the effects resulting from the absence of a communication strategy, especially when combined with lack of prior planning and training:

> "The central government was not only slow in informing municipal governments about the nuclear power plant accident, but also failed to

> convey the severity of the accident. Similarly, the speed of information in the evacuation areas varied significantly depending on the distance from the plant. Specifically, only 20 percent of the residents of the town hosting the plant knew about the accident when evacuation from the 3km zone was ordered at 21:23 on the evening of March 11. Most residents within 10km of the plant learned about the accident when the evacuation order was issued at 5:44 on March 12, more than 12 hours after the Article 15 notification—but received no further explanation of the accident or evacuation directions. Many residents had to flee with only the barest necessities and were forced to move multiple times or to areas with high radiation levels. There was great confusion over the evacuation, caused by prolonged shelter-in-place orders and voluntary evacuation orders. Some residents were evacuated to high dosage areas because radiation monitoring information was not provided. Some people evacuated to areas with high levels of radiation and were then neglected, receiving no further evacuation orders until April."[42]

The cacophony of conflicting information creates similar problems. As the media and the public scramble to gather information, various sources of authority, which may have inaccurate, conflicting or outdated information, are sought out. During the TMI incident, conflicting information provided by different authorities fueled public confusion, concern, and mistrust of officials and was only remedied after "the President of the USA ordered that all official assessments must come from a single source of official information located in a facility close to the location of the accident."[43]

Furthermore, if the information flow is not managed properly by official sources, the media "are very likely to seek the views of 'self-appointed experts'"[44] which may complicate the situation further. During an incident in Turkey in 1999 where 10 people were injured due to cobalt-60 sources that were sold as scrap metal, the IAEA noted that there was severe pressure from the media to pour concrete over the area where the source was located, which would have actually been detrimental to recovery operations and locating other sources – luckily the pressure was resisted.[45]

On the other hand, with proper information management, the media may serve as an asset. After former spy Alexander Litvinenko was killed by polonium-210 in 2006 in London, the British authorities followed an exemplary public and media communication strategy that included providing Q&A documents on a website, holding press conferences, making staff available for interviews according to the deadlines of media agencies, providing visual backdrops for television, providing information about locations and dates at which individuals may have had intakes of polonium-210, and clearly communicating to the public both the developments and the message that polonium-210 was not an external radiation hazard.[46] Although these efforts consumed staff resources and were logistically challenging, it was essential to establishing and maintaining public confidence.

Ankara is not renowned for its transparency and accountability. Still, Turkish policymakers, respective authorities, and the private companies that will be involved in the Akkuyu project should re-examine the example of how Ankara handled the Chernobyl incident and consider that pre-education and effective communication are essential factors in augmenting the effectiveness of safety and precautionary measures, ensuring public trust, and maintaining long-term public support for nuclear energy. Furthermore, both transparency and accountability serve to ensure the quality of decision-making as well as shielding regulators, utilities, operators, and emergency response agencies from undue political influence.[47]

2.2.4. Resisting Political Pressure

Undue political influence may present another complicating factor to emergency response operations. For one, even before an emergency takes place, political influence over the national regulator, politically motivated licensing, cozy relations with the operator and utilities, or corruption could hamper capabilities in both preparation and response phases. Furthermore, due to the stakes involved and mounting public pressure, political authorities might feel compelled or enticed to meddle in the emergency response process. The Fukushima case presents a good example in this regard.

In this case, the Office of the Prime Ministry (hereafter Kantei) broke the planned chain of command. Instead of communicating with the nuclear emergency response authority and the regulator Nuclear and Industrial Safety Agency (NISA), Kantei directly contacted the Fukushima site and the operator Tokyo Electric Power Company (TEPCO). The disruption of accurate communication between these actors, as well as the failure of the planned accident response architecture of the government, compelled Kantei to take matters into its own hands. An *ad hoc* decision-making group formed to deal with the crisis, which included politicians that were neither nuclear experts nor had a clear sense of the on-site situation.[48] One manifestation of this inexperience was that Prime Minister Naoto Kan was not fully aware (nor was he advised properly) that a necessary first step in response to the accident was declaring a state of emergency. As the Kantei's distrust towards the operator, regulator and emergency response authority mounted, the Prime Minister decided to visit the site himself and give directions which "diverted the attention and time of the on-site operational staff and confused the line of command."[49] Although the operator and regulator agreed on initiating several measures – such as the injection of seawater – Kantei, which was unaware of this decision, intervened and hampered the process. Furthermore, as the decisions were made on an *ad hoc* basis, governmental agencies could not cooperate as necessary. In fact, the government decided to establish a government-TEPCO headquarters at TEPCO, which complicated the originally planned communication and chain of command even further, disrupting TEPCO's response and causing disorder in the NPP site.[50] These issues were further exacerbated, according to the Japanese investigation commission report, by the 'obedience to authority' mindset of the TEPCO management, which instead of taking strong decisions and clearly communicating them to the government, as was its responsibility, "insinuated what it thought the government wanted and therefore failed to convey the reality on the ground."[51]

Finally, by focusing its efforts on areas where its intervention was unwarranted, the government forgot its main priority and failed to address major issues such as deficiencies in the evacuation. As summed in the Japanese investigation commission report:

> "At all times, the government's priority must be its responsibility for public health and welfare. But because the Kantei's attention was focused on the ongoing problems at the plant— which should have been the responsibility of the operator—the government failed in its responsibility to the public. The Kantei's continued intervention in the plant also set the stage for TEPCO to effectively abdicate responsibility for the situation at the plant". [52]

2.3. *Recovery*

The late phase of an incident occurs when recovery and consequence management actions are aimed at reducing radiation levels to "acceptable levels for unrestricted use"[53] and may last years. The end goal of this period is to enable the resumption of normal social and economic activity. This is mainly achieved through decontamination activities, such as topsoil removal and roof cleaning. Although the means necessary is highly dependent on the circumstances of the incident, one critical issue remains the same for all cases "what to do with the waste?"[54] Therefore the IAEA recommends that recovery actions also be planned in advance.

The other important aspect of recovery operations is mitigating the psychological and other non-radiological consequences of the incident. For one, evacuated or relocated people will be eager to return to their homes and businesses. Once the public and the media believe that the emergency response phase is over, considerable pressure to return to normal living conditions ensues.[55] According to the IAEA, this pressure may compel officials to take highly visible actions to satisfy public demand, but these actions may have limited or even detrimental effects on the recovery process. Hence, in addition to having a communication strategy with the media and the public, authorities should maintain a high level of credibility and resist the temptation to undertake actions that would have limited or negative effects on public safety.

In worst-case scenarios, the psychological effect may be overwhelming. "Interference in funerals of victims, shunning victims or people from the affected area, refusing to buy products from the area, refusing to sell airline tickets to people from the area, having abortions due to a fear of genetic effects, refusing to provide medical treatment to victims"[56] are only some of the incidents that the IAEA lists. Due to the combination of their fear of radiation, misinformation about the event, lack of sufficient explanatory information and the ensuing mistrust of authorities and experts, people may harbor feelings of helplessness and loss of control over their own lives. Furthermore, the application of measures aimed at reducing public stress, such as compensations, may have the adverse effect by creating misconceptions about the actual health risks involved – which was the case in Chernobyl.[57] Therefore the authorities must have carefully thought-out strategies for recovering both the environment, and the mental/physiological of the individuals effected and the general public.

3. NUCLEAR ACCIDENT AND CONSEQUENCE MANAGEMENT IN TURKEY

This section aims to elaborate on Turkey's accident and consequence management capabilities in addition to investigating potential safety and security measures that can be undertaken by the responsible bodies for managing incidents in nuclear power plants under current conditions.

3.1. The First Phase: Regulatory Preparedness

The first official document defining allocation of resources and responsibilities to national and local level institutions and the development of necessary capabilities of all actors ranging from national regulators to the local emergency response teams on the ground is the Disaster and Emergency Response Services Regulation (*Afet ve Acil Durum Müdahale Hizmetleri Yönetmeliği*). This Regulation was issued on the Official Gazette number 28855 dated December 18th, 2013, and has been in force since then.[58]

In the framework of Article 6 of this Regulation, the Disaster Response Plan of Turkey (*Türkiye Afet Müdahale Planı – TAMP*) was put into force in 2013 to ascertain the roles and responsibilities of service groups and coordination units that would work together in disaster and emergency response in addition to identifying the basic principles of response planning.[59] A clear allocation of responsibilities among related central and local bodies as well as emergency response teams on the ground regarding chemical, biological, radioactive and nuclear risks (CBRN) are also defined in TAMP.[60] The Prime Ministry Disaster and Emergency Management Authority (AFAD) accordingly set and deployed CBRN teams, which have particularly been concentrated in the southeastern frontier provinces against increased potential CBRN risks emanating from the Syrian Civil War. AFAD tasked almost 400 CBRN experts, more than 200 personnel from 11 search and rescue brigades, and over 150 personnel from AFAD provincial directorates related to CBRN.[61]

The main document defining the responsibilities and capabilities of experts and teams is the Turkish *Draft National Radiation* Emergency *Plan* (*Ulusal Radyasyon Acil Durum Planı Taslağı – URAP*). URAP was developed by the *Turkish* Atomic Energy Authority (TAEK) in line with TAMP and AFAD is expected to implement it as the coordinating authority.[62] Though pending ratification at the time of writing, this plan defines the basic terminology as well as the legal basis for relevant authorities in the case of a radiation emergency. In addition, it determines the respective service groups and allocates the roles and responsibilities to related ministries, institutions, and service groups. It is possible to say that URAP is an attempt to establish an integrated and coordinated emergency management/response system in the event of radiological and nuclear emergencies in on- and off-site emergency response facilities. In many aspects, the document mirrors IAEA publications on nuclear accident and consequence management and forms the basis of Turkey's plans in this regard.

3.2 The Institutional Structure

Ministries and institutions responsible from any emergency radiation event in Turkey listed in the By Law on the Tasks Concerning Chemical, Biological, Radiological and Nuclear Hazards[63] (*Kimyasal, Biyolojik, Radyolojik ve Nükleer Tehlikelere Dair Görev Yönetmeliği*) and the By Law on the National Practices in Case of Nuclear and Radiological Hazards (*Nükleer ve Radyolojik Tehlike Durumu Ulusal Uygulama Yönetmeliği*)[64] are as follows:

1. The Disaster and Emergency Management Presidency of Prime Ministry,
2. Turkish Atomic Energy Authority,
3. The Ministry of Interior,
4. The Ministry of Health,
5. The Ministry of Food, Agriculture and Livestock,
6. The Ministry of Transport, Maritime Affairs and Communications,
7. The Ministry of Environment and Urbanization,
8. The Ministry of Energy and Natural Resources,
9. The Ministry of Foreign Affairs,
10. The Ministry of Forestry and Water Affairs,
11. Turkish General Staff,
12. General Directorate of Turkish State Meteorological Services,
13. Turkish Red Crescent,
14. Ministry of Family and Social Policies,
15. Ministry of Customs and Trade,
16. Presidency of Religious Affairs.

This designation is mirrored in URAP, which gives AFAD and TAEK the primary roles and responsibilities. As far as nuclear energy is concerned, TAEK is responsible for determining the basis of the national policy and the related plans and programs regarding the peaceful utilization of atomic energy. In cooperation with TAEK, AFAD is the main national regulatory agency that will decide the country's safety and security measures and standards in regards to Turkey's overall accident and consequence management structure, including nuclear facilities. Both of these institutions are responsible for the establishment of an integrated and coordinated emergency management system to plan for and respond to radiological and nuclear emergencies.

3.2.1. The Turkish Atomic Energy Authority (TAEK)

TAEK is the national authority responsible for research and development activities in nuclear energy and technology.[65] The Law on Turkish Atomic Energy Authority, dated 1982, authorizes TAEK as the regulatory body for all nuclear and radiation activities and facilities in Turkey. TAEK is the sole authority that can grant approval, permission, and license pertaining to the site selection, construction, operation, and environmental protection of nuclear power and research reactors and nuclear fuel cycle facilities. TAEK, accordingly is responsible from making the necessary inspections and controls, to limit (restrict) the operating authority in case of noncompliance with the permission or license. TAEK has the authority to cancel licenses permanently or temporarily and to make recommendations to the Prime Minister for closing down installations. Furthermore, TAEK is responsible for the safe processing, transport, permanent, and temporary storage of radioactive waste. It determines the general principles for all kinds of prospection, exploitation, purification, distribution, import, export, trade, transport, use, transfer and storage of nuclear raw material, fissionable material and strategic materials used in nuclear fields. TAEK operates as the responsible authority for radiological and nuclear safety, preparing and implementing decrees and regulations on nuclear material and facilities. In addition to its tasks in civilian nuclear and radiological research, international outreach, training, and education in the nuclear field, TAEK is also charged with enlightening the public in nuclear matters. [66]

In order to fulfill these duties and responsibilities, TAEK is comprised of five departments and three research and training centers.[67] Among those bodies, the Department of Nuclear Safety (DNS) is responsible for regulatory activities in nuclear safety and security.[68] DNS is the responsible unit for the licensing of nuclear installations (review and assessment of documentation related to nuclear safety) and the preparation and amendment of regulations and inspection of nuclear installations. Nuclear power plant licensing activities are carried out by DNS in coordination with the Advisory Committee on Nuclear Safety (ACNS) and The Vice President for Nuclear Power and Safety.

The Department of Radiation Health and Safety is the responsible body for regulatory activities in radiation, transport and waste safety.[69] Moreover, it is tasked with a variety of duties, including deciding upon and implementing necessary measures in case of a radiological accident; taking precautionary measures against radiological contamination; and the authorization or suspension of the entry, exit, transit and transport of radiation sources and persons, contractors, institutions and governmental bodies associated with these activities.

3.2.2. The Disaster and Emergency Management Presidency of Prime Ministry (AFAD)

The national coordinating authority for disasters and emergencies including nuclear and radiological emergencies is the Disaster and Emergency Management Presidency.[70] AFAD was established in 2009 under the auspices of the Prime Ministry with Law No.5902, replacing three general directorates and taking over their responsibilities.[71] Now, AFAD is the responsible institution for Turkey's disaster and emergency strategy and sets the roles and responsibilities at both the national and local level. AFAD's duty is to coordinate all institutions and organizations that take part in preparation for disasters, manage their consequences, and develop policies in this regard.[72]

AFAD runs a wide range of operations in numerous areas. Its purview ranges from natural disasters such as earthquakes and floods to social disasters, as refugee and immigrant influxes, and technological disasters such as CBRN attacks and dispersion. In sum, in case of emergencies, disasters, and civil defense, AFAD is the determining and coordinating authority in preparation, mitigation, response, and recovery operations nationwide.

The disaster and emergency management structure coordinated by AFAD has reached a high level of regional and local coverage throughout the country to locally coordinate and manage disasters, in line with the institutional decentralization policy. AFAD currently hosts Provincial Directorates of Disaster and Emergency[73] (*İl Afet ve Acil Durum Müdürlükleri*) in all 81 provinces of the country, and the Disaster and Emergency Search and Rescue Brigades[74] (*Afet ve Acil Durum Arama Kurtarma Birlikleri*) in 11 provinces, most of which are based in sensitive earthquake zones and population centers. With regards to Akkuyu, the closest Disaster and Emergency Search and Rescue Brigade is based in the neighboring city of Adana.

According to its 2013-2017 Strategic Plan, AFAD has a holistic approach to disaster and emergency management and has introduced a new disaster management model in Turkey by shifting the focus from 'crisis management' to 'risk management.'[75] This model has four important pillars:

1. Increasing institutional capacity to limit the impact of hazards and to minimize the risks triggered by disasters,
2. Building up systematic approaches and integrated disaster and emergency management processes,
3. Systematic incorporation of disaster management activities into development policies to reduce/mitigate negative aspects of such disasters on the population,
4. Enhancing coordinated efforts among public, private sector and civil society actors.[76]

As AFAD increased the demand for the disaster and emergency management cycle (prevention/mitigation, preparedness, response, post-disaster rehabilitation/reconstruction), the maturity level of respective institutions has also started to increase for the transfer of know-how and technical support. One of the best examples of this know-how transfer is the road map document on the protection of critical infrastructures in Turkey.[77] This initiative, pioneered by AFAD, was released in September 2014 with the participation of all related parties in Turkey on the protection of critical infrastructures. The document is the first official document that defines and categorizes critical infrastructure in Turkey as well as the duties and responsibilities of all relevant authorities.

In the hierarchical structure of responsibilities, the Disaster and Emergency High Commission is placed at the top.[78] The Commission meets at least twice in a year but may meet additionally if the chairman deems it necessary. The Commission approves all plans, programs, and reports related to disasters and emergencies. The main duties and objectives are to specify the measures to be taken; to facilitate and supervise their implementation; to provide coordination among organizations, institutions, and NGOs; and to evaluate the situation after the event. The approval and testing of emergency plans and procedures are to be completed before the first shipment of nuclear fuel arrives on the Akkuyu site. Similarly, with its Regulation on the Physical Protection of Nuclear Facilities and Nuclear Materials, TAEK requires plant operators to submit 'Top Secret' plans for the physical protection of the plant, which must incorporate measures on emergency response and the physical protection of nuclear material during transportation, for TAEK's approval.[79] According to Article 11.3 nuclear material cannot be moved to the facility before TAEK approves this plan.

The second body in the hierarchical order is the Disaster and Emergency Coordination Board and its main duties are to coordinate between the foundation, institutions, and non-governmental organizations; to evaluate information; to identify measures to be taken; to ensure the application of this measures; and to supervise in case of disaster and emergency situations.[80] The Board meets at least four times a year and may meet if the chairman deems it necessary. The secretariat of the Board is conducted by AFAD.

3.3. Formulating Response Plans

As mentioned above, the main document defining the responsibilities and capabilities of these related bodies is Turkish National Radiation Emergency Plan (URAP). URAP's main intention is "to specify both basic national and local level guidelines for planning, responding to any radiation emergency situation developed within the country or abroad as well as conducting international relations."[81] Thus the plan contains detailed clauses to coordinate activities of related ministries, institutions, and local districts with the aim of conducting integrated and coordinated emergency management systems against potential radiological and nuclear emergencies. These plans take into consideration incidents that may happen on Turkish soil, territorial waters, exclusive economic zones, and even neighboring countries.

In line with the relevant IAEA publications, URAP defines the targets of emergency response as follows:

1. Retaking control of the situation,
2. Preventing on-site and off-site detrimental consequences of the emergency,
3. Preventing or minimizing heavy deterministic consequences,
4. Rendering first aid and emergency medical response; delivering critical medical response and treating radiation injuries,
5. Minimizing the risk of stochastic effects,
6. Minimizing non-radiological effects,
7. Informing the public,
8. Protection of property and the environment,
9. Taking measures to restart social and economic activities when the suitable environment reinstated.[82]

With these aims at hand, URAP sets 15 separate service teams whose tasks include logistics, fire response, communications, search and rescue, foodstuffs, agriculture, livestock, and psychosocial support. Mirroring the IAEA's regulations, nuclear facilities are categorized according to the risks involved. The Akkuyu and Sinop

NPPs along with the nuclear warships visiting Turkish ports are under Category 1, the highest level of radiation emergency category.[83] URAP delegates the responsibility of planning for radiation emergency plans at the national level for this category to AFAD and TAEK. Both of these institutions are also responsible from the coordination of any activities related to the emergency preparedness and response at the local level together with the district governors and operators.

As set forth by the Regulation on Disaster and Emergency Management Centers[84] ministries, associated bodies and local administrations are tasked with establishing Disaster and Emergency Management Centers (*Afet ve Acil Durum Yönetim Merkezi* – DEMC). According to URAP, AFAD DEMC, in tandem with the Prime Ministry's DEMC, is the body responsible for response, coordination, and collaboration at the national level. When it comes to radiological emergencies, TAEK DEMC takes the lead and is responsible for radiation monitoring, coordinating, and implementing emergency response activities and advising relevant authorities on the protective measures that need to be taken.[85] In cooperation with the Ministry of Foreign Affairs, TAEK is responsible for informing the IAEA and other related international bodies, requesting assistance, and notifying other states in case of trans-border radiological incidents.

Turkey is one of the countries that initiated establishing its own Radiation Early Warning System (RESA) starting from 1986. After the Chernobyl accident, many countries were compelled to have an emergency system that could provide information on the long-range atmospheric transport of radioactive nuclides resulting from a nuclear accident that could break out in foreign countries. There are currently 193 stations installed in Turkey.[86] TAEK DEMC is the main institution responsible for controlling the RESA system and sharing its measurements with the European Radiological Data Exchange Platform (EURDEP).

3.4. Implementation Practices

URAP defines the chain of command and means of coordination among the various authority levels. AFAD and TAEK are the main bodies tasked with almost every item on the plan from preparing a national guide for the specification of the roles and duties of the emergency response personnel to the details regarding their protection.

These two bodies are also responsible for the evaluation of health risks emanating from radiation as well addressing the public and media.[87] AFAD and TAEK were given the responsibility to designate and control acceptable levels of radiation in the air, food, agricultural products and livestock. AFAD also has the responsibility of appointing an official speaker to publicize precautionary information to the public, the media, and other outlets. Furthermore, TAEK and AFAD are tasked with evaluating and disclosing the effects of radiation on workers and the public, taking actions regarding contaminated crops, livestock, and property.

As is the case internationally, the facility operator is charged with classifying any nuclear and radiological emergency situation on-site and developing specific protection measures according to URAP. Operators are also responsible for taking on-site measures and promptly notifying the off-site emergency authorities, namely the Provincial Disaster and Emergency Management Center (*İl Afet ve*

Acil Durum Yönetim Merkezi – IAADYM). IAADYM is responsible for taking off-site actions to prevent or mitigate the consequences of a nuclear and radiological emergency situation.

IAADYMs are responsible for the mitigation of and response to emergencies at the local level. While the operator conducts mitigation activities on-site, IAADYMs are responsible for conducting off-site activities in coordination and cooperation with local governorship and municipal administrations. IAADYMs are also responsible for notifying national level authorities of the emergency. It is expected that AFAD and TAEK DEMCs will work together with the Prime Ministry's DEMC to respond to emergency situations on a national level and to coordinate activities of all related bodies. As for addressing the public and media, TAEK is given the responsibility to reach related bodies, including the Directorate of Religious Affairs (in order to utilize centralized announcement systems of mosques) to notify the public as soon as possible.

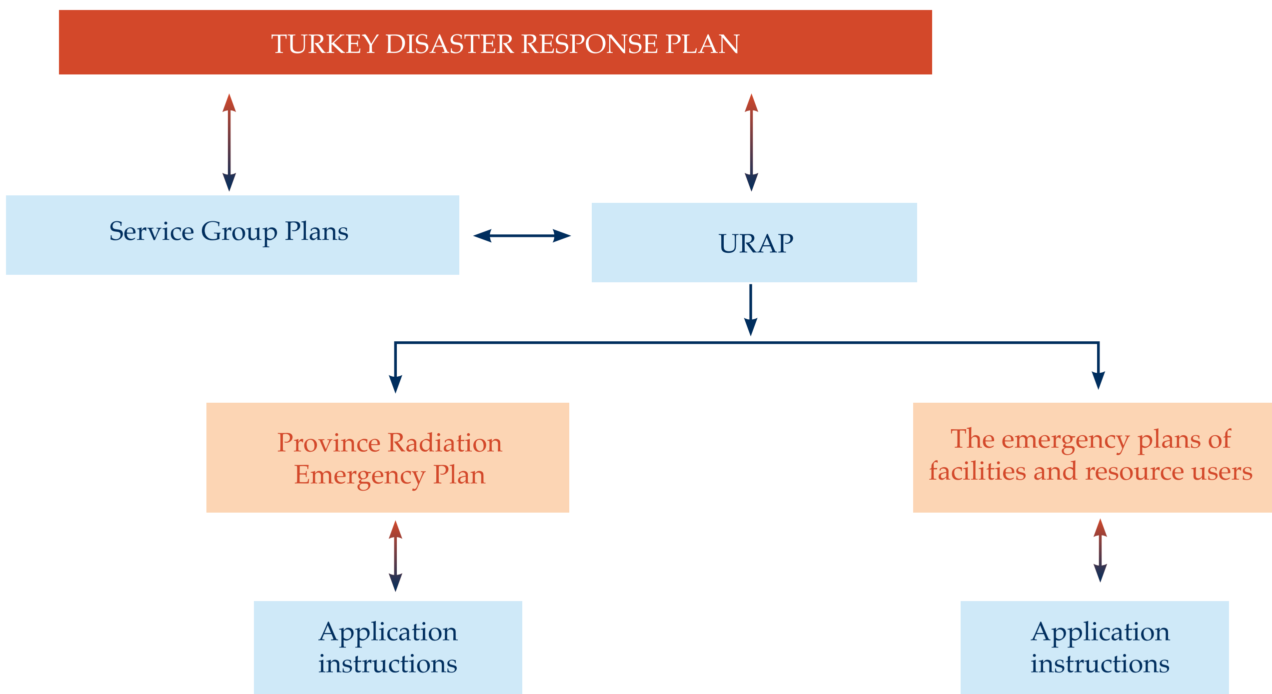


Figure 2.3: Plans that will be taken as basis in radiation emergencies

URAP and its liason to other emergency plans in case of a radiation emergency situation:[88]

URAP lays down a condition for facility operators to designate an "Emergency Manager" in order to notify the facility operators about emergency situations within the facility. This manager and other site officials are responsible from addressing local authorities of the emergency situation. At the local level, URAP entitles the governor or one of his/her deputies at the district level as "Off-site Emergency Manager." If the emergency situation will affect more than one district, AFAD is expected to coordinate emergency activities of these local authorities as the authorized national institution to respond to radiation emergency situations.

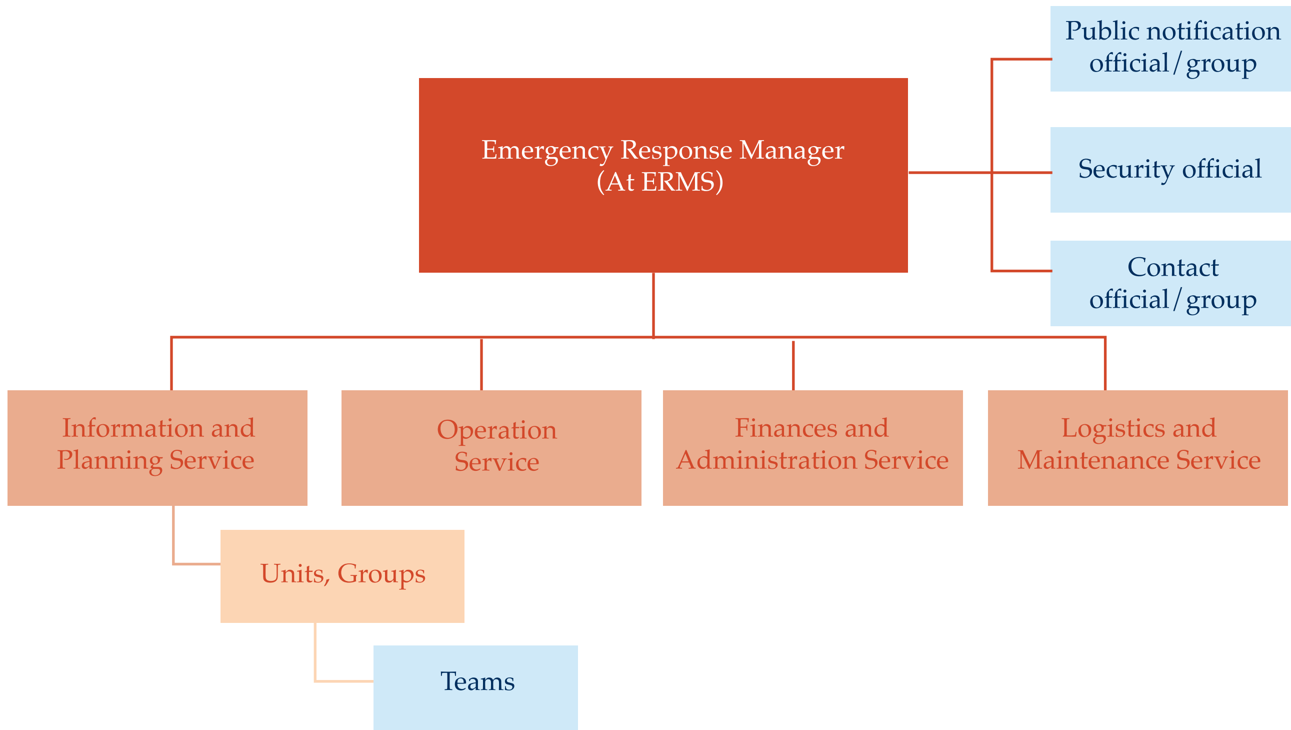
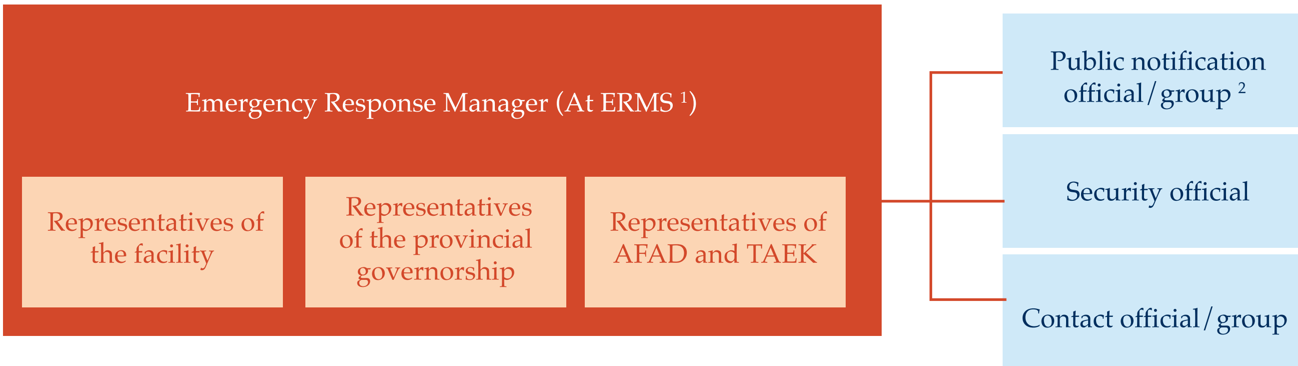


Figure 3.1 The main structure of incident management

For Figure See Ulusal Radyasyon *Acil Durum Planı*- URAP, p.23.

Taking into consideration the worst case scenarios such as Goiânia, Chernobyl and Fukushima, URAP mentions that large-scale emergency situations are also conceivable and those situations inherently necessitate special, big–size emergency teams, sometimes consisting over a thousand emergency personnel. URAP's solution to this kind of special emergency operation is the composition of an integrated "Emergency Management Group" (*Acil Durum Yönetimini Yönetim Grubu*) composed of national and local level emergency managers with a capacity to conduct big-scale, complicated emergency response operations. Each and every member of this big group is envisioned to conduct his/her responsibility during the emergency situation and these individual members of the group would be under the supervision of the Emergency Manager, who is responsible for the entire Emergency Management Group.[89] This Emergency Management Group is expected to function at the emergency location and to address media's expectations in order to inform the public.

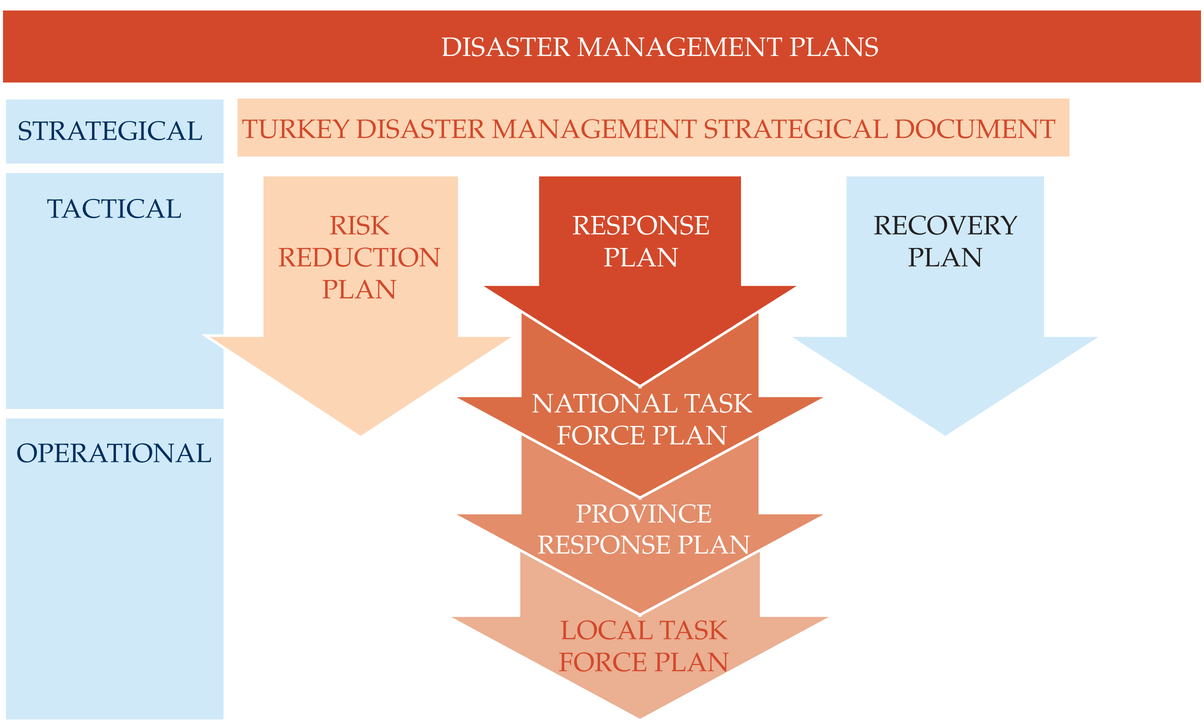


(1) Emergency Response Management Site
- Organizations that response to radiation emergencies and other emergencies
(2) Public Notification Center
- The press official of the provincial governorship (under the coordination of AFAD's press advisor)

Figure 3.2 The organizational map of the management group and affiliated personnel

For Figure see Ulusal Radyasyon Acil Durum Planı- URAP, p.24.

AFAD and TAEK are also responsible for the emergency recovery process. The decision to abolish any kind of restrictions and arrangements stemming from the radiation emergency situation is under the authority of these two institutions. URAP, at the end of the emergency situation, gives the responsibility for developing a guide for lessons-learned to AFAD and TEAK. The operator, TAEK, AFAD, and local authorities are expected to review emergency planning, preparedness, response, and recovery situations as soon as possible and work together to draw conclusions on the efficiency and effectiveness of the emergency management process, setting up a dynamic accident and consequence management for nuclear power plants in Turkey.



Source: Power point presentation titled "Integrated Multi – Hazard Early Warning System"[90] by AFAD

4. THE POTENTIAL ROLE OF THE TURKISH ARMED FORCES

In case of a crisis that would necessitate consequence management functions, the Turkish Armed Forces (TSK) may play a supporting role in coordination with AFAD and TAEK. In such a scenario, the first and foremost duty for TSK would be to support the off-site security forces in order to maintain security and order around the facility. The assets of TSK could be deployed to prevent security breaches and take measures against social disorder to avert additional tensions, or to impose orderly compliance with consequence management decisions such as evacuations.

According to the Regulation on Disaster and Emergency Response Services, military units and headquarters most proximate to a site of potential or actual disaster and emergency have to abide by the orders of the provincial and district governorships if they demand assistance, except during military mobilization and war.[91] In doing so, the military units have to provide all necessary equipment, vehicles, and personnel in a timely manner, without waiting for approval from their superiors. Additionally, AFAD has the legal right to commission the Armed Forces' capabilities in case of necessity for missions that require advanced support. In this regard, as recently as May 2014, the Authority called for the Turkish Military's logistical capabilities for airlifting assistance to Bosnia, which was suffering from a flood disaster.[92] In another example in southeastern Turkey, AFAD utilized military assistance and vehicles to evacuate people that were trapped due to heavy snowfall.[93]

In addition to its role as a conventional security provider, TSK is also equipped with CBRN defense capabilities. With regards to consequence management duties within Turkey's nuclear energy security, the Turkish Armed Forces' chemical, biological, radiological, nuclear (CBRN) units and school may also play a role. In this respect, Turkish CBRN experts note that:

> "The CBRN defense battalion of the Turkish land forces provides a rapidly deployable, credible CBRN defense capability suitable for protecting land forces in the field and if needed, to support civilian agencies. The Turkish army has formed a fully professional CBRN battalion and the Turkish navy has established a special CBRN unit, known as Maritime WMD Prevention and Training Centre Command especially for maritime interdiction operations. In addition, the medical command of the Turkish armed forces has a special medical CBRN unit in Ankara and a decontamination capability. There is one further capability, worthy of mention, and this is the CBRN rapid response unit, also formed fairly recently and integrated into the CBRN battalion. This unit is a source of particular pride for the Turkish armed forces as it composes all the various CBRN disciplines."[94]

Therefore AFAD's Regulation on Duties Concerning Chemical Biological Radiological and Nuclear Hazards[95] also attains duties and responsibilities to the Turkish General Staff in case of a CBRN emergency. The document notes that the General Staff and TSK provide all the support that is asked of them without jeopardizing their core tasks as part of civil-military cooperation. The General Staff is tasked with providing its assets to detect, salvage, sample and decontaminate CBRN materials and provide information to be used in the drafting of CBRN risk analyses upon demand by AFAD. It is also tasked with reporting tips, information and intelligence pertaining to smuggling, terror and sabotage activities by using CBRN weapons, materials and hazardous waste to AFAD and the respective provincial governorship.

Moreover, TSK CBRN School and Education Center Command is also tasked with collaborating with AFAD over training instructors, information exchange, developing mutual assistance and cooperation. The Armed Forces' CBRN School also trains necessary personnel from other institutions and bodies, including the medical sector, police forces, and civil emergency officers.[96] As such, the CBRN School may play an essential role in fostering Turkey's consequence management/emergency response capabilities and strategic culture. Such a training program could be extended to cover the private security team protecting Turkey's newly-established nuclear facilities. Besides, a basic training could be provided to medical personnel and civil servants working in nearby facilities.

Overall, under the Turkey Disaster Response Plan penned by AFAD and the draft National Radiation Emergency Plan drafted by AFAD and TAEK designate the General Staff, and as such, the Turkish Armed Forces, to support actions under: communication, security and traffic, search and rescue, health, fire, shelter, transportation, evacuation and relocation, and CBRN.[97] URAP further notes that in cases where its assistance is demanded during situation evaluation, reporting and initial response, implementation of urgent protective measures, the initial phase of the emergency, and recovery actions, the General Staff is tasked with ensuring that its CBRN units operate at the areas that the Emergency Manager designates.

One alternative role that the Armed Forces could play in case of a major incident involving the Akkuyu facility, would be linked to the declaration of a state of emergency. Officially, apart from deterrence and capability development for warfighting, one of TSK's duties remains supporting "disaster relief efforts for earthquake, fire, flood, landslide, rock fall, avalanche, etc. in accordance with Article 112 of the Internal Service Code No.211 and Article 7 of the Act No. 7269 on Relief Efforts by Measures Taken due to Disasters Affecting Common Life."[98] According to Turkish legislation, 'state of emergency' could be declared not only upon traditional security threats, but also in response to disasters. In case of an incident that demands robust consequence management/disaster relief efforts with regards to nuclear plants, it would be likely for the government to declare a 'state of emergency'. The Armed Forces would be given the duty of restoring order under the emergency law.[99]

On the other hand, TSK's role and authority during the state of emergency has been subject to change over the years. The role and authority designated to TSK in cases of a state of emergency have first been curtailed in 2010 and 2013 over worries that they could be used as justification to intervene in politics. After these amendments, TSK could participate in domestic operations only upon call from the government or provincial governorates.[100] Nevertheless, as terrorist violence mounted in Turkey, especially since 2015, the military's role and ability to take initiative in counterterrorism operations has been expanded through new legislation approved in July 2016. These amendments gave TSK considerable autonomy and authority once the government called the military to restore law and order, such as to control other security and law enforcement forces to confront internal security threats, decide upon the size, deployment and structure of its forces, and enter into property, be it public or private.[101] Yet a few days after these amendments, on July 15th, a clique within TSK's ranks attempted a *coup d'état* in the country. As a result, the structure of the Turkish Armed Forces, its respective authority and duties, as well as the overall civilian-military relationship in the country has been subject to an extensive overhaul. As such, the recent developments have cast doubt over TSK's autonomy in decision making in the state of an emergency, making it more likely that it will primarily act as an auxiliary actor in case of an incident involving Akkuyu – akin to the framework established through URAP.

In the grand scheme of emergency response and consequence management ecosystem in Turkey, from a hierarchical standpoint the TSK is likely to remain under AFAD and the respective provincial governorship. In a potential incident concerning Akkuyu or its associated materials in transport, AFAD may call upon TSK to provide its assets and the provincial governorship would act as the Off-site Emergency Manager. Considering that the provincial governorship would also act as the commanding authority to TSK assets in a conventional security threat – as detailed in the respective chapter of this volume concerning Akkuyu's physical security – this structure may provide the centralized decision making system that is essential to dealing with incidents involving NPPs.

Going forward, there is still room for improvement in TSK's CBRN capabilities in order to provide the utmost assistance to Turkey's future nuclear security, even though there has been considerable progress in TSK's detection, decontamination and consequence management capabilities in the 2000s. The abovementioned training activities should be enhanced to cover more personnel with a specific focus on Turkish nuclear energy infrastructure and security. Moreover, Turkey could benefit from NATO capabilities more efficiently in terms of CBRN-related capacity building measures with a specific focus on consequence-management. For instance, Ankara is not accredited to the Alliance's Joint CBRN Centre of Excellence in the Czech Republic.[102] Such a move could boost the Armed Forces' expertise and key capabilities in terms of consequence management.

5. THE BUILD-OWN-OPERATE MODEL AND TURKISH-RUSSIAN COOPERATION

When we look at the broader picture, we can say that Turkey is party to the relevant international conventions related to the early notification and assistance in nuclear emergencies and TAEK is recognized as the competent authority for communication with the IAEA regarding information on nuclear or radiological incidents and emergencies. Thus, as far as accident and consequence management is concerned, we can expect from the Turkish example that Turkey will regulate its nuclear power plants in line with the IAEA's rules and standards in case of nuclear emergencies. Turkey also has bilateral agreements with Bulgaria, Romania, Ukraine, and Russia regarding early notification in case of nuclear emergencies and plans to make additional bilateral arrangements with other neighboring countries.

Nevertheless, in an unprecedented act for the global nuclear industry, Turkey and Russia signed an intergovernmental agreement on May 2010 for the Russian state-owned Rosatom to build, own, and operate (BOO) a nuclear facility at the Akkuyu site in Turkey. Typical arrangements for nuclear facilities envision some type of public-private cooperation at which the host government either has a stake in the venture and/or assumes the control of the facility after a predetermined period of time. In this scenario, Russia will assume all costs and financial risks associated with the 20-plus billion dollar project. As such, Rosatom, the Russian state-owned company, while partnering with local and potentially international private companies, will continue to own the facility for the duration of its lifetime, which is around 60 years. As Ankara will have no direct control of the facility, it will be as if Turkey is buying electricity generated from an NPP abroad. While Turkey will have some indirect control, such as through its regulators, the BOO model may still present some challenges to Turkey's accident and consequence management plans vis-à-vis the prospective Akkuyu NPP.

For one, the arrangement was not purely economic to begin with and depends very much on the political relations between Russia and Turkey. The political backdrop of the Bushehr NPP in Iran, which in addition to technical difficulties contributed to the postponement of the plant's completion for decades,[103] provides a good example of how bilateral and international political relations may beset nuclear energy deals. Though Turkey does not present an international proliferation concern as Iran does, the Akkuyu NPP will be owned and operated by a state-owned company – hence relations between Ankara and Moscow may come to plague the deal. Furthermore, Russia has utilized its energy resources as a geopolitical tool in numerous instances, such as in the Ukrainian example, and may come to do so with regards to the Akkuyu deal. Originally, when the Turkish-

Russian relationship was at a historic high, the worry of spectators, including some of the authors of this publication was that both the Kremlin and Ankara could put pressure on the operator, contractors, and Turkish regulators to expedite the project at the expense of safety and security measures. Afterwards, the relations reached a historic low after the confrontation over the Syrian civil war and the downing of a Russian warplane and the tarnished relationship between the two countries had the potential to delay the construction of the facility – if not lead to its cancellation of the project altogether. While now under a period of normalization, the uncertainty and instability of bilateral relations may additionally act as a complicating factor for the continuous cooperation necessary for the safe and secure operation of the facility, as well as coordination in case of an emergency.

One other complicating factor could be the leniency of the Turkish political elite to impose top-down decisions regardless of their lack of experience or technical know-how on the given issue. As the Fukushima example highlights, such undue political influence may have considerable disruptive effects on the entire architecture. Even before an emergency takes place, political influence over the national regulator, politically motivated licensing, cozy relations with the operator and utilities, or corruption may hamper capabilities in both preparation and response phases. The 'obedience to authority' mindset of TEPCO as referred to above, may have parallels in the Turkish case as both TAEK and AFAD are branches of the Prime Ministry, and, as such, the appointment of their personnel and leadership, and the designation of their budget depend on the political leadership. As such, relations between the Kremlin and Ankara, Rosatom and Ankara, and the contractors of the project and Ankara, may have undesirable effects on AFAD's and TAEK's decision-making even against all their planning and arrangements, because there is little to insulate the two organizations from political pressure.

Another concern is the potential for the project company to prioritize economic considerations over public safety. As the company will continue to own the plant for the duration of its lifetime, and as the financial risks and burdens are not shared – i.e. upwards of 20 billion USD resting solely on Russia's shoulders – in case of an emergency the company may be less willing to take drastic measures, such as injecting seawater as was the case in Fukushima, that would render the unit inoperable. Indubitably, the project company may not be expected to be benevolent – it is the regulators and the host government that is responsible for ensuring that public safety is the top concern. Yet, the political interests involved and the lack of guarantees over TAEK's and AFAD's immunity to political pressure may cause disruptions or delays in the realization of this responsibility. Furthermore, as the project company will have strong ties to the political leadership in Russia, Turkish-Russian bilateral ties may delay otherwise urgent decisions from being undertaken.

Alternatively, in case of an emergency, the project company may decide to confer with Rosatom HQ for appropriate measures before identifying the Turkish side. As was the example in many radiological emergencies listed in the IAEA's respective publication, operators may be inclined to respond to emergencies first before reporting to national authorities. On the one hand, the experience of the Russian side, both in operating nuclear facilities and responding to emergencies may be a valuable tool. On the other, if Rosatom HQ enters the equation as another player before decisions are taken or implemented, the time-sensitiveness of the given emergency can be severely disrupted. As such, the Turkish leadership and regulators should ensure that no confusion exists with regards to how the operator will report to the Turkish authorities and what the chain of command will be. In the meantime, the ongoing collaboration between the Russian and Turkish sides, one example of which is the education of Turkish students that will work at the Akkuyu site in Russian universities, should be expanded further, regardless of the negative political climate. This collaboration should also be deepened with regards to the harmonization of response plans and mechanisms of the operator and those of the Turkish national authorities to avoid redundancies, conflicting and contradictory planning, and to overcome the language challenge – i.e. to make sure that respective personnel in charge of response mechanisms should be fluent in a predetermined language, whether it be Turkish, Russian or English, in order to overcome potential delays or confusions.

Furthermore, at the time of writing, TAEK lacked the technical capability and experience to adequately fulfill such an immense responsibility in a worst-case scenario. For one, its experience in managing nuclear plants is limited to research reactors. Second, there is a limited pool of nuclear experts in Turkey from which TAEK can recruit.[104] TAEK continues to outsource the evaluation process of the Akkuyu NPP and its license applications. Even if regulations are in place, TAEK would still need to strengthen its capabilities in order to ensure the compliance of the operator. As AFAD is likewise inexperienced in radiological emergencies, the Turkish leadership should promote the expansion of both organizations' capabilities. This would not only increase its national capital but also ensure Turkish institutions do not end up being dependent on the Russian side in case of an emergency due to their lack of experience, or make erroneous decisions in critical situations.

The preparations of both TAEK and AFAD suggest that the sides have incorporated media outreach and public notification into their thinking. Still, as the facility will be operated by a state-owned company, both the operator and Russian state sources may emerge as alternative sources of information. Unless the Turkish side takes strong steps to ensure that its designated branch is the sole responsible authority and that it relays timely information to the public, the media and the public will look up to TAEK, AFAD, Rosatom, Turkish leadership, Russian leadership, and self-appointed experts for information, which would create confusion, loss of confidence, and distrust as multiple precedents listed by the IAEA have shown. Moreover, Russia is trying to promote the BOO model as a preferable alternative for prospective nuclear newcomers in the Middle East and Southeast Asia – the first example being Akkuyu. As its prestige and lucrative nuclear deals rest on the successful operation of the facility, the Russian side may try to downplay the issue in any given emergency and may affect the Turkish public's receptivity to recommendations and orders given by Turkish authorities. Both of these potential issues emerge as likely scenarios given that the Turkish leadership in recent years has become less transparent and the response to any given crisis, such as terror attacks, has been limited to imposing a media blackout rather than informing the public. If this trend continues, it may severely affect both public health and confidence and intensify the psychological, non-radiological effects of a potential radiological emergency.

6. CONCLUSION AND RECOMMENDATIONS

Since Akkuyu will be Turkey's first major nuclear undertaking, it may present both opportunities and challenges. On one hand, the country and its institutions are inexperienced in the nuclear field, which may mean that it will be ill prepared and respond poorly to a potential emergency in its prospective NPP. However, this also gives Turkey the ability to incorporate the lessons learned by nuclear energy-generating states, regulators, international organizations, and the industry as a whole after decades of utilizing nuclear power in order to build a top-notch architecture to operate NPPs and deal with associated risks. The construction of the Akkuyu NPP is expected to start in 2018, with the first unit becoming operational in 2023.[105] Thus, while Ankara has some time to make the necessary regulations, developing the necessary operational capabilities and capacity building may take longer, and thus need to be prioritized.

The establishment of AFAD in 2009 as a competent authority for emergency response has been a step in the right direction with regards to the disaster and emergency response capabilities of the country. It is understood that AFAD's both centralized and localized structure makes it a good candidate for undertaking the emergency response management for prospective NPPs in the country. Its ongoing collaboration with local governments, authorities, non-governmental organizations, and private institutions on various issues – such as responding to earthquakes, terror attacks, and refugee influxes – has given it the ability to bolster its skills and establish local procedures and points of contact that iy may utilize in a radiological incident.

This holistic outlook may be vital in case a natural disaster triggers a radiological incident, as was the case in Fukushima. Still, the multitude of AFAD's tasks and its focus and experience on non-radiological emergencies, most notably earthquakes, may mean that at its current state, AFAD may not be able to fully fulfill the requirements of a radiological emergency. Thus, it is vital for both AFAD and TAEK to develop their capabilities, increase their collaboration and harmonization with Russian authorities and local response organizations, and establish a permanent structure solidifying this synchronization until the NPPs are completed. As Turkey has very limited experience in cooperating with foreign actors on a project of this magnitude and importance, formulating ways of collaborating with the Russian side regardless of bilateral political relations, and continuing to do so for six decades, will be a considerable challenge for both sides. It may be beneficial for both organizations to cooperate further with their international counterparts, such as the IAEA, FEMA, and NRC.

On another note, the increasingly centralized decision-making culture in Turkey deserves mention in the nuclear context. Such centralization enables institutions to rapidly gather funds, draft resolutions, and implement them – meaning that if there is political will, much ground may be covered in a short amount of time. However, it also means that even competent institutions may come under severe political pressure, hampering both their capabilities and their response mechanisms. Additionally, politically motivated appointments may cause organizations to lose valuable personnel and may have ripple effects over the overall response structure as points of contact are lost due to appointments and forced resignations. Therefore, Turkish lawmakers should look for ways to insulate regulators from political pressure, especially during times of crisis.

With all these issues concerned, this paper offers the following recommendations to bolster Turkey's emergency and accident preparedness, response, and recovery capabilities:

- The country must rapidly take steps to bolster the capabilities and know-how of its respective institutions and foment the human capital knowledgeable on nuclear energy.
- Local responders, such as doctors, firemen, and gendarmerie, should be educated about nuclear and radiological incidents, dealing with their consequences, and means of protecting themselves. These efforts should include worst-case scenario planning for local actors.
- The key role of the provincial governorship as Emergency Manager should be strengthened through the provision of necessary training to the governorship concerning potential emergencies surrounding Akkuyu, as well as familiarizing the governorship with the response mechanisms and structure. This process should be repeated at the appointment of new governors throughout the lifecycle of Akkuyu and its decommissioning.
- Educating the local population on practical information, such as understanding warning signals should be done in cooperation with AFAD, TAEK, and potentially local NGOs.
- The delineation of responsibilities between TAEK and AFAD should be clarified. This may be achieved through making clarifications in the draft National Radiation Emergency Plan, or through classified internal arrangements. Either way, these arrangements should be disclosed to the respective local and national bodies tasked with emergency response.
- All arrangements, plans, procedures concerning radiation emergencies should be incorporated into realistic, relevant, and regular exercises.
- Ways for insulating collaboration with Russian authorities and the operator from the fickleness of bilateral political relations should be sought. As nuclear incidents may be the result of deliberate attacks and sabotage, this point may become considerably important for the security arrangement and cooperation between Turkey and Russia.
- AFAD, TAEK, and local responders should be insulated from undue political influence from political leaders that have little to no knowledge on radiological matters and lack a clear understanding of a given crisis situation. The designation of a competent decision maker from either one of these organizations as the linchpin of emergency decisions, drafting of the respective hierarchy of authority and responsibilities, as well as making appropriate inter- and intra-agency communication arrangements should be realized.

- Turkish organizations should incorporate red team analyses to their response plans. These analyses should include low-probability/high-impact scenarios, as well as cases in which there are severe obstructions to acting accordingly to pre-planned arrangements (e.g. electricity shortages, flooding, road blockages, severe traffic).
- The CBRN capabilities of the Turkish Armed Forces should be bolstered through domestic capacity building and international cooperation. These capabilities should be utilized to train and educate stakeholders in the country's emergency response and consequence management ecosystem.
- The media and public outreach strategy should be formulated to ensure the prompt, clear, and regular provision of information, with the primary consideration in such messaging being public safety.

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Turkey's Future With Nuclear Fuel And Radioactive Waste: Transport Safety And Security

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1. INTRODUCTION

Embarking on a nuclear energy journey, Turkey has to be prepared for ensuring the safe and secure transportation of nuclear and radioactive material on domestic and international air and sea routes. Transshipment safety and security covers the stages of importing nuclear fuel, transferring it to interim storage, shipping spent fuel and radioactive waste, and decommissioning the nuclear power plant. However, the terms of the additional agreement on nuclear fuel and waste have not been concluded in the May 2010 intergovernmental agreement (IGA) between Russia and Turkey on the construction and operation of a nuclear power plant in Akkuyu, Mersin.

Turkey will be outsourcing nuclear fuel and does not appear to have any plans for generating a national reprocessing capability. Hence, Turkey will likely ship spent fuel to Russia, in which case the national plans and procedures for secure interim storage and transportation of spent fuel and radioactive waste should be agreed upon by all stakeholders (i.e. Ankara, Russia's Rosatom State Atomic Energy Corporation, and the private security company).

This chapter first identifies the international and domestic legislative and regulatory frameworks on the safety and security of the transportation of radioactive material in a descriptive manner. It then takes a close look at transport safety by mapping out the operational and legal role of each stakeholder in ensuring the physical protection of the cargo and public safety. Recognizing the high security risks associated with the transport of nuclear and radioactive material (e.g. protests, terrorist attacks, theft, or sabotage) the chapter then provides an overview of the security measures and the roles of respective Turkish authorities in response mechanisms. It is clear that the "build-own-operate" (BOO) mechanism for the Akkuyu power plant creates less incentives for the Turkish government, especially since the intergovernmental agreement is expected to address Turkey's concerns, whilst giving the weight of responsibilities in transport safety and security to the Russian side. Akkuyu is frequently referred to as a Russian nuclear power plant in Turkey. However, it is crucial to remember that the agreement is political and that it needs to be negotiated based on the premises of Russia's legislature. Additionally, the BOO mechanism does not address Turkey's need for an independent regulatory body and the indigenous capability to oversee Russia's actions on Turkish soil. Hence, the central recommendations in this chapter are, specifying the detailed action and contingency plans for nuclear fuel and waste transport with Russian authorities through a separate agreement in a timely fashion, and identifying a clear coordination mechanism among Turkish law enforcement authorities with clear responsibility areas.

2. LEGISLATIVE AND REGULATORY FRAMEWORK

While Turkey has taken steps towards establishing a domestic framework for the legislation and regulation of the nuclear energy program, the overarching legislative and regulatory framework is set by international codes of conduct and regulations that Turkey abides by. Domestic efforts reveal that, in addition to the absence of an independent regulatory authority, the level of customization of international regimes to circumstances unique to Turkey's geopolitical considerations in the Akkuyu case remain insufficient in the legislation. What further complicates the legislative and regulatory framework is the uncertainty arising from the incomplete aspects of the intergovernmental agreement between the Russian Federation and Turkey. Given the volatility of political relations between Turkey and Russia following the November 2015 Turkish downing of the Russian warplane and the subsequent rapprochement mid-2016, it is questionable whether the terms of these side agreements will be acceptable to Russia. Despite Turkey's reference on Russian expertise in exporting nuclear technology, Turkey still remains responsible in adopting international norms and best practices to be able to audit Russian activity in Akkuyu.

2.1. International Framework for Transport Security

The international regimes, codes, and regulations that Turkey abides by can be broadly categorized under the United Nations (UN) and the International Atomic Energy Agency (IAEA). Akkuyu Environmental Impact Assessment (EIA) report, as well as the Turkish legislation refer to Turkey's membership to these regimes. In reality, the Turkish legislation has mostly derived from these documents with no customization, which are most frequently referred to as constituting a sufficient framework for Akkuyu. Since Russia is an exporter of nuclear energy, Turkish documents also refer to the Russian experience in providing nuclear technology safely and securely. Despite the fact that the Akkuyu plant will be built, owned, and operated (BOO) by the Russian Federation, Turkish authorities are responsible for the safety and security of the nuclear cargo within Turkish territory.

2.1.1. United Nations International Maritime Organization (IMO) Conventions

Along with the "International Ship and Port Facility Security Code," IMO provides an overarching framework for nuclear transport security in seas, with the following codes:

2.1.1.1. International Maritime Dangerous Goods (IMDG) Code

The implementation of this 2000 code is mandatory, in conjunction with Chapter 7 of the 1974 International Convention for the Safety of Life at Sea (SOLAS) and Ships International Convention for the Prevention of Pollution (MARPOL 73/78).[1] Chapter 2.7 of the IMDG code applies to radioactive materials that have been labeled as Class 7.[2] Similarly, the UN Recommendations on the Transport of Dangerous Goods, developed by the UN Committee of Experts on the Transport of Dangerous Goods and the Globally Harmonized System of Classification and Labeling of Chemicals, Chapter 2.7 defines Class 7 radioactive material and assigns unique UN numbers to radionuclides.[3]The code distinguishes *low specific activity* material for limited specific radioactivity of natural and depleted uranium and thorium as well as their solid waste.[4] The package needs to be tested for shielding under impact and heat, measured for transport index (TI), i.e. maximum radiation level at 1 meter distance, and the criticality safety index (CSI) for fissile material, and classified according to the radionuclide. Radioactive material that is not classified as *low dispersible* cannot be transported by air, albeit some of these limitations do not apply to sea transport.[5]The authority on the IMDG code in Turkey is the Ministry of Transport, Maritime Affairs and Communication, Directorate General for Dangerous Goods and Organization of Combined Transport.[6] The Turkish authority is responsible for the implementation of the code, including the following:

1. Training and certification of all personnel for the handling and transportation of dangerous cargo,
2. Implementing and inspecting a radiation protection program in coordination with the Turkish Atomic Energy Agency (TAEK),
3. Executing a quality inspection of packaging and ensuring adherence to international standards (i.e. IMO and IAEA) in coordination with relevant Turkish authorities on these measures,
4. Authorizing the special transportation of radioactive materials in coordination with TAEK, following the stacking regulations in IMDG,
5. Testing and certifying the packages along with the Turkish Standards Institution,
6. Informing relevant Turkish authorities in case of accidents, theft or sabotage.[7]

Since the Turkish authority is clearly defined, the application of the IMDG code to Turkey is likely to be successful. However, each area of responsibility should be supplemented by detailed plans particular to the transport of nuclear material.

2.1.1.2. INF - International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel Plutonium and High-Level Radioactive Wastes on Board Ships

The implementation of the 2001 code is mandatory in conjunction with Chapter 7 of the 1974 International Convention for the Safety of Life at Sea (SOLAS). According to their aggregate level of radioactivity, the code divides classes of vessels into three as follows:

- Class INF 1: Ships certified to carry materials with aggregate radioactivity less than 4000 tera-becquerels (TBq.)
- Class INF 2: Ships certified to carry irradiated nuclear fuel or high-level radioactive waste with aggregate radioactivity less than 2x106 TBq and plutonium with aggregate radioactivity less than 2x105 TBq.

- Class INF 3: Ships certified to carry irradiated nuclear fuel, high-level radioactive waste, and plutonium with no restriction.[8]

In the Akkuyu case, the ships that will carry the nuclear fuel, spent fuel, and radioactive waste will be Class INF 1 and INF 2.

2.1.2. IAEA Regulations, Code of Conduct

Historically, the focus of IAEA regulations, addressing the transport of radioactive material, has been on safety (i.e. the IAEA Safety Standard Series; in particular, the 1996 Regulations for the Safe Transport of Radioactive Material, TS-R-1, the latest 2005 version referred to in the Turkish Ministry of Energy and Natural Resources, "Regulation on Safe Transportation of Radioactive Materials"). Additional publications on transport safety include the following:

- NP-061-05 Safety rules at nuclear fuel storage and transporting at nuclear power utilization facilities,
- NP-073-11 Rules for physical protection of radioactive substances and ionization sources during transportation,
- PBYa-06-09-90 Nuclear safety rules for storage and transportation of nuclear hazardous and fission materials.
- NRP-93 Standards for strength computation of transportation packing sets for nuclear fission materials.

IAEA established a network of arrangements regarding the protection of radioactive materials, most notably its INFCIRC/225/Rev.4 from 1999, entitled "Physical Protection of Nuclear Material and Nuclear Facilities" (originally published in 1975 as INFCIRC/225), which complements the 1980 Convention on the Physical Protection of Nuclear Material (CPPNM).[9] Turkey became party to the INFCIRC/225 in 1986.

In 2004, IAEA published its Code of Conduct on the Safety and Security of Radioactive Sources (IAEA/CODEOC/2004). This revised version of a code originally dated 2001, mostly reflected the concerns following 9/11, of the *deliberate* acquisition of radioactive sources for malicious use, whereas previously the central concerns revolved around theft out of ignorance.[10] According to the code, states should assign transport security levels based on the D-value (i.e. the operational definition of the dangerous source).

In addition, IAEA Board of Governors, GOV/2004/40, identified "Measures to Strengthen International Cooperation in Nuclear, Radiation and Transport Safety and Waste Management" and created international action plans for strengthening the preparedness as well as the response system to nuclear and radiological emergencies.[11]

Despite this historical focus on safety, IAEA acknowledged the need for an integrated approach to nuclear security against terrorism, as a result of which IAEA Nuclear Security Series, Implementing Guide, Security in the Transport of Radioactive Material was published in 2008. While IAEA's instructions help to identify the threats and vulnerabilities in transit, it is the State's responsibility to ensure transport security, designate an independent competent authority to implement and inspect the legislative and regulatory framework, and establish criminal penalties for non-compliance with the requirements for security in transport.[12] The operator is only responsible for implementing security measures for radioactive material in accordance with national requirements.[13]

Within the international nuclear security regime, Turkey has taken steps to adopt best practices in Akkuyu. After the 2012 Seoul Nuclear Security Summit (NSS), Turkey participated in IAEA technical meetings in July 2012, October 2013, and February 2014 to contribute to the "Draft Implementation Guide on Physical Protection of Nuclear Materials During Transport," "Implementing the Legislative and Regulatory Framework for Nuclear Security," and "Draft Implementing Guide on Physical Protection of Nuclear Facilities" respectively in October 2013. The IAEA also organized a workshop on the physical protection of nuclear materials and facilities for newcomers to nuclear power in Ankara.[14] Turkey has also committed to the IAEA "International Physical Protection Advisory Service" follow-up mission.[15] However, Turkey should continue to customize the IAEA resources based on the BOO model with Russia at Akkuyu.

2.1.3. International Civil Aviation Organization (ICAO)

ICAO develops standards and publishes the "Technical Instructions for the Safe Transport of Dangerous Goods by Air", which contains a list of dangerous goods and the requirements for packing, labeling, and documenting radioactive materials.[16] ICAO also co-sponsors the 2013 IAEA Joint Radiation Emergency Management Plan to be implemented by the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE) ad-hoc Working Group on Air and Maritime Transportation to respond to radiation emergencies.[17]

In line with the ICAO and IAEA technical regulations, the International Air Transport Association (IATA) publishes annually the "Dangerous Goods Regulations" (DGR).[18] In the Turkish case, the relevant competent authority is the Turkish Civil Aviation Authority.

2.1.4. United Nations Economic Commission for Europe (UNECE)

The commission is the owner of the European Agreement on the International Carriage of Dangerous Goods by Road (ADR), defining the classification, labeling, and packaging of dangerous goods by road in accordance with IAEA regulations.[19] In line with other UN codes, Chapter 2.7 of the agreement is dedicated to Class 7 radioactive materials.[20] UNECE also publishes the "Recommendations on the Transport of Dangerous Goods," known as the *'orange book*.'[21]

The main competent Turkish authority that is responsible for UNECE is the Ministry of Transport, Maritime Affairs, and Communications, Directorate General for Regulation of Dangerous Goods and Combined Transport.

2.1.5. Convention on the Physical Protection of Nuclear Material (CPPNM)

Signed in 1980, CPPNM covers nuclear materials used for peaceful purposes while they are transported internationally and is the only international legally binding agreement for the physical protection of nuclear materials.[22] An amendment, named "Nuclear Security- Measures to Protect Against Nuclear Terrorism," which was adopted in 2005 however is not yet in full effect, extends its scope to include the domestic use, storage and transportation of nuclear materials and the protection of nuclear materials and facilities against theft and sabotage.[23]

Turkey is a member of the CPPNM and fully implements its provisions. Turkey has also ratified its 2005 Amendment in July 2015. Turkish documents usually refer to the international regimes and documents as being sufficient. However, according to Article 2A of the amended convention; "each state party shall establish, implement, and maintain an appropriate physical protection regime applicable to nuclear material and nuclear facilities under its jurisdiction with the aim of protecting against theft and other unlawful taking of nuclear material in use, storage, and transport."[24] Hence the State party, which is Turkey in the Akkuyu case, is responsible for establishing and maintaining a legislative and regulatory framework that covers transport. However, "the responsibility of a state for ensuring that nuclear material is adequately protected extends to the international transport thereof, until that responsibility is properly transferred to another State, as appropriate."[25] Thus, Turkey cannot solely rely on Russian authorities for ensuring physical protection.

3. DOMESTIC FRAMEWORK FOR TRANSPORT SECURITY

National-level measures consist of laws on nuclear security in the national legislature and criminal penalties for law enforcement.

The current nuclear regulatory framework consists of the Turkish legislation and regulations, IAEA safety fundamentals and requirements, and the regulations of the vendor country, being the Russian Federation in the Akkuyu case. The Law on Construction and Operation of Nuclear Power Plants and Energy Sale (5710) passed in 2007, states that the nuclear power plant investment may be based on public, private, or public-private partnerships. The legal framework is built on the Law on Turkish Atomic Energy Authority (2690) of 1982, the Draft Nuclear Energy Law on Waste Management and Decommissioning, and the Environmental Law (2872) which requires an Environmental Impact Assessment (EIA) report.[26]

One common element in these regulations is that there is no customization for the Turkish system and almost no role for Turkish authorities except inspections by TAEK when necessary. There is heavy emphasis on the operator's responsibility in creating management mechanisms, complying with relevant regulations, bearing all costs, and ensuring the safety and security of transportation.

3.1. Turkish Ministry of Energy and Natural Resources, Regulation on Safe Transportation of Radioactive Materials, No: 25869, 8/7/2005 (Enerji Bakanlığı, Radyoaktif Maddelerin Emniyetli Taşşınması Yönetmeliği)

Published on the Official Gazette on July 8, 2005, this regulation covers the protection of individuals and the environment during all stages of the transportation of radioactive material with concentrations of radioactivity exceeding 10 folds of the values referred to in the Annex, based on the 1996 IAEA Regulations for the Safe Transport of Radioactive Material.[27] The regulation, under the Turkish Atomic Energy Authority, identifies the numerical limits to radioactivity for each radionuclide and radioisotopes, material quantity per package and per package type (Articles 17-32). It also defines the transport and criticality indexes (TI and CI accordingly) based on the measurement of maximum radiation level at any point within 1 meter distance from the package (Articles 54-58). The packages have to be identified using the appropriate UN labels and an exclusive identification number (Article 63). The packages also have to be tested against water immersion, drops, thermal changes and other factors to test their containment and shielding (Articles 200-221). Each package containing more than 5 grams of fissile material in 10 liters is subject to multilateral approval (Article 232).

However, the regulation does not specify relevant national and international authorities in response to accidents and the details of an emergency plan (Articles 12 and 13). Inspections on request are referred to the "relevant competent authority" (Article 222).

3.2. Maritime Traffic Regulations for the Turkish Straits[28]

Pursuant to Article 26 of the Regulation dated 1998, vessels carrying nuclear cargo or waste are required to give notice 72 hours prior to passage and present documents certifying their conformity with IMO standards and other relevant international treaties.[29] Passage of such vessels have been subject to the "permission" of the Undersecretariat of Maritime Affairs under the 1994 Regulations,[30] which were subsequently amended to its current version taken into account the IMO Maritime Safety Committee Recommendations.[31] The Implementation Instructions, signed into effect by the Ministry of Transport, Maritime Affairs and Communications on October 16, 2012 provides in its Article 9 that vessels carrying nuclear cargo or waste are to transit through in day time, with a pilot and accompanied by towage and with vessel traffic allowed for that single direction.[32]

3.3. Turkish Law No: 5710 Concerning the Construction and Operation of Nuclear Power Plants and Sale of Energy, Draft Nuclear Energy Law (Nükleer Güç Santrallarının Kurulması ve İşletilmesi ile Enerji Satışına İlişkin Kanun)

Entered into force on November 21, 2007, Article 5-4 of the law states that the establishment of a national radioactive waste fund and decommissioning accounts to finance the interim storage and transport of the radioactive material.

According to Article 5-5 of the law, in case of an accident during the transport of radioactive material or waste, the provisions of the 1960 Paris Convention on Nuclear Third Party Liability apply.

Turkey's Draft Nuclear Energy Law states that the operator will contribute to the waste management fund, through which the Turkish government will establish a national radioactive waste management infrastructure. The contribution of the operator will be proportional to the type, status, and amount of radioactive waste, which the operator may choose to transfer to the national management organization. Nevertheless, since neither the draft law nor its details are publicly available, it is difficult to assess its effectiveness.

3.4. Turkish Atomic Energy Agency, Regulation on Radioactive Waste Management (Türkiye Atom Enerjisi Kurumu, Radyoaktif Atık Yönetimi Yönetmeliği)

Entered into force on March 9, 2013, this regulation covers the safe management of radioactive waste within the scope of nuclear energy and ionizing radiation sources for other purposes.[33] According to the regulation, the costs and management of radioactive waste are under the responsibility of the "person carrying out this activity" (Article 5). Article 6-5 states that "radioactive wastes which are generated as a result of activities carried out outside the boundaries of the Republic of Turkey cannot be transported inside the boundaries for processing, storage or disposal purposes." Several clauses in the regulation refer to a very broad (i.e. "all necessary measures shall be taken by the authorized person") approach, which does not designate clear tasks and responsibilities, particularly in case of criticality accidents (Article 10). However, for the safety and security of the radioactive waste facility, it is stated in Article 14 that the "authorized person" for the facility will establish and apply a management system covering all phases, including decommissioning. Characterization and classification of radioactive waste based on radioactivity level are left to the generator of the waste (Articles 19 and 20). Article 26 states that "radioactive wastes shall be collected in the places where they are produced." However, spent nuclear fuel is only temporarily stored on-site before being transferred to an off-site spent fuel storage facility or radioactive waste facility for reprocessing or disposal, including in another country (Article 52-4). In the Akkuyu case, the spent fuel will be kept for several years in interim storage until it is shipped to Russia.

Regarding transportation, the regulation refers to the "Regulation on Safe Transportation of Radioactive Materials" and renders the "person authorized with operation or decommissioning of the facility" the responsible actor in developing "quality management, radiation protection and on-site emergency procedures for on-site transportation" (Article 27).

3.5. Ministry of Transport, Maritime Affairs and Communication, Regulation on the Transport of Hazardous Materials by Sea (Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, Tehlikeli Maddelerin Deniz Yoluyla Taşınması Hakkında Yönetmelik)

This regulation entered into force on March 3, 2015, and covers the loading, stacking, transportation, unloading, and transport from the ship of hazardous cargo, as party to the International Convention for the Safety of Life at Sea (SOLAS) and Ships International Convention for the Prevention of Pollution (MARPOL 73/78).[34]

According to the regulation, hazardous cargo carrying ships and vessels have to notify the port administration 24 hours prior to entry, and the hazardous materials brought into the port overland or by rail should be notified at least 3 hours in advance (Article 6). The cargo official is responsible for providing the necessary documents, classification, identification, packaging, and labeling of the cargo in accordance with regulations on hazardous materials, training the relevant personnel on safety and security as well as providing support in case of emergencies and notifying relevant authorities (Article 11-2). The port operator is responsible for the safe mooring of the vessel, loading, handling, and unloading of the hazardous cargo, keeping an up-to-date inventory of the materials, proper packaging and documentation of the cargo, prompt transfer of materials that cannot be temporarily stored in the port, and preparing an evacuation plan (Article 11-3). The captain of the vessel is responsible for requesting all necessary documents and escorts to the hazardous material, conducting safety checks and controls, ensuring safe entry and exit from the port, and notifying relevant authorities in case of an accident (Article 11-4).

The regulation does define monetary fines for violating the provisions in Article 16, however the fines are very minimal (i.e. 1,000 Turkish Liras for lack of appropriate notifications and a maximum of 75,000 Turkish Liras for continued noncompliance with the "Hazardous Substances Compliance Certificate" for three months). Moreover, this regulation has no reference to radioactive materials and special conditions that would apply.

The Akkuyu EIA report refers to the Straits as being already in use for radioactive materials, but states that the issue is out of the scope of the assessment.[35] Hence, there is no detailed account of nuclear cargo originating from the Akkuyu plant. The report also almost entirely ignores the possibility of sea accidents, arguing that in the 12 years between 2001 and 2012, the total sea activity in the Antalya, Mersin, Iskenderun, and Taşucu area indicates no risk for explosive and flammable cargo.[36] The reference to a "close to ignorable risk" in the report proves that the Turkish government is unprepared and unconcerned towards accidents at sea. On the Russian side, main regulations on the transport of nuclear materials are approved by the Ministry of Natural Resources and Environment of the Russian Federation (Minprirody of Russia), mainly the "Procedure for Companies and Organizations Transporting Nuclear Materials, Radioactive Substances or Associated Products" (July 22, 2009, No. 222).[37] According to the Akkuyu EIA report, the Russian procedures that are comparable with the IAEA procedures are covered by these rules, also called as the NP-053-04 on the transport of radioactive materials.[38] However, Pekar points to Article 50 of the Russian Environmental Protection Law prohibiting the "import for storing or burying of radioactive waste and materials from abroad."[39] While there are amendments in the Russian legislation to allow temporary storage of spent fuel and waste from reprocessing, Rosatom has not signed any contracts to import spent fuel. Furthermore, Russia currently does not have a facility for reprocessing the Akkuyu plant's VVER 1200 type spent fuel.[40]

4. TRANSPORT SAFETY

According to a Turkish Ministry of Environment and Urbanization statement, transport and handling of nuclear fuel and analyses of accident scenarios are covered in the Akkuyu EIA report, Section V.2.12.7.11 and the Preliminary Safety Analysis Report, subject to TAEK's approval.[41] Both TAEK and the Turkish Ministry of Transport, Maritime Affairs and Communication are responsible for inspecting the transport of radioactive materials.

In the Akkuyu case, most of the information regarding the routes are publicly available in the EIA report. The highways that are connected to Akkuyu include the Mersin-Antalya highway and the connection road from Akkuyu to Büyükeceli. There are no railroads connected to Akkuyu, nor any commercial or military airports in Mersin. The 10-km air space around the Akkuyu plant is expected to be closed to overflights.[42] Since there are no other modes of transport nearby Akkuyu, there is heavy emphasis in the report on the responsibilities for the Turkish General Directorate of Highways.

One common objective in the transport of nuclear materials is aiming for short and simple routes to minimize risks. In terms of maritime transport, 80% of the construction material for Akkuyu will be shipped through the Taşucu port in Silifke, and only 20% will be carried by land.[43] Taşucu is the closest customs point to Akkuyu. According to the EIA report, there will be one ship coming to Taşucu from Russia each week.[44] However, once the construction is complete, the Akkuyu project site will include two piers in the east and the west, with no access for third party use.[45] Turkey aims to minimize land transport in order to optimize its road use.

Turkey does not possess a nuclear waste management facility. According to the IGA with Russia, waste management should be the responsibility of the Akkuyu project company. Furthermore, all spent fuel will have be shipped back to Russia for storage and possible reprocessing, contingent upon an agreement, which has yet to be negotiated. Currently, there is no plan for handling and transporting spent fuel. The EIA refers to a possibility that the storage units for spent fuel could also be shipped to Russia.[46] However, it is not clear whether Russia will agree to these terms. Under the assumption that Russia will accept Turkey's terms, the main risks associated with the spent fuel that will come out of Akkuyu concerning Turkey, will be its temporary storage at or near the nuclear plant as well as its transportation from fuel cooling ponds to permanent storage.

4.1. Physical Protection of the Cargo

According to TAEK's Regulation on the Physical Protection of Nuclear Facilities and Nuclear Materials "nuclear materials cannot be transported unless a physical protection plan including the physical protection measures to be taken with regard to the transportation of nuclear materials as well as an emergency action plan is submitted for the approval of the Authority with a confidentiality level of "Top

Secret" and approved by the Authority"[47] (Article 11-3). The "transport physical protection plan" (Article 12-1) notes:

> "Before the transportation, the shipper shall submit the transport physical protection plan including the route, alternative routes, resting areas, delivery arrangements at destination, transport transfer transactions; the identifications of the carrier, the receiver and the authorized persons who will accept the delivery; the transport procedures, accident procedures, emergency action plan, identification information and duties of other responsible personnel, information and documents related to reporting, and any other information or document that the Authority may request, to the Authority for approval, with a confidentiality level of "Top Secret". If it deems necessary, the Authority shall grant approval after carrying out an actual inspection on-site. Transportation cannot be done unless approved by the Authority"[48].

Article 31 calls for the establishment of a temporary transport control center (TCC) to provide communication. The location of this center has not been made public.

Article 32 states that the responsibilities for the physical protection of the cargo shall be determined by an agreement between the shipper and the receiver. This agreement has not been finalized between Turkey and Russia.

While the EIA report also refers to this national physical protection plan for the Akkuyu plant, it is not clear whether this plan is comprehensive and is ready to address possible issues that could arise from the contents of the agreement between Turkey and Russia.

4.2. Public Safety

While the financial risks associated with the storage and removal of spent fuel, as well as decommissioning are under the direct responsibility of the operator, the environmental risks associated with any malfunction in the safe handling of radioactive waste has direct consequences on the Turkish population in the vicinity of the facility and throughout the country. Due to the geographical setting of the facility, any accident at a nuclear power plant would result in cross-border contamination, potentially reaching countries throughout the Middle East, the Mediterranean Sea and the Black Sea in the Turkish case.s

The EIA submitted initially by Rosatom in June 2013 did not meet the Turkish Energy Ministry's safety criteria and was re-submitted in 2014 due to "deficient information".[49] In April 2014, Akkuyu NPP JSC, filed for the third time with the Turkish Ministry of Environment and Urbanization, the EIA report on the construction project.[50] [51] The report was authorized by the Turkish government in December 2014, however it was later claimed that there was a forged signature of a nuclear engineer on the report.[52]

According to the EIA, the on-site storage unit at Akkuyu is planned to be used for spent fuel from 4 units for 4 years.[53] However, the spent fuel pool is sufficient for 10 years of operation, with the capacity for additional interim storage in case of need.[54]

The EIA states that, historically, there has not been any radiological accident during the transport of nuclear material with industrial purposes.[55] It is argued that this success is due to the excellence in international norms and the quantity of nuclear fuel being less than other forms of fuel. Hence, in the Turkish case, it is argued that the emergency plans designed by the IAEA will be sufficient.

TAEK has not been able to select a company to evaluate the Rosatom reactor plans for safety standards. This report is the prerequisite for obtaining a construction license, launching tenders for subcontracts valued at approximately $8 billion, and starting the construction in 2016.[56] According to the IGA with Russia, the Turkish side is responsible for facilitating the insurance of licenses and the required permits. In 2014, Turkey finalized the tender required to grant the "Procurement of Technical Support Services for Review and Assessment of Construction License Application of Akkuyu NPP" construction license and TAEK signed the contract with the UJV Rez, a.s. of Czech Republic.[57]

In consideration of possible routes to radiation exposure, the IAEA has established a Q system methodology for each radionuclide considering stochastic health effects in a probabilistic nature, considering accidents due to operating errors, equipment failures, and leaks from sealed sources during transport.[58] International Commission on Radiological Protection has a guide on "Protection of the Public in Situations of Prolonged Radiation Exposure".

5. TRANSPORT SECURITY AND RISK ASSESSMENT

The EIA appears to be more focused on the safety issues and the physical security of the containers during transportation than with securing the shipment from possible outside threats. There are no evaluations as to how external risks, such as terrorist threats to the vessel carrying the fresh or spent fuel, would be avoided or how the company will coordinate with the "Coast Guard and other relevant public agencies" which have the responsibility for security throughout the Turkish territorial seas. Furthermore, the EIA does not mention security measures beyond the territorial sea.

5.1. Security Measures and Roles for Response

The intergovernmental agreement between the Russian Federation and Turkey states in Article 12/4 that the responsibility for waste management and decommissioning is placed on the project company. However, it is unclear how Akkuyu AŞ will manage the transshipment of fuel and waste to and from Akkuyu NPP.[59] The EIA report dated 2014 simply mentions that the fuel will be delivered by maritime carriage to the dock at the Akkuyu area and then be transferred directly by road to the NPP.[60]

As the route will include the Straits, and thus Istanbul, which is a densely populated area where the width of the Straits can drop to less than a kilometer, security measures both on board and around the vessel will be required, as well as coordinated measures with land based law enforcement agencies. As for providing security on the vessel, there is precedent for armed guards being used (case of Pacific Pintail and Pacific Teal in 1999). Indeed, Article 35 of the TAEK Regulation on Physical Protection calls for armed personnel. However, who will provide the armed security personnel is not clear. As the Coast Guard jurisdiction and responsibility under its law does not include providing such protection for private parties, this will likely fall on Akkuyu AŞ. A private security company will probably need to be set up as the task requires specialized and specifically trained personnel. Unless specific provisions are agreed upon by a possible agreement on transfer, as envisaged by Article 12/2 of the IGA, an Act concerning Private Security Services[61] would be applicable for such shipment originating from and traversing Turkish territory. The Act asserts that the establishment of private armed security units or utilizing the services of a private armed security companies is subject to the permission of the Provincial Governor, without prejudice to international obligations concerning security in ports and airports (Article 3). The establishment of private security companies itself is subject to the permission of the Ministry of the Interior, and the provision of such services by aliens is subject to the condition of reciprocity (Article 5).

At present time, the Ministry of Transportation, Maritime Affairs and Communication does not permit the use of private armed security personnel on board Turkish flagged vessels even for passage through the Gulf of Aden, where pirate attacks are frequent.[62] However, the same ministry is currently working on legislation to allow and regulate private armed security personnel on board Turkish flagged vessels.[63] Even in the case of a foreign flagged vessel being used to transport the fuel or waste, ports being the territory where the coastal State has complete jurisdiction, the matter of private armed security personnel will need to be specifically addressed either in the form of a permission to be granted to Akkuyu AŞ under the Act concerning Private Security Services or specific provisions in an agreement under IGA Article12/2.

On board security needs to be complemented by other security forces on sea. This task obviously falls within Coast Guard capabilities. According to Article 35 of the TAEK "Regulation on the Physical Protection of Nuclear Facilities and Nuclear Materials," transports of nuclear materials by sea shall be under the guard and escort of the Turkish Coast Guard Command during the shipment within territorial waters of Turkey as well as the loading and unloading at Turkish ports.[64] Interestingly, the regulation calls for Coast Guard escort only until the vessel clears Turkish territorial waters. However, Coast Guard law also empowers it in the Turkish Exclusive Economic Zone beyond territorial sea to discharge the duties it is assigned under national law.[65] The type of the guard is undefined for transport by road, rail, or air.

Shore based precautions are also needed: As the breadth of the Straits are narrow, it essentially takes only a few minutes by a fast boat to reach the vessel from any number of mooring areas or even the boathouses of *yalis* on the Bosphorus. As such, the geological conditions of the potential route for Akkuyu's fuel and waste necessitate Turkish policy makers and security elite to contemplate a comprehensive plan, which should encompass an exhaustive threat analysis, for ensuring the physical security of the radioactive cargo.

5.2. Risks

The main security risks associated with the transport of nuclear material are protests, terrorist attacks, theft, diversion, and sabotage. Turkey's proximity to the active conflicts in the Middle East and instability that stems from domestic terrorism add to these risks.

International protests so far have targeted transshipments through third State waters. In 1992 shipment from Japan had to stay clear out of South African and Portuguese EEZs as they demanded. In 1995 *Pacific Pintail* carrying spent fuel was banned from the EEZs of Argentina, Chile, Brazil, South Africa, Nauru and Kiribati and the territorial seas of Antigua, Colombia, Dominican Republic and Porto Rico. Chile went as far as threatening to send its warships if the vessel did not leave the calmer waters of its EEZ, where the vessel had turned to escape the perilous conditions off Cape Horn.[66] On numerous occasions, CARICOM and the Pacific Islands Forum have issued objections to the transit of nuclear shipments through their waters.[67]

The decommissioning of the nuclear reactor from San Onofre NPP in Southern

California may be a precautionary account. Burial in California or transporting it across the US to South Carolina where it was to be buried were "rejected because of US laws governing the disposal of nuclear wastes and because of liability concerns".[68] Instead, the US planned to ship it by a sea journey around South America, the southern tip being one of the most dangerous maritime passages. This plan too had to be abandoned following a warning by Argentinian officials to the effect that the vessel would be intercepted and escorted out if it attempted to pass through its EEZ. This came after an Argentinian court order prohibiting this passage, citing the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal.[69] Nuclear cargo is at its most vulnerable point during shipment.[70] By boarding a vessel carrying MOX fuel during its passage through the Panama Canal in 1998, Greenpeace has demonstrated that the cargo is even more at risk from threats in narrow waterways.[71]

Luckily for Turkey and Russia, Akkuyu fuel and waste will not need to cross any other areas than Turkish and Russian territorial sea and EEZ. However, if another NPP is indeed built in Sinop, it is likely that the transshipment will have to traverse the Mediterranean to be processed elsewhere. As such, Turkish authorities will have to consider the implications of nuclear fuel and waste transshipment from both a security and safety perspective and from the perspective of bilateral relations in the Sinop project.

Curiously, the EIA refers to getting prior "authorization" from the "transited countries" when planning the route that the shipment of spent fuel shipment will take.[72] It is unclear whether this statement envisages that the shipment of spent fuel, which will have to be the subject of a separate treaty, will be made through the land route while the original fuel will declaredly reach Mersin by the sea route.

A brief look at the history of protests from States, to the effect that they will not allow passage of nuclear cargo through their territorial sea or EEZ, reveals that Turkey (or the carrier) may have to face serious challenges. If spent fuel is to be processed in a facility other than in Russia then the likely route out of the Mediterranean will take this ultra-hazardous cargo through waters between Libya and Malta, where mass irregular migration has already put strains on policing maritime areas. The fight against migrant smugglers has led to the securitization of border controls. Even the United Nations Security Council has felt compelled to endorse Chapter VII measures on the matter.[73] In addition, the volatile situation in Libya with rivalling authorities, one being the UN-backed government and the other in Tripoli backed by powerful militias, should be taken into account when planning for the voyage. Malta, which is just around 200 nautical miles (nm) across from Libya and requires prior notification of hazardous cargo through its territorial sea[74], is not likely to lean towards a route closer to its shores.

The maritime shipment of fuel from (and the likely shipment of the waste back to) Russia by way of the Aegean may also engender political and legal complications. In the current state of 6 nm territorial sea, plotting a route through the high seas without entering the Greek territorial waters is possible. However, the Aegean Sea is already the subject of multiple jurisdictional disputes between the parties. In 1995, the Turkish parliament declared in a plenary session that in the event of extension by Greece of its territorial sea in the Aegean to 12 nm (which would close off a route between the Mediterranean and the Black Sea through the high seas), the parliament would "grant the Government all authority including military, to protect and defend the country's vital interests" in a joint statement by all "political parties represented in the legislature".[75] The dispute concerning the delimitation of the continental shelf is currently in a standstill following the Bern agreement of 1976 to refrain from unilateral acts. While the continental shelf grants coastal States rights over the seabed and subsoil without prejudice to the status of the waters above as high seas, it may still be a relevant consideration as it serves as a template for EEZ[76] declarations. It also demonstrates how tensions tend to lead to confrontations in this area.[77] Given that the international practice mentioned above favors coastal State restrictions over passage of ultra-hazardous cargo and that the regional environmental treaties mentioned below contain obligations, which emphasize the protection of the environment, the possibility of protests from Greece should not be overlooked.

While the safety and security of the facility is the primary responsibility of the operator, in this case the Russian Federation, it is the Turkish government's responsibility to minimize terrorist threats against nuclear facilities on Turkish soil and in Turkish waters. Turkey is responsible for responding to calls for security support, preventing unauthorized groups getting close to sensitive sites, and protecting against plane, truck, missile, and long-range bomb attacks.[78]

In the NTI 2016 index, among 152 countries without weapons-usable nuclear materials, Turkey ranks 27th in the "most favorable nuclear materials security conditions" against theft category, with an overall score of 77 out of 100.[79] Turkey also scored 93/100 and ranked 12th in global norms, 93/100 and ranked 22nd in domestic commitments and capacity. Considering that the country remains a nuclear newcomer and its capabilities will improve in order to overcome the challenges posed by Akkuyu and its other nuclear undertakings, these rankings suggest that Turkey is at a relatively good place to start. Yet the country's risk environment score and ranking have been considerably lower, with a score of 39/100 and ranking 103rd.[80] In consideration of its geographical proximity to regions with active conflict, Turkey will need to take a proactive stance on transport security of nuclear materials.

Concerns of an ISIS radiological dispersal device (RDD), known as dirty bomb, and catastrophic nuclear terrorism are worrisome. In November 2015, 10 grams of Ir-192 capsules, a radioactive isotope of iridium and a Category 2 radioactive source according to the IAEA, were stolen from a storage facility near Basra belonging to the US oilfield service company Weatherford. The gamma rays in this isotope is used to test materials in oil and gas pipelines, owned by the Istanbul-based SGS Turkey company. While the material was eventually found dumped next to a gas station in Zubair, 9 miles south of Basra, neither SGS nor Weatherford claimed responsibility for the facility's security. Only months after, a suspect linked to the Paris bombers, Mohammed Bakkali was found with surveillance footage of high-ranking Belgian nuclear official at the Mol nuclear research facility on radioactive waste, raising fears that ISIS is intending to obtain radioactive material. Judging from these incidents, it is clear that Turkey has to adopt a robust mechanism to enhance its nuclear security measures, particularly against theft during transport.

6. CONTINGENCIES AND LIABILITY

A critical issue in ensuring the safety and security of the cargo, environment and human life is the existence of sound contingency planning and a satisfactory liability regime. The aforementioned troubled planning for the shipment of the decommissioned nuclear reactor from San Onofre by the US, may be a cautionary example in this regard as well. The Department of Transportation had initially objected to the maritime transport around South America as it found out that Southern Californian company, Edison, needed to draw up more realistic plans for salvage in case of sinking. The State Department also demanded that the company show detailed salvage contingency plans and an adequate liability insurance.[81]

The 2014 EIA states that Russian companies are among the foremost establishments handling such shipment, appear to rely mainly on the specialized training of the personnel they employ and require that all vessels engaged in carriage of radioactive or nuclear material, have an emergency action plan for accidents.[82] Nonetheless, the Turkish side cannot solely rely on entrusting the Russian companies, but should rather be engaged actively in the contingency planning process.

6.1. Contingency Response Planning and Salvage

Under Law No.5902, the Disaster and Emergency Management Authority attached to the Prime Minister's Office (AFAD) is in charge of coordinating the response to radiological events. The report prepared by the Working Group on Technological Disaster Risk Reduction identified the "integration of maritime emergency management into the national emergency management for effective assistance and cooperation" as one of the actions that need to be undertaken. To this end, Action 2.6 includes "planning, measures and intervention for nuclear and radioactive pollution at sea" and foresees legislative and planning preparations.[83] AFAD and TAEK are among the authorities responsible for the action, and Coast Guard Command is the relevant authority.

The Turkish Armed Forces have radiological and nuclear response capabilities in the form of CBRN Defense Battalion and CBRN Special Response Force.[84] However, as their primary objective is responding to the use of CBRN in armed conflicts and to ensure continuity of military activities, their relevance for contingency planning in a maritime transportation would probably be limited. It should also be noted that while the Coast Guard is within the organizational structure of the Turkish Armed Forces, it serves under the orders of the Ministry of Interior during peacetime.[85]

The 2014 dated EIA does not properly address the prevention of, emergency planning for or dealing with accidents or attacks during transportation of fuel or waste. Coupled with the apparent lack of general regulation and coordination for radiological or nuclear incidents at sea, the need for an in depth EIA for the transportation of fuel and waste should be emphasized even more.

6.2. Liability Regime

Turkey is party to the Paris Convention on Third Party Liability in the Field of Nuclear Energy and the 2006 Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention, but not the 2004 Protocol to Amend the Paris Convention. Turkey, Russia and Japan are not parties to the 1971 Convention relating To Civil Liability in The Field of Maritime Carriage of Nuclear Material, which exonerates the carrier for liability in a nuclear accident if the operator of the facility from which the nuclear cargo was transported is already liable under the Paris Convention.

The provisions of the Paris Convention and the Vienna Convention are not explicitly incorporated into the Turkish national law. Article 5(5) of Law No.5710 on Construction and Operation of Nuclear Power Plants and Energy Sale simply states that the Paris Convention as well as other international and national regulations are applicable in case of "accidents during carriage of nuclear fuel or radioactive waste." Other relevant national legislations include Article 71 of the Law on Obligations holding the operator of facilities that involve "significant danger" responsible for damages; and Article 3(g) and Article 28 of the Law on Environment, which incorporates the 'polluter pays' principle. The Paris Convention puts a maximum of 15 million SDR on the operator's liability. However, it has been reported that Turkey's Draft Nuclear Energy Liability Law calls for the establishment of a nuclear damage determination commission exceeding the limits of the operator liability, and requires the operator and nuclear fuel carrier to guarantee and insure the plant for possible damages.[86] The draft law enforces a strict liability for both the operator of the nuclear facility and the carrier of nuclear materials up to a maximum limit, with also an obligation to take liability insurance up to that limit. The carriers are given the option of posting a guarantee instead of insurance. The State is responsible for damages exceeding this upper limit.[87] Although there are general principles applicable to the issue of liability of the carrier under the Turkish private law and the reference in Article 5 of Law No. 5710, which incorporates the provisions of the relevant treaties[88], the enactment of a specific legislation envisaged in this draft law would allow for more accuracy.

7. REGIONAL CHALLENGES

Even though the route of the shipment of the fuel and radioactive waste could be arranged to transit only through Turkish and Russian maritime areas, protection of the marine areas is a common interest to all riparians of shared seas and as such is subject to international obligations and even third party compliance mechanisms.

7.1. International Law Rights and Obligations concerning Transshipment of Nuclear Materials

Past objections and protests against the shipment of nuclear cargo have claimed that environmental rights allowed a coastal State to restrict the rights of innocent passage through their territorial seas, even restrict the freedom of navigation in the EEZ. While possible maritime carriage of nuclear fuel to and waste from Akkuyu NPP will not traverse maritime areas of third party States and so will not have to deal with any "ban" on transit, it will still have to comply with international rules on the protection of marine environment. These rules represent the application of the precautionary principle and the duty of cooperation. Moreover, these rules are applicable not only by virtue of general international law, but also are enshrined in specific regional treaties. Turkey is a party to these treaties, namely, the Bucharest Convention on the Protection of the Black Sea Against Pollution of 1992 and the Barcelona Convention for the Protection of the Mediterranean Sea Against Pollution of 1976 as amended in 1995.The precautionary principle requires "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason to postpone cost-effective measures to prevent environmental degradation."[89] Of specific relevance to the subject at hand, this principle is enshrined in the Barcelona Convention Article 4 using the same wording. The concrete ways and means by which this principle would be put into effect are the preparation of the EIA of the activity and the duty of consultation.

Recently, the International Court of Justice (ICJ) has held that the preparation of an EIA is, "a practice, which in recent years has gained so much acceptance among States that it may now be considered a requirement under general international law to undertake an environmental impact assessment where there is a risk that the proposed industrial activity may have a significant adverse impact in a transboundary context."[90]

The 2014 EIA on Akkuyu is very sparse on the impact assessment of the carriage of the fuel and waste by sea. There may to be two reasons for this: Firstly, neither the current Environmental Impact Assessment Regulation of 2014 in its Annex I nor do any of the previous regulations that may have been applicable to the Akkuyu project after the project begun with the IGA in 2010 list "carriage" of nuclear or radioactive material among projects subject to EIA.[91] The other more pragmatic reason appears to be complacency of the fact that radioactive materials have already transited to Russia through the Turkish Straits[92] without any incidents. However, now the case is quite different from when Turkey was simply the transit

State between two third parties instead of the actual origin country. Moreover, the domestic legislation leaving the carriage radioactive materials outside of the scope of EIA requirements do not absolve a State of its international obligations. It is worth reminding that one of the significant cases where the inadequacy of the EIA was among the concerns was the Sellafield MOX Plant Case between the UK and Ireland concerning the carriage of spent radioactive fuel in the Irish Sea between the two States.[93]

Another international obligation regarding hazardous transboundary activities is the duty of cooperation. The duty of cooperation for "States bordering an enclosed or semi-enclosed sea … in the exercise of their rights and in the performance of their duties … to coordinate the implementation of their rights and duties with respect to the protection and preservation of the marine environment"[94] is not only a general principle of international law,[95] but also is frequently relied upon by Turkey in the context of Aegean Sea disputes with Greece.

The Bucharest Convention Article 14 also calls on States to "cooperate in preventing pollution of the marine environment of the Black Sea due to hazardous wastes in transboundary movement." The Protocol on the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal of 1996 annexed to the Barcelona Convention goes even further in its Article 6(4) through asserting that "the transboundary movement of hazardous wastes through the territorial sea of a State of transit only takes place with the prior notification by the State of export to the State of transit." Turkey has become party to this protocol in 2004 and it has entered into force in 2008. It is of course possible to plot a course for navigation without entering the territorial waters of Greece in the Aegean. Indeed, if the EIA is taken as a quasi-official then "prior authorization" (going one step further from the notification requirement of the Protocol to the Barcelona Convention) from the transit country (i.e. Greece) would need to be negotiated. To avoid this, the route would need to keep to the high seas portions of the Aegean or within the narrow band of Turkish territorial waters, very close to the shore. However, in the latter scenario nearly the whole voyage would have almost the same characteristics as travelling through the Straits. Moreover, no matter the route, the unavoidable proximity to Greek territorial waters would probably leave Greece keen to remind Turkey of its obligations, including an EIA for the transportation itself.

7.2. Compliance

The region in consideration already suffers from tensions concerning hydrocarbon exploration, as Turkish challenges to delimitation agreements remain in place. Turkey may have to explain its position concerning the carriage of nuclear materials at the Compliance Committee of the Barcelona Convention under such a political backdrop. The Compliance Committee is a non-adversarial mechanism set up to help Member States to better implement the convention. Turkey may apply to the committee within its own initiative or another Member State may refer an issue to the attention of the committee. Yet the committee I produces neither judgments nor binding decisions, but mere recommendations to assist the Member State in bringing their operations into conformity with the Barcelona Convention.

8. RECOMMENDATIONS AND CONCLUSION

While Turkish authorities have found refuge in referring to the intergovernmental agreement with Russia and to Turkey's membership to the global nuclear-related regimes, a closer look at the domestic legislative and regulatory frameworks for transport reveals that Turkey is hoping for the best scenario in avoiding risks.

According to a Turkish media report dated February 20, 2014, the IAEA Integrated Nuclear Infrastructure Review (INIR) on the Akkuyu nuclear power plant, which the Turkish Energy Ministry refused to share with a local court, stated that Turkey should define a national policy for the "front and back-end" of the nuclear fuel cycle (i.e. identify national responsibilities for the disposal of spent fuel and radioactive waste).[96] While this issue remains unresolved, there are a number of transport related issues that Turkish decision makers need to address in their consultations with the Russian authorities.

- A more detailed Environmental Impact Assessment is needed to assess the risks associated with the transport of nuclear material, especially in reference to the roles of relevant Turkish authorities and their action plans.
- All staff with access to nuclear facilities and transport should be carefully vetted, selected, and trained.
- Turkey should clearly define the penalties for illegal possession and trafficking of nuclear materials, including during transport, as well as the protocols for local and national law enforcement.
- Since Turkey will be outsourcing nuclear fuel and shipping spent fuel to Russia, the national plans and procedures for secure interim storage and transportation of spent fuel and radioactive waste should be agreed upon by all stakeholders.
- The physical protection system and safety response systems should be customized to Turkey and close coordination amongst these systems should be established.
- Turkish stakeholders should be ready to evaluate, prepare, and agree upon detailed and long-term plans and procedures to minimize risks related to radioactive waste. As such, cost estimates and contingency planning should be revised more thoroughly. These plans and procedures should also clearly identify the decommissioning stages, size and location of long-term radioactive and hazardous material storage and dump sites in order to reassure all stakeholders.[97]
- All stakeholders should prepare and agree on precise plans and procedures for contingency planning, which involve all stages of transport.
- The precise manner of transportation of fuel and waste need to be determined with Russia. If the deployment of private armed security on board is foreseen, legislation needs to be enacted. In any case, modality and procedures for information sharing and cooperation between land-based law enforcement agencies and the Coast Guard need to be established.

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59. On the other hand, Article 6 of the Essential Elements on the Host Government Agreement Annex to the Agreement between Turkey and Japan on Cooperation for the Development of Nuclear Power Plants and the Nuclear Power Industry leaves this to the responsibility of Turkey with the Project Company contributing to the cost. Practical cosiderations on the manner of transport considered in this part of the present report still apply though. (RG 23.05.2015 - 29364)
60. EIA Report, 2014, p.100 of Chapter V.2.2.2.
61. RG 26/6/2004 Sayı :25504
62. T.C. Ulaştırma, Denizcilik ve Haberleşme Bakanlığı, Deniz ve İçsular Düzenleme Genel Müdürlüğünün 26.03.2012 tarih ve B.02.1.DNM-4229 sayılı yazısı
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65. Coast Guard Command Law, art.4(A).
66. VanDyke, ODIL 1996, 386-7.
67. For detailed account, VanDyke, "Ocean Transport of Radioactive Fuel and Waste" in *The Oceans in the Nuclear Age*, Caron and Scheiber (ed.s), 2010, pp.152-156.
68. VanDyke, 2010, p.156
69. *ibid.* p.158. In fact art.1 of Basel Convention excludes radioactive waste which "are subject to other international control systems" from its scope.
70. INFOCIRC 225/Rev.4 (corr), art.8.1.1
71. Han, Çelikpala, Ergün, Nuclear Security: A Turkish Perspective, edam, p.60.
72. EIA Report, 2014, p.109 of Chapter V.2.2.2
73. UNSC res.2240(2015) authorizing States operating in the region to take forcible measure against smuggler vessels on the high seas.
74. VanDyke, ODIL, 2002, p.86.
75. TBMM Tutanak Dergisi, Dönem 19, Yasama yılı 4, Cilt 88, 121. Birleşim, 8.6.1995, Perşembe, p.136-7.
76. The EEZ includes sovereign rights over natural resources of the seabed, subsoil and the water coloumn thus is concurrent with the continental shelf when declared. However while the continental shelf rights are *ipso facto*, EEZ only exists if and when declared.
77. Tensions arose twice before between Turkey and Greece concerning cotinental shelf rights, once in 1974 which led to Greece referring the matter to the UN Security Council and the ICJ simultaneously and once again in 1987 when after declarations of intent to "take action" by both sides, the situaton was quelled through diplomatic means. (Fuat Aksu, *Türk Dış Politikasında Zorlayıcı Diplomasi*,

Bağlam Yayıncılık, Ankara, 2008, p.167, 169.)

78. Or, Saygin, Ulgen, 2011, p. 39.
79. "The 2016 NTI Nuclear Security Index: Theft and Sabotage, Building a Framework for Assurance, Accountability, and Action," Nuclear Threat Initiative, Third Edition, January 2016, pp. 22-23, 27.
80. Ibid.
81. Van Dyke, Ocean Transport, p.157.
82. EIA Report, 2014, p.109 and p.121 of Chapter V.2.2.2
83. 2014-2023 Technological Disasters Roadmap Document, 2014, AFAD, p.30 and 31.
84. For detailed explanations on these see, *Nuclear Security: A Turkish Perspective*, EDAM, 2015, p.62-64.
85. Coast Guard Command Law, art. 2.
86. Necip Kağan Kocaoğlu, "Nükleer Tesis İşletenin Hukuki Sorumluluğu: Karşılaştırmalı ve Uluslararası Özel Hukuk Analizi", Ankara Barosu Dergisi, cilt.68, sayı 2010/2, s.58.
87. Başak Başoğlu, "Nikleer Santral İşletenlerin Hukuki Sorumluluğu", presentation in Conference on Legal, Political and Ecological Aspects of Nuclear Energy, Istanbul Bilgi University, 25 June 2014, Istanbul.
88. These would have been applicable even without this incorporation by virtue of article 90 of the Turkish Constitution which provides that the treaties which Turkey is party to have the same hierarchical status as laws in the Turkish legal system.
89. Principle 15, Rio Declaration on Environment and Development.
90. Pulp Mills on the River Uruguay (Argentina *v.* **Uruguay), Judgment, 2010, para.204.** Neither of the parties before the Court in this Case were signatories of the 1991 Espoo Convention on Transboundary EIA thus making an EIA prior to undertaking an activity which may cause significant harm is now considered a customary international rule.
91. For the current Environmental Impact Assesment Regulation see, Official Gazette, 25 November 2014 no. 29186. For the 2013 Regulation repealed by the 2014 Regulation, Annex I list see, Official Gazette 3/10/2013, no. 28784; for the 2008 Regulation, Annex I list repealed by the 2013 Regulation see, Official Gazette 11 July 2008, no. 26939.
92. EIA 2014, Section X, p.14.
93. The MOX Plant Case (Ireland v. United Kingdom), (Provisional Measures, Order of 3 December 2001) ITLOS No. 10, and MOX Plant Arbitration (Jurisdiction) (2003) PCA (www.pca-cpa.org)
94. UNCLOS art.123.
95. The MOX Plant Case (Ireland v. United Kingdom), ITLOS, Order of 3 December 2010, para.82.
96. Tolga Tanis, "IAEA 'secret' report reveals Turkey's nuclear duties," *Hurriyet Daily News*, June 1, 2015.
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Nuclear Cooperation in the Middle East: Exploring Ways Forward

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1. INTRODUCTION: THE MOVE TOWARDS NUCLEAR POWER IN THE MIDDLE EAST

As the political will towards maintaining or establishing nuclear energy programs wavered following the Fukushima disaster in 2011, many countries in the Middle East have continued to inch towards becoming nuclear newcomers. Against the backdrop of political instability, conflict and geopolitical competition that has come to plague the Middle East for decades, some countries in the region have expressed ambitious nuclear agendas.

While states have their individual rationales for pursuing nuclear energy projects, there are also overarching reasons. For one, though many states in the region enjoyed rich hydrocarbon resources for decades, the decrease in oil prices in recent years has lowered the appeal of oil as a stable source of national income.[1] This has been an especially pressing problem for countries that were unable to diversify their economies sufficiently and continue to rely on natural resources. In the meantime, the demand for electricity has continued to increase for most countries. Thus nuclear energy appears as a low-cost and environment friendly alternative for freeing up domestic hydrocarbon resources for export, while providing a long-term alternative to rising energy demands.

For other countries, that are poor in hydrocarbon resources and rely on outside suppliers for their energy needs, nuclear energy has emerged as an alternative that could allow resource diversification and energy security, while lowering dependence on external actors and meeting rising electricity demands in the long-term. Another concern has been the need for desalination projects, which represent a major source of potable water in the Persian Gulf, and the potential use of nuclear energy in such projects.[2]

Although there is a rising interest in the region towards nuclear energy, many countries lack domestic capabilities for furthering their own projects and are reliant on foreign suppliers. This necessitates the countries to build up their institutional and human capital to meet the challenges that nuclear projects pose. Faced with similar challenges and sharing the same goals, it could be in the interest of Middle Eastern states to cooperate. This chapter aims to outline the ways in which states in the region may collaborate on their prospective nuclear projects. It sets out by providing an introduction on the nuclear developments in the region. It then provides examples of existing international cooperation in the field of nuclear energy. The authors later articulate on how the states may bridge their political differences and outline particular areas in which they can collaborate. The chapter concludes by providing recommendations.

1.1. Background on the Potential Newcomers

1.1.1. Iran

Against the notorious debate surrounding its nuclear program, Iran remains the most invested country in the region to nuclear power. Iran began its nuclear program in 1957 with the Atoms for Peace program of the United States,[3] and its first research reactor came online a decade later. Shah Pahlavi's ambitious nuclear agenda, which envisioned the construction of 23 nuclear reactors[4] with 23.000 MWe capacity,[5] aimed to free oil and gas reserves for exports and Iran's petrochemical industry, while meeting the rising demands for electricity. Yet, it is speculated[6] that his nuclear energy program was accompanied with a clandestine program for the development of nuclear weapons.

Though the construction of Iran's first nuclear power plant in Bushehr was initiated in 1975 by German companies, their work was stopped following the 1979 Islamic Revolution in Iran. The country's other nuclear deals were likewise cancelled after the revolution and lay dormant for decades. It was in 1992 that Iran reached a deal with the Russian government in order to continue the Bushehr project.[7] Political complications surrounding Iran's nuclear program, disagreements with Russia over the return of the fuel used in the facility, and technical issues came to delay the project, which began its commercial operation in September 2013.[8] In 2014, Iran reached another agreement with Rosatom to build at least two more reactors in Bushehr and four more in other sites that are not decided upon yet, as part of a deal in 1992.[9]

In the 2000s Iran also built fuel enrichment plants at Natanz and Fordow, and a heavy water reactor at Arak, which came to form the basis for international proliferation concerns. The Joint Comprehensive Plan of Action, reached between permanent five members of the United Nations Security Council and Germany (P5+1) and Iran in July 2015,[10] aimed to alleviate these concerns through curtailing Iran's uranium enrichment and plutonium production capabilities, as well as ensuring the ability of the International Atomic Energy Agency (IAEA) to verify Iran's compliance.[11]

In 2013, Iran announced that 16 sites had been chosen for the construction of new nuclear plants over the course of the next 15 years.[12] In addition to Russia, China has emerged as a preferable party for cooperating on Iran's nuclear project, whereas the country also plans to build indigenous reactors. Furthermore, the country agreed upon a long-term project with Hungary that would entail the design and development of a 25 MWe and a 100 MWe reactor that would be built in Iran and potentially sold across Asia and Africa.[13] As long as the proliferation concerns of the international community is satisfied, which Israel and countries across the Gulf are not in agreement with, it is likely that Iran's nuclear energy ambitions will continue over the long term. With its nuclear past, Iran has accumulated considerable experience, expertise and human capital to further its ambitions.

1.1.2. Israel

Israel's nuclear program remains limited to its alleged nuclear weapons program. Israel's initial research reactor was provided by the United States under the Atoms for Peace initiative in 1955, whereas France was involved in the construction of the Negev Nuclear Research Center in Dimona. Both the nuclear reactor and reprocessing facility became operational by mid 1960s, which is speculated to lay at the heart of the country's nuclear weapons program.[14] Israel has considerable specialization in nuclear matters, owing to both its research and education opportunities at the graduate level[15] and the opaque nuclear program that it has led for over five decades.

In 2007, it was announced that Israel might pursue a nuclear energy program and yet, following the Fukushima disaster, Israeli Prime Minister Benjamin Netanyahu declared the cancellation of the program.[16][17] Additionally, in 2014 Geological Survey of Israel (GSI), began working on detecting appropriate fields for a potential nuclear power plant to be built.[18]

1.1.3. Saudi Arabia

Saudi Arabia has plans to build 16 nuclear power reactors for peaceful purposes over the course of the next two decades, and the first reactor is planned to become operational in 2022.[19]

Despite its possession of abundant hydrocarbon resources, nuclear energy is still on the agenda of Saudi Arabia as the country consumes over one fourth of its oil production domestically, which is projected to rise exponentially and result in significantly decreased export capacity.[20] Furthermore, the country has concerns pertaining to the environmental factors, sustainability and desalination. In 2010, the Kingdom announced that "the development of atomic energy is essential to meet the Kingdom's growing requirements for energy to generate electricity, produce desalinated water and reduce reliance on depleting hydrocarbon resources."[21]

The King Abdullah City for Atomic and Renewable Energy (KA-CARE) has been established in order to advance the nuclear energy agenda as well as to have a competent entity in the country to represent it in the agreements signed with foreign companies.[22] An agreement has been reached with Korea Atomic Energy Research Institute (KAERI) to make assessments on the potential for building nuclear reactors and sharing knowledge and expertise on the construction, management, safety and security of the SMART reactors.[23] In another initiative, Saudi state-owned Taqnia and Argentinian state-owned INVAP have agreed to develop nuclear technology mainly for desalination purposes.[24] KA-CARE also signed an agreement with China in order to build a high-temperature reactor, and a cooperation agreement with Rosatom on a number of issues, including the design, construction and operation of nuclear research and power reactors, desalination plants, particle accelerators, provision of fuel cycle services, fuel and waste management, and the education and training of nuclear specialists.[25]

Nuclear research in Saudi Arabia can be traced to 1977 to the establishment of King Abdul-Aziz Center for Science and Technology and a nuclear engineering department was established at King Abdulaziz University the same year.[26] The Kingdom's Atomic Energy Research Institute was established a decade later.[27] The country has no nuclear research reactors and its nuclear expertise appears to be very limited, though its international nuclear agreements, such as those with South Korea, Russia and China, provide it with the possibility of establishing nuclear research reactors and collaboration in future research.[28]

1.1.4. United Arab Emirates

While rich in oil reserves, the United Arab Emirates (UAE) has a steadily rising electricity consumption that is expected to grow by more than two-fold by 2020. The UAE's oil exports comprise a third of its economic activity. The state has implemented policies in order to diversify the economy and reduce its dependency on oil exports and it started importing natural gas in 2008 to meet the energy demand for electricity production and water desalination, while addressing environmental concerns.[29]

Against this backdrop, the UAE released a white paper on an energy study in 2008 which outlined nuclear energy as a safe and clean alternative. Since then, in the words of the International Atomic Energy Agency:

> "the UAE is pursuing a peaceful, civilian nuclear energy program that upholds the highest standards of safety, security, nonproliferation and operational transparency. Government officials, nonproliferation advocates, and energy experts worldwide have called the UAE approach a gold standard for countries interested in exploring nuclear energy for the first time."[30]

The Emirates Nuclear Energy Corporation chose Korea Electric Power Corporation (KEPCO) for its first NPP in Barakah.[31] The plant with four 1400 MWe units is under construction and is slated to begin its full operation by 2020.[32] The country is also exploring the possibility of setting another plant in Dubai in the future.[33]

The UAE has signed numerous cooperation and mutual understanding agreements, including those with France, Republic of Korea, Australia, Argentina, Japan, Russia, the United States and the United Kingdom.[34] The country's waste management strategy entails the development of an endogenous storage and disposal program along with exploring the possibility of regional cooperation.[35]

Against the tangible steps that it has taken towards nuclear power in the past few years, the UAE lacks the human capital and experience necessary for running a nuclear program. Its nuclear program therefore includes the establishment of a graduate level program for raising nuclear engineers and vocational training for nuclear technicians.[36] Khalifa University in Abu Dhabi currently has a dedicated nuclear engineering department. The same university also hosts the Gulf Nuclear Energy Infrastructure Institute (GNEII) established in collaboration with the United States aimed at training regional decision makers in nuclear matters.[37] Additionally, there is a program to train and educate professionals in the nuclear field in Abu Dhabi Polytechnic, which gave its first graduates in 2014.[38]

1.1.5. Jordan

The economy of the Jordan has been affected in no small measure by the volatility and uncertainty of the energy market as it is almost entirely dependent on imports for its energy needs. Its main option at the moment is natural gas imports, which do not guarantee energy security for the country as evidenced by consecutive disruptions in the natural gas flows from Egypt.[39] Renewable energy is considered as an option, which would only research fruition in the long-term, whereas oil shale, remains a limited option in the medium–term. In light of these facts, the Kingdom issued a Royal Decree in 2007, that sets peaceful nuclear power as a goal in light of considerations relating to energy security, diversification of resources, decreased dependency and uncertainty of the market.[40] Nuclear option is considered a viable alternative planned to be capable of supplying 20% of the energy mix in the future, and mass deposits of uranium of the Kingdom is an advantage in terms of nuclear fuel.[41]

Jordan Atomic Energy Commission has been responsible for planning and enacting the nuclear power program and it has selected Rosatom State Corporation as the preferred bidder.[42] Jordan signed an intergovernmental agreement with Russia in 2015 for the construction of two VVER-1000 units that would contribute to 48% of Jordan's electricity.[43] Plans for four nuclear reactors are envisioned in the long term under the BOO model, whereas smaller reactors are also in the agenda of the country.[44]

Although it has a "well developed academic infrastructure, providing a strong foundation in disciplines required for a nuclear power program"[45] Jordan nonetheless has limited human capital and experience in nuclear sciences and research. Still, a number of undergraduate and graduate degrees have been offered in nuclear sciences in Jordanian institutions since 2007, and Jordan's first research reactor was built in 2013. Furthermore, through its cooperation agreement with North Carolina State University, Jordan University of Science and Technology students have online access to a virtual reactor for training purposes. The country also hosts a regional research center, discussed in more detail below, dubbed the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME) center.

1.1.6. Egypt

Egypt has considerable coal reserves, as well as the 3rd largest natural gas reserves and 6th largest proven oil reserves in Africa.[46] It also has availability for renewable energy resources and aims to increase the share of renewable energy in the mix up to 20% until 2020.[47] Diversification of the energy mix, reliability and sustainability of the resources, energy efficiency and a reform of the country's energy markets have been among the priorities in the energy strategy of the country.[48] Egypt's nuclear voyage began in the 1950s as it engaged in a nuclear partnership with the Soviet Union. The country's civilian nuclear energy program bore no fruit thus far, though its interest has been revived in 2006.[49] At the time for writing, the most likely candidate appears to be Russia, which decided to loan Egypt $25 billion for the construction of an NPP in Dabaa that is planned to begin operations in 2024.[50]

The country has accumulated some experience in the nuclear field, thanks to the research reactor supplied by the Soviet Union that reached criticality in 1961 and an Argentine supplied research reactor that became operational in 1997. The Inshas Nuclear Research Center that hosts both these units, also hosts a fuel manufacturing plant, a hot cell complex, and a waste management facility.[51] Furthermore Egypt has been raising nuclear engineers since the establishment of a dedicated department in the Alexandria University in the 1960s.[52]

1.1.7. Turkey

Turkey's nuclear voyage began in 1955 with the Atoms for Peace program. The country's first research reactor came online in 1962 and it began feasibility studies for its first NPP a few years later. Although there were multiple attempts to attain nuclear energy since then, numerous political issues, including political instability, numerous coups, and wavering political will, economic issues, such as financial crises and the country's reluctance to assume costs and financial risks associated with the NPP, as well as technical issues have prevented the realization of these plans. The most tangible step thus far has been the intergovernmental agreement between Ankara and Moscow signed in 2010 for the construction of four VVER-1200 units in Akkuyu, Mersin in southern Turkey under the build own operate financial model, which the Russian state-owned Rosatom will assume. Against delays, the project is expected to bear fruit within the next decade. The country's second tangible step has been to reach an agreement with a Japanese-French consortium led by Mitsubishi Heavy Industries and GDF Suez in 2013. As part of the deal, four Atmea1 reactors, that are expected to come online within the next decade, will be built in the northern Sinop province under the build own transfer model. Furthermore, Turkey is reportedly in talks with the China State Nuclear Power Technology Corporation – Westinghouse consortium for the site selection and feasibility studies for a third NPP,[53] and aims to meet 10 percent of its electricity demand from nuclear power by 2030.

Turkey currently hosts three nuclear research reactors. Its first nuclear research center, the Çekmece Nuclear Research and Training Center, established in Istanbul on 1962, was replaced with a more capable reactor in 1981, and a nuclear fuel pilot production plant was established in the same facility in 1986.[54] Turkey established another research center in Ankara in 1967, which currently hosts the country's first proton acceleration facility and its only electron accelerator. Another reactor has been established in Istanbul Technical University in 1979 for educational purposes, whereas a separate training and education center on nuclear matters has been established in Ankara in 2010. In addition to its accumulated experience in nuclear energy and its applications through these research facilities, the country also has a number of undergraduate and graduate level degrees on nuclear sciences. Nonetheless, it is estimated that between 1962 and 2010 only 315 undergraduate, 615 graduate and 135 PhD students had graduated from these degrees, and a number them have branched off to other areas that would have no bearing on the country's nuclear program.[55] Therefore, against its past, the country still lacks the human capital that it needs to support its ambitious nuclear agenda. A part of this gap is expected to be met through training Turkish students at Russian universities as part of the Akkuyu deal. Still, considering that these students will be employed at the Akkuyu NPP, Turkey will still need to invest in its nuclear training opportunities and seek external partnerships for developing its human capital in the nuclear field.

1.1.8. Other Countries

While there are no other apparent candidates to become nuclear newcomers at the moment, other states in the Middle East have shown an interest in nuclear energy with varying degrees.

Kuwait's initial attempts in 1970s were cancelled due to the Three Mile Island incident and the Iraq-Iran War,[56][57] whereas its second attempt that began in 2009 was cancelled after the Fukushima disaster.[58] Still, developing infrastructure for a nuclear program remains among the strategies of Kuwait Institute for Scientific Research.[59]

In 2010, Qatar endorsed the idea of having a regional nuclear program despite an earlier feasibility study in 2008 that concluded nuclear energy was not an attractive option.[60] Qatar also reached a cooperation agreement with Russia's Rosatom, and with South Korea for purposes of training local nuclear experts, a preliminary research for three years and the subsequent construction of a research reactor.[61][62]

Oman is another GCC country that considered nuclear power as an option and ran its own preliminary research on the issue. While the country similarly announced that nuclear energy was not a viable option in 2008, it supported the idea of a regional nuclear program among GCC countries and declared its willingness to invest into the nuclear program of another GCC country.[63]

Iraq and Libya had nuclear weapons programs in the past, while Syria was implicated by the IAEA for establishing a plutonium production reactor, which was bombed by the Israeli air force in 2007. While Syria and Libya have expressed an interest in pursuing nuclear energy projects, the ongoing security situation and political uncertainties in both countries prevent this possibility in the near future.

2. PRECEDENTS OF NUCLEAR COOPERATION

2.1. *International Arrangements*

A significant amount of international diplomatic efforts and resources have been devoted to devising mechanisms of cooperation in the field of nuclear security, including on safeguarding nuclear material, preventing the proliferation of nuclear weapons and preventing nuclear materials from falling into the wrong hands. Yet there have also been considerable strides with regards to collaboration on the peaceful uses of nuclear energy, including on the generation of nuclear power, as well as the determination of standards for nuclear energy and safety.

Three international agreements stand out in this regard. The first is the Convention on the Physical Protection of Nuclear Material (CPPNM), which was adopted in 1979 and entered into force in 1987. The CPPNM is the only international legally binding arrangement in the field of the physical protection of nuclear material with over 150 parties.[64]

A second initiative has been the Convention on Nuclear Safety (CNS), which was adopted in 1994 and currently has 78 parties.[65] The CNS sets international safety benchmarks for land-based nuclear power plants and legally commits its parties that operate such facilities to abide by these standards. The obligations of party states include those on "siting, design, construction, operation, the availability of adequate financial and human resources, the assessment and verification of safety, quality assurance and emergency preparedness."[66]

The third such arrangement is the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, which is the first international legal instrument that addresses spent fuel and radioactive waste management.[67] While the convention, which currently has 72 parties,[68] primarily covers the safety of spent fuel and radioactive waste of civilian installations, it also applies to military or defense originated spent fuel and radioactive waste if they are utilized in civilian programs. All three of these arrangements are overseen by the International Atomic Energy Agency (IAEA).

2.1.1. International Atomic Energy Agency

International organizations have played an essential role in fostering civilian nuclear cooperation. The foremost of these organizations is the International Atomic Energy Agency. The IAEA was formed in 1957 as an independent intergovernmental organization, yet it reports to the United Nations General Assembly and Security Council. The Agency's first focus is on the peaceful uses of nuclear technology, where it tries to encourage cooperation, research and development, and scientific and technical collaboration on the physical, chemical, agricultural, medical, and water related applications of nuclear technology.[69] Secondly, the Agency works to promote nuclear safety and security internationally, through providing its members a myriad of resources, including sharing best practices, conducting safety, security and preparedness reviews and training activities, as well as setting the standards and regulations on the use of nuclear energy for peaceful means, including nuclear power. Lastly, it serves as the watchdog of the Nuclear Non-Proliferation Treaty (NPT) and works to verify that its safeguards are met.

On nuclear power, one of the IAEA's primary roles continues to be the creation of international regulations and sharing of best practices. Throughout its existence, the IAEA has created numerous safety standards and regulations which form the basis of many national regulations. In addition to a number of non-binding security instruments, the IAEA also has generated binding instruments, including the Convention on the Physical Protection of Nuclear Material and the 2005 Amendment, Convention on Early Notification of a Nuclear Accident, Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Convention on Nuclear Safety, and Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.[70]

Furthermore, the IAEA has promoted technical collaboration projects with the aim of enhancing national regulatory capability and improving nuclear power plant (NPP) safety in a number of countries. The main recipients of these collaboration projects were former Soviet Union states in eastern and central Europe, many of which lacked the human, technical and regulatory capacity to ensure the safety of their nuclear operations after the collapse of the USSR. In a more recent initiative, the IAEA began offering potential nuclear newcomers Integrated Nuclear Infrastructure Reviews (INIR). These missions aim to assess the successes and shortcomings of a given nation in developing the infrastructure necessary for running a nuclear program. The missions are undertaken upon the request of a Member State and include site visits, interviews, document reviews by specialized international experts and IAEA staff, which provide suggestions and recommendations after the review. The first mission was conducted in Jordan in 2009, and later included Bangladesh, Belarus, Indonesia, Poland, Thailand, Turkey, the United Arab Emirates, Vietnam, as well as South Africa – which already has a nuclear power program.[71] As such, the IAEA continues to make direct and tailored contributions to the nuclear energy programs of its members.

In order to quell worries about the transformation of states with peaceful nuclear power programs into nuclear proliferators, a number of actors have proposed the establishment of guaranteed international nuclear fuel provision systems. One of the fruits of these proposals was the establishment of an International Uranium Enrichment Center (IUEC) by Russia and Kazakhstan in 2007. The main aim of the IUEC was to provide states with "assured access to uranium enrichment … without transferring the sensitive technology or restricting development of national nuclear fuel cycle programmes".[72] The Center allows for nuclear newcomers to have an equity in the project[73] and gain access to low-enriched uranium fuel, without allowing access to sensitive technology that could lead to nuclear proliferation. Another initiative has been the Low Enriched Uranium (LEU) Bank, that will be established in Kazakhstan in 2017 under the auspices of the IAEA. The Bank would guarantee fuel reserves for nations "that find themselves unable to procure LEU from the open market for political reasons".[74] The aim is to ensure that such nations would not be compelled to develop indigenous fuel cycle capabilities that could lead to proliferation concerns over time.

2.1.2. Organization for Economic Co-operation and Development

The Organization for Economic Co-operation and Development (OECD) also hosts a Nuclear Energy Agency (NEA) under its auspices. NEA represents 31 countries with 86 percent of the world's installed nuclear capacity.[75] The NEA is geared towards experience and best-practice sharing, and technical cooperation between its members in nuclear safety, technology and science, as well as environmental and legal issues. NEA also promotes international collaborative programs, including those on decommissioning costs, decommissioning and dismantling, uranium resources, waste management, operational safety, nuclear law and medical radioisotopes, and produces publications arising from these programs.[76] The NEA also works closely with other organs of the OECD, the IAEA, with the nuclear industry and stakeholders, as well as non-OECD members.

2.2. *Regional Cooperation*

2.2.1. The European Union

The idea of a Union-wide collaboration on nuclear energy is as old as the European Union itself. The European Atomic Energy Community (EURATOM) was established through the Treaties of Rome in 1957 with the aim of establishing a common market for nuclear energy. EURATOM covers all civilian purpose nuclear activities of the EU and continues to work towards providing a common market in nuclear materials, ensuring nuclear fuel supplies, and guaranteeing that nuclear materials are not diverted from their intended purposes.[77]

The European Union also continues to set up common rules on issues such as the safety of nuclear installations, the safe disposition of radioactive material and radiation protection, among others. The Union has also set up financial decommissioning assistance programs for its members, Bulgaria, Lithuania, and Slovakia for the decommissioning of old Soviet-type nuclear reactors.[78] Additionally the European Commission has also set up strategic investment funds, that could potentially be used in nuclear plants and related infrastructure.[79] EU member states themselves have also gathered to undertake a number of initiatives to promote the role of nuclear energy in the EU's energy mix, collaborate on providing standardized utility requirements for light water reactors, and establish joint research and development (R&D) projects.[80] Moreover, there are a number of independent European organizations that aim to promote cooperation with and among nuclear regulators and technical organizations over numerous issues, including nuclear safety, radiation protection, accident management and waste management. A number of these initiatives are not exclusive to the members of the EU, and branch out to other states in continental Europe and beyond. Furthermore, the EU also hosts a number of monetary assistance programs, such as those offered by the European Bank of Reconstruction and Development, the European Investment Bank, and the European Parliament for the improvement of safety in the nuclear facilities of former Soviet Republics – some of which were also expanded to potentially cover Turkey and Middle East.[81]

2.2.2. Other Regional Cooperation Mechanisms

Due to the sensitive nature and potential military uses of nuclear technologies, nuclear cooperation between actors outside the scope of a neutral international organization or an established alliance runs at the risk of being plagued by mutual mistrust and political tensions. One mean that has allowed states to overcome such issues have been the establishment of Nuclear Weapons Free Zones (NWFZ). While the issue falls outside the scope of this paper as it falls under the proliferation debate, it should be noted that a number of initiatives that have led to NWFZs, have also allowed states to collaborate on numerous fields concerning the peaceful uses of nuclear energy, including R&D and emergency preparedness. The existing NWFZs are in:

- Latin America and the Caribbean, established with the Treaty of Tlatelolco with 33 parties,
- South Pacific, established with the Treaty of Rarotonga with 13 parties,
- Southeast Asia, established with the Treaty of Bangkok with 10 parties,
- Africa, established with the Treaty of Pelindaba with 28 parties,
- Central Asia, established with the Treaty of Semipalatinsk with 5 parties,
- Mongolia, which has declared itself a NWFZ

Outside these regions a number of countries have also established means of multilateral nuclear cooperation. These include, but are not limited to, a collaborative effort between Japan, China and South Korea over nuclear safety and information exchange during emergencies, the Arab Atomic Agency as a subsidiary to the Arab League which works on nuclear science and its applications, the Arctic Military Cooperation Program established between the United States of America, the Russian Federation and Norway, which was superseded by a bilateral program between Russia and Norway, over radioactive waste in the Arctic and the decommissioning of nuclear submarines.[82]

2.3. *Intergovernmental Nuclear Cooperation*

There are also mechanisms established among governments in order to foment cooperation in specific issues pertaining to peaceful uses of nuclear energy. The Generation IV International Forum, for example, focuses on new reactor designs and has identified six reactor concepts that could potentially be deployed commercially by 2030. The project aims to enhance safety, physical protection and improve the utilization of natural resources, while reducing capital costs and wastes.[83] Similarly, the Global Nuclear Energy Partnership focuses on developing new nuclear technologies, including proliferation resistant recycling technologies in order to enhance efficiency, reduce waste and minimize proliferation concerns. The Contact Expert Group, was another initiative that was undertaken with the aim of enhancing the safety of waste management in Russia and foment cooperation on radioactive waste management issues. The International Science and Technology Centre was established as a joint initiative by Russia, Japan, the EU and USA with the aim of giving nuclear weapons scientists from former Soviet Republics a chance to utilize their skills in peaceful programs. As such, the multilateral nuclear cooperation setting is quite variegated and is open to further diversification.

2.4. *Bilateral Cooperation*

Nuclear cooperation on a bilateral level is a common practice among nations. The nature of nuclear partnerships is virtually non-exhaustible – some examples of which are cooperation on reactor design, plant licensing, fuel and waste management, transportation of radioactive materials, capacity development, operational safety analyses, training, radiation monitoring, emergency management, research and development. The United States alone has peaceful nuclear cooperation agreements, dubbed 123 agreements, with 22 nations.[84] The US and Russia also have a long history of collaborating on nuclear safety issues in order to overcome the challenges posed by the deficits in Russian capacity after the collapse of the USSR.

Cooperation between utilities and regulators are also common practices in the nuclear setting. One rather new concept is fuel leasing, where the supplier leases its fuel to another country and takes back the fuel after it is spent for disposal or reprocessing. Due to the proliferation concerns regarding Iran's nuclear program, the fuel contract between Russia and Iran is based on such a principle. It is possible for this concept to be developed further as Russia is showing an interest in the issue.[85]

2.5. *Cooperation at the Industry Level*

International cooperation amongst operators, regulators, utilities and other stakeholders in nuclear programs form another layer of cooperation, which mostly exists outside the reach of governments. One major example of such mechanisms is the World Association of Nuclear Operators (WANO). WANO was established in 1989 following the Chernobyl nuclear disaster to link "the leaders of every commercial nuclear reactor in the world"[86] with the aim of increasing the reliability and safety of NPPs by benchmarking and assessing performance through sharing information and best practices. It currently represents over 130 members that operate 430 NPPs worldwide and also involves vendors and reactor designers. WANO focuses on the operation of NPPs, instead of their design and regulation, and has four major programs. These are on peer reviews, operating experience, technical support and exchange, and professional and technical development.[87]

In its first two years, WANO accomplished one of its major objectives, which was facilitating technical exchanges between former Soviet and Western NPPs. Technical staff from every NPP in former Soviet Union visited plants in the West, whereas personnel from Western NPPs visited every plant in former Soviet Union.[88] By the end of 2009, every commercial nuclear power plant in the world had been peer-reviewed at least once. WANO aims to ensure that every plant is subject to an outside review at least every three years and a full WANO peer review at least every six years.[89] WANO also conducts follow-up peer reviews to ensure that the operators act upon its recommendations[90] and ultimately confronts with the utility's board if necessary.[91] Following the 2011 Fukushima disaster, WANO undertook steps to increase its internal strength and "have teeth with its members".[92] The organization also moved to include accident mitigation and severe accident management amongst its goals, as well as expanding its peer review structure.[93]

WANO also has collaboration mechanisms to assist nuclear newcomers. The organization aims to conduct a pre-startup review for all new constructed NPPs worldwide, which evaluate how prepared operators are to initiate the operation of the NPP. As "the transition from a "construction mentality" to an "operations mentality" at a nuclear power plant is a delicate period"[94], the assistance of the global nuclear industry to fledgling nuclear facilities may prove an essential tool in reducing incidents.

There are numerous industry-level initiatives aside from WANO. The World Institute for Nuclear Security (WINS) gathers together both governmental and private organizations tasked with on-site nuclear security, with the aim of enhancing capabilities to counter theft of nuclear materials and their utilization in terrorist acts. The World Nuclear Association (WNA) gathers together nuclear vendors, utilities, and other companies involved in various aspects of nuclear energy, including uranium mining, conversion, enrichment, fuel fabrication, nuclear waste management, among others. WNA has numerous initiatives geared towards enhancing cooperation within the industry, as well as promoting "a wider understanding of nuclear energy among key international influencers".[95] Additionally, the International Association for the Environmentally Safe Disposal of Radioactive Materials (EDRAM) that consists of waste management organizations from 11 nuclear power countries focuses on long-term disposal and waste management issues, whereas the Multinational Design Evaluation Programme (MDEP), formed amongst regulators of its 14 members, aims to develop multinational regulatory standards for the design of Generation IV reactors.[96] Such cooperation mechanisms among the nuclear industry and between independent or quasi-independent regulators and utilities, may present more room for collaboration on a diverse range of issues compared to the cooperation between governments, which is inherently subject to political influences.

3. BRIDGING THE GAPS

3.1. Previous Attempts at Nuclear Cooperation in the Middle East

In 2006, the GCC announced its plans to develop a common civilian nuclear program.[97] The existing electricity grid that links large and medium sized cities across the borders of the GCC states contributed to the feasibility of such a joint-project.[98] Even though the GCC sought consultation from the IAEA on the issue, the proposition has borne no fruit thus far. Nonetheless, it is argued that countries with small grid capacities could stand to benefit from such a cooperation instead of pursuing their individual nuclear programs which require considerable investments.[99] On the other hand, for states with larger grid capacities, sharing financial burdens and risks may serve as an incentive.

Saudi Arabia offered an alternative proposal in 2007 over the establishment of a regional capacity for uranium enrichment. The Saudi side argued that the GCC and its neighbors should base such a facility in a neutral country outside the region, which would provide guaranteed supply of enriched fuel so that the countries would not need to develop their endogenous capabilities.[100] Intent on developing its nuclear capabilities, Iran was among the states that rejected this offer. Conversely, an earlier offer by Iran for GCC countries to benefit from its enrichment program was similarly rejected by the Saudi side, with the Defense Minister Sultan bin Abdulaziz stating that his country "doesn't need nuclear assistance from any country".[101]

As such, at the time of writing, it is hard to argue that any meaningful nuclear cooperation exists in the Middle East aside from joint scientific research projects and accident management plans as elaborated below, which do not cover the region as a whole. In the meantime, the Joint Comprehensive Plan of Action designed to curb Iran's nuclear program has alleviated the proliferation concerns of the international community to some extent. However, some states in the region that have had historical enmities with Tehran, most notably Saudi Arabia and Israel, are not readily relieved about the threat that Iran poses. The critics of the deal both in the region and across the globe argue that due to the relief that the deal will provide Iran with the gradual removal of sanctions, Iran will be at an economically and technologically empowered position by the time that the clauses of the deal expire, and hence pose a greater threat and proliferation risk.[102] Therefore Tehran may need to take efforts to ameliorate the concerns of its regional rivals before the post-JCPOA environment becomes conducive to nuclear cooperation. On the other hand, Israel itself is believed to possess nuclear weapons, which complicate the prospects of regional non-proliferation and disarmament efforts.[103]

Of course, Middle Eastern nuclear issues do not exist in a vacuum and are parts of the regional competition, mistrust and threat perceptions, that remain beyond the purposes of this chapter. Still, what may be relevant for the region is the success story behind how Argentina and Brazil transformed their nuclear competition, which was expected to lead to nuclear proliferation, into a relationship of cooperation.

3.2. The Argentina-Brazil Nuclear Rapprochement

As far as nuclear rapprochements go, the example of Brazil and Argentina presents a valuable case study. The relationship between the two countries was once characterized by a competition for regional influence, and extended to as far as their independence in the early 1800s. Though the last direct armed conflict between the two countries was in 1825, their rivalry continued, including on concrete disputes such as the sharing of water resources.[104] As Argentina initiated its nuclear program in the 1950s, Brazil followed suit to catch up,[105] and their rivalry moved on to the nuclear realm, with a considerable threat of proliferation. Each side identified the other as a major threat to its national security, and both invested in indigenous uranium enrichment and ballistic missile capabilities.

There are additional parallels between the past rivalry between Argentina and Brazil, and the existing rivalries characterizing the Middle East today. In the 1970s, both Brazil and Argentina were ruled by authoritarian regimes, their nuclear policies especially were characterized by opaqueness, their bilateral diplomatic and political relationship was very narrow, and they had low levels of social interdependence.[106]

Yet the decision of the two countries to deescalate and cooperate on nuclear matters "reshaped the regional environment in South America as a whole, for it spilled over to include areas like freer trade, democracy promotion and joint military exercises".[107] It was the combination of several factors that drove Argentina and Brazil to cooperate instead of continuing their rivalry.

For one, both countries faced considerable political and economic challenges domestically as well as internationally. Argentina faced considerable external threats, a weakened economy due to failed policies, and mounting international criticism for the human rights violations committed by its military regime. On the other hand, Brazil faced major economic issues, and the ability of the Brazilian military regime to control the country was eroding rapidly.[108] Therefore one of the root causes of their decision to cooperate was their relative weakness at the international stage.

As the two countries were gradually moving towards democratization, the nuclear policies of both countries was increasingly seen as a "caprice of military regimes … and had become too expansive and cumbersome to sustain."[109] Furthermore, there appeared to be an empathy between the military regimes of Argentina and Brazil over the scope and priorities of each other's nuclear programs. It appears that neither side believed that there was an imminent danger of the other achieving a breakout capability, and they never "felt sufficiently fearful about the other's nuclear intentions"[110] which prevented the competition from spiraling out of control. The nuclear sector professionals in both countries similarly developed a mutual empathy rather than enmity, which contributed to sustaining the nuclear cooperation between the two countries.

One of the issues that brought Argentinian and Brazilian leaders together was their mutual distaste towards international non-proliferation regimes. The two countries believed them to be the attempts of nuclear powers to curtail peripheral countries from developing nuclear technological capabilities. They were especially critical of US-led attempts that emphasized technology denial, and as a response, both countries stepped up their uranium enrichment programs in the 1970s. Interestingly enough, as Argentina and Brazil scurried to relieve themselves of international pressure, one proposal came from US congressman Paul Findley for the two countries to develop a bilateral inspection scheme outside the purview of the NPT, which he argued could relieve worries in Washington and across the globe about the potential proliferation threat that both countries pose.[111] Although the Brazilian side dismissed the proposal, the Argentinian side saw it as a potential basis of cooperation.

Another crucial ingredient to the nuclear rapprochement between the two countries was the role that the institutions in each country played in bridging the gaps. The empathetic posture of the two militaries was reflected by the fact that both sides "made it a point to communicate the news of their acquired uranium-enrichment capabilities through special envoys before announcing to the wider world".[112] Faced with similar pressures regarding the international non-proliferation regime, the foreign ministries of Brazil and Argentina adopted similar positions at the international stage, fomenting an environment of shared interest and mutual trust, which contributed to the development of ties at the nuclear field. An additional, and perhaps equally important factor was at the low-politics and unofficial level.

"Starting in January 1977, technical exchanges between the two nuclear energy-commission's officials facilitated the development of interpersonal relationships between Argentine and Brazilian nuclear professionals. Among scientists, ties developed in doctoral programs in Europe and the United States, as well as in international nuclear scientific conferences … By the mid-1980s, there was a significant flow of information at a practical, unofficial level between Argentine and Brazilian nuclear personnel. It is no wonder that soon after their first nuclear cooperation agreement, the two sides set out to develop joint nuclear-industry projects."[113]

A final element was the personal efforts of presidents Raul Alfonsin of Argentina and Jose Sarney of Brazil. After coming to power by the end of 1983, Alfonsin saw normalizing relations with Brazil as a potential way of recovering from economic recession, restoring Argentina's international standing after its defeat in the Falklands War, and establishing his own authority domestically. The Brazilian government was initially cautious, but the Argentinian proposal found better audience after the beginning of democratization in Brazil in 1985 and the subsequent Sarney administration. The sides agreed upon establishing a working group on what would amount to their nuclear rapprochement, and the two leaders met on November 1985 for the first time, announcing that the nuclear programs of their countries would only be limited to peaceful purposes. The rapprochement gained significant momentum afterwards. As the two presidents met in various nuclear facilities in the two countries, they decided first to remove the veil of secrecy in their nuclear programs, then to turn the working group into a permanent commission to institutionalize bilateral cooperation, and later agreed upon a set of goals regarding their cooperation and timetables for their realization.[114]

It is important to note that these strides were made before full political democratization, and social and economic interdependence. Furthermore, as Alfonsin was pushing his counterpart for further cooperation and transparency, he was well aware that Sarney struggled to consolidate his authority domestically. For Sarney, Argentinian overtures served as an opportunity to assert his authority in the nuclear field and strengthen his image as a statesman.[115] As such, the conditions for both sides were far from favorable, and scoring a major policy shift necessitated diligent statesmanship from both leaders to navigate in such stormy seas.

Although the leadership of the two countries changed in 1989, the rapprochement continued on, with the establishment of the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials to carry out inspections in the early 1990s, and the establishment of safeguards between themselves and the IAEA. In 1994, the two countries joined the Tlatelolco Treaty that establishes Latin America as a NWFZ, and subsequently joined the NPT. This ongoing cooperation has also resulted in collaboration on practical projects, with the sides agreeing on "30 structuring projects on reactors and nuclear waste, fuel cycle, nuclear applications and regulations" in 2008.[116]

4. PROSPECTS FOR NUCLEAR COOPERATION IN THE MIDDLE EAST

As outlined above, many states in MENA find themselves in the same predicament: while they have a heightened interest towards nuclear energy for economic, political and strategic reasons, they lack endogenous capabilities. Against this backdrop, it could be mutually beneficial for states to collaborate on various aspects of their respective nuclear programs in order to alleviate the technical, financial and operational challenges associated with establishing nuclear power programs from scratch. Yet the MENA region features a very complex political environment characterized by ideological polarities, mistrust, frozen conflicts and open hostilities. This backdrop hinders region-wide cooperation of any sort, let alone in a strategic issue such as nuclear energy. Nonetheless, there are potential venues of collaboration that the region as a whole or groups of states may decide to engage upon, if the suitable political atmosphere is cultivated.

4.1. *Making the Land Arable*

Against the visible political obstacles to regional cooperation, states in MENA also have incentives to cooperate. For one, the costs of constructing and operating a nuclear facility, as well as managing its waste and potential accidents are measured in billions of dollars. Likewise, establishing the legal and organizational framework to manage a country's nuclear undertakings demands considerable resources. Hence cooperation amongst nuclear newcomers in the region may be based on strong financial rationales. Cooperation in building the capacity of administrative agencies that will be involved in different aspects of nuclear projects would also pave the way for easing pressures on resource allocation. Sharing lessons learned during the initiation of nuclear projects and throughout their operation could enable strengthening the nuclear safety and security practices of MENA countries. Eventually, regionalization could ease the dependency of nuclear newcomers in the region to nuclear providers abroad. Arguably, if sufficient momentum is gathered and cooperation among a number of states is achieved, states may be compelled to bandwagon out of fear that being left out may leave them at a competitive disadvantage.

4.1.1. Confidence Building Measures

Utilized primarily in security and conflict related settings, confidence building measures (CBM) allow parties to gradually deconstruct the mutual mistrust and insecurity with the ultimate aim of enabling cooperation or reducing the likelihood of further hostilities. Proposed CBMs are components of the attempts at the establishment of a Nuclear Weapons Free Zone (NWFZ) or a Weapons of Mass Destruction Free Zone (WMDFZ) in Middle East. The issue has been debated, with limited progress for decades, and remains tangential to the purposes of this article. Nonetheless, some CBMs that were proposed by a United Nations study on means that would facilitate the establishment of a NWFZ in Middle East could also be useful on this context. Two of these propositions are the inclusion of all nuclear facilities in the region under IAEA safeguards, and commitments by states in the region to abstain from pursuing domestic fuel processing capabilities.[117] It might be valuable to pursue similar confidence building measures to foment cooperation in peaceful uses of nuclear energy in the region, which in turn might actually serve to facilitate progress towards the establishment of a regional NWFZ or WMDFZ. Likewise, the accession of all countries in the region to the Non-Proliferation Treaty, and to the Additional Protocol may serve as a confidence building measure that could enable cooperation in peaceful uses of nuclear energy and allow for further distance to be covered in the path towards the establishment of a WMDFZ in the region.

4.1.2. Alternative Uses of Peaceful Nuclear Technology

Potentially, cooperation in alternative uses of nuclear technology may lay the groundwork for future cooperation in nuclear power. There are a multitude of ways in which nuclear technology is used to enhance human life. In agriculture, radioisotopes are used for a wide array of applications: including, to increase genetic variability in crops, control against pests and insects, preserve food, and serve as fertilizers. Radioisotopes also prove their utility in tracing and measuring underground water resources, detecting leakages in irrigation channels and dams, understanding the dynamics of surface waters, and measuring soil moisture.[118] Radiation and radioisotopes are widely used in medicine, in both diagnosing diseases and treating them. There are also many commercial and industrial uses of radioisotopes. It is possible for states in the region to establish collaboration mechanisms in any of these fields, especially in the form of research and development cooperation between scientists, engineers and technicians. One example is the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME) Center in Jordan, which will conduct advanced research in fields including biology, medical sciences and archeology. The SESAME Center will provide a rare opportunity for scientists from states with antagonistic relations in the region to work together. Its current members are Bahrain, Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, the Palestinian Authority and Turkey.[119]

4.1.3. Cooperation on Peripheral Issues

A potential source of cooperation might be to focus on peripheral tasks associated with nuclear power programs. At the private level, such cooperation may encompass partnerships among construction companies for the construction of NPPs in the region. It is similarly possible for utility companies to cooperate in devising ways of integrating NPPs efficiently in the national grid. At the governmental level, regulators and respective agencies may play a role in facilitating such cooperation and may engage in multilateral exchanges themselves. As desalination emerges as one of the primary motivations behind the interest in nuclear energy in the region, especially among Gulf states, desalination technologies may also present a preferable venue for cooperation. In this regard, if allowed to foster without government intervention, collaboration at the private level may provide ways of circumventing political tensions in the region. With luck, collaboration at the private level, bilateral partnerships and multilateral initiatives may potentially pave the way for further cooperation in nuclear power programs.

4.2. *Potential Areas of Cooperation on Nuclear Energy*

In light of the examples of international cooperation in nuclear energy, three major areas of emerge for Middle Eastern states.

4.2.1. Capacity Building

At the moment, only Iran hosts nuclear power plants, whereas some others have nuclear research reactors. Faced with inexperience in running nuclear programs, one potential area of cooperation could be among nuclear regulators in the region. Technical exchanges may facilitate building the institutional and regulatory capabilities of the regulators. Joint-training and capacity building efforts may alleviate the burdens of training the human capital necessary for regulatory agencies. Moreover, as the demand for human capital in nuclear newcomers will not be limited to regulatory agencies, owing to the fact that the countries will need to train nuclear scientists, engineers, and other qualified personnel that will be employed in NPPs, there may be numerous opportunities for cooperation in this regard. Furthermore, once plants go online, peer reviews might serve as important tools to enhance the safety and security culture of NPPs across the region.

4.2.2. Emergency and Consequence Management

Cooperation in reporting incidents at nuclear facilities, early warning systems and radiation monitoring may provide more straightforward paths of cooperation for the states in the region. At a wider lens, preparing for nuclear emergencies and consequence management would also emerge as mutually beneficial areas of cooperation. Members of the Gulf Cooperation Council are already taking steps towards developing a Regional Radiological and Nuclear Emergency Preparedness and Response (RRNEPR) Plan[120] which may be expanded to include other countries in the region and deepened to incorporate capacity building exercises and joint-response initiatives.

4.2.3. Regionalism

Gradually, states may be interested in reducing their dependency to external actors and may seek to develop their own capabilities. Yet due to the political circumstances of the Middle East, nuclear energy ambitions of states in the region go hand in hand with proliferation concerns. Hence, when it comes to the development of capabilities, especially on sensitive areas such as the fuel cycle, unilateralism may raise eyebrows and aggravate the already tense security situation in the region. One alternative would be the joint-development of these capabilities, be it concerning fuel supply, fuel cycle, waste management and storage. While politically sensitive, a number of factors that may propagate cooperation in such areas exist. The Iran nuclear deal restricts some of Iran's nuclear capabilities, such as fuel enrichment, while promising international cooperation in other areas, such as over light-water reactors – which may allow Tehran some room for maneuverability for seeking external cooperation.

Jordan has considerable uranium reserves, which may become preferable alternatives to states in the region for logistical reasons. Turkey, among other countries, is interested in gaining the ability to build its own reactors after reaching a level of maturity, whereas the UAE is a very visible party in international nuclear initiatives. Technical cooperation, research and development activities, as well as the joint-development of capabilities can happen through regional initiatives or the establishment of working groups under the auspices of international organizations such as the IAEA and WANO.

4.3. The Build Own Operate Model and Regional Cooperation

As the region's appetite towards nuclear energy increased, Russia, and the Build Own Operate (BOO) model it promotes have emerged as desirable alternatives. In addition to Turkey, Jordan has expressed an interest in the Russian BOO model. Egypt has signed a deal with Moscow for receiving a $25 billion loan for the financing of its first nuclear power plant, which will be built by Russia's Rosatom. Meanwhile, Saudi Arabia has also signed a nuclear cooperation agreement with Rosatom, that covers cooperation in nuclear reactors, provision of nuclear fuel cycle services, waste management, and training nuclear energy specialists.[121] As Russia is trying to position itself as a viable alternative for nuclear newcomers in the MENA region, it is probable for other states in the region to take similar routes.

In the meantime, if Turkey and Jordan indeed become the first two countries in the region to host Russian NPPs, this may open up the possibility of cooperation in their nuclear projects. While the reactors that both countries host may be of different generations – as Jordan's initial interest was towards the VVER-1000 model[122] while Turkey opted for VVER-1200 – both reactors will host Russian technology, and will be built, operated and owned by Rosatom. Considering that this may alleviate concerns regarding the sensitive nature of nuclear projects, it might be easier for Turkey and Jordan to cooperate in matters such as peer reviews and exchanges between regulators and personnel in nuclear facilities.

Another potential area of cooperation may be linked to the supply of fuel for the NPPs of the two sides. As outlined in the respective chapter of this volume, while the sea route emerges as one of the alternatives for the transfer of fuel for the facility, this has security, safety and environmental risks. Jordan may opt to obtain fuel directly from the Russian supplier without tapping its own stockpiles. In this case the only sea route would pass from the perilous waters of the Gulf of Aden, creating major security risks for the shipment. If the air route is not preferred, an alternative may be the shipment of fuel initially to Israeli or Egyptian ports, and from thereon using the land route to access Jordanian territory. In such a scenario, Turkish territorial waters or facilities may emerge as transit routes. Alternatively, if Jordan opts to tap into its own uranium resources through the assistance of an international third party, Turkey and other states in the region that have ambitions to build and operate their own nuclear facilities in time, may cooperate with Jordan as a fuel supplier in the long term. Therefore, the Eastern Mediterranean region can be a host to multilateral collaboration over the transshipment of radioactive and nuclear cargo, which may lead the sides to expand their cooperation to other aspects of nuclear technology in the long term.

5. CONCLUSION AND RECOMMENDATIONS

Many states in the Middle East have shown an interest towards nuclear power for decades. More recently, they have begun to take tangible steps towards realizing these goals. As this interest is rooted on visible challenges such as the need for energy mix diversification, lowering dependency on hydrocarbon sources, and finding long-term alternatives to rising electricity demand, it is likely that a number of countries will obtain nuclear power in the coming decades. Nonetheless, the road to becoming a nuclear newcomer is full of hurdles, whereas the countries are currently inexperienced in nuclear matters and lack technical, institutional and human capabilities that would allow them smoothen this process. Considering that the states have comparable goals and face similar burdens, cooperation emerges as a mutually beneficial alternative that would alleviate potential challenges. As the Argentina-Brazil nuclear rapprochement suggests, such cooperation could spill over and have a direct positive impact on regional cooperation in other realms, including on non-proliferation. Yet there are considerable political and security related obstacles towards multilateral and bilateral cooperation in nuclear matters in the Middle East. Hence this paper recommends the following for states in the region:

- Seek common ground for reaching an understanding over non-strategic nuclear matters, including on early warning, radiation monitoring and reporting nuclear incidents.
- Remove political obstacles against cooperation among the fledgling nuclear industry and nuclear experts in the region.
- Pursue initiatives that would provide bilateral or multilateral assurances on the limitation of nuclear activities in the region to solely peaceful ones.
- Where possible, involve international actors such as the IAEA to find tangible venues for regional cooperation.
- Avoid singling out states, and where possible, promote ways of involving all interested parties in regional cooperative mechanisms, even if at an observatory capacity.
- Synchronize policies concerning the safety and security of nuclear material in the region, especially with regards to the cross-border transit of nuclear fuel and waste.
- Promote scientific and technical cooperation, and joint research and development initiatives among nuclear scientists, engineers and technicians across the region.
- Find means of establishing bilateral or multilateral cooperation among regulatory agencies and utilities.
- Take stronger steps towards the realization of a Nuclear Weapons Free Zone or Weapons of Mass Destruction Free Zone in the Middle East and prioritize confidence building measures.

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MANAGING THE RISKS OF NUCLEAR ENERGY: THE TURKISH CASE

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