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A JOURNAL DEVOTED TO SPACE LAW AND THE LEGAL PROBLEMS ARISING OUT OF HUMAN ACTIVITIES IN OUTER SPACE.

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SECOND INDEPENDENT REVIEW OF CANADA'S REMOTE SENSING SPACE SYSTEMS ACT*

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ABSTRACT

The Remote Sensing Space Systems Act and its Regulations came into force on 5 April 2007. Pursuant to section 45.1 of the Act, Global Affairs Canada tasked the Institute of Air and Space Law (IASL) at McGill University's Faculty of Law with conducting an independent review of the Act "in order to assess, in particular, [the Act's] impact on technological development and on the implementation of international agreements and treaties."[1] This independent review constitutes the second five-year phase of the Act's existence (from 2012-2017) and considers the provisions, operation and implementation of the Act. The findings in this review stem from a belief that although the Act was appropriate and useful at the time of its enactment in 2005, the players, activities, technology and internationalization of remote sensing activities have since changed significantly and outgrown the confines of the Act. Several recommendations have been made in order to effectively and efficiently achieve the stated objectives of the Act, namely: to reinvigorate the licensing office tasked with implementing the Act and to adopt a general

* This article is an edited and updated version of a report prepared by the authors for Global Affairs Canada (formerly the Canadian Department of Foreign Affairs and International Trade) in February 2017 and tabled before the Canadian Parliament on 5 April 2017. The authors would like to thank the industry representatives and government officials who took the time to engage with our questions and comments, and provide us with invaluable information. In addition, the authors would like to thank, in particular, Gilles Doucet for his timely and helpful advice regarding many of the technical issues addressed in this review

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[1] Remote Sensing Space Systems Act, S.C. 2005, c 45 (Can.), at §45.1 [hereinafter Remote Sensing Act].

Outer Space Act to regulate space activities that are not, strictly speaking, remote sensing but currently regulated as such.

I. INTRODUCTION

The Remote Sensing Space Systems Act (RSSSA or Act) and Regulations[2] establish the regulatory framework applicable to Canadian remote sensing space systems and the distribution of data collected by such systems. The legislation's aim is "protecting Canada's national security, national defence [sic] and foreign policy interests, while supporting [Canada's] continued leadership in the provision of satellite remote sensing data and services to government and private clients."[3] Therefore, the RSSSA serves the function of protecting public interests and promoting private interests pertaining to remote sensing, while also implementing Canada's international obligations.

In 2000, the Canadian government entered into the bilateral Agreement Concerning Operation of Commercial Remote Sensing Satellite Systems[4] with the United States to ensure that private remote sensing activities would be controlled by each State even after the commercialization of the industry so as to protect the shared national security and foreign policy interests of both States.[5] The agreement was spurred on by the recognition that both Canada and the United States had mutual interests in promoting the privatization of remote sensing systems; in particular, Canada's planned development of RADARSAT-2 (an advanced remote sensing satellite that would use a microwave radar system called Synthetic Aperture Radar (SAR)), which would be owned and operated by a private entity, was a significant factor explicitly mentioned in the agreement.

Subsequently, the Minister of Foreign Affairs, jointly sponsored by the Minister of Public Safety and Emergency Preparedness, the Minister of National Defence and the Minister of Industry, introduced Bill C-25 on 23 November 2004 that would eventually become the RSSSA. The Bill

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[2] Remote Sensing Space Systems Regulations, SOR/2007-66 (Can.) [hereinafter Remote Sensing Regulations].

[3] *Canada Tables Legislation Regulating Remote Sensing Space Systems,* GOV'T OF CAN. (Nov. 23, 2004), https://www.canada.ca/en/news/archive/2004/11/canada-tables-legislation-regulating-remote-sensing-space-systems.html.

[4] Agreement Between the Government of Canada and the Government of the United States of America Concerning the Operation of Commercial Remote Sensing Satellite Systems, Can.-U.S., June 16, 2000, T.S. No. 14.

[5] *See id.*

received Royal Assent on 25 November 2005 and came into force on 5 April 2007. Neither the RSSSA nor the Regulations have been amended in the decade that has followed their coming into force.

The RSSSA establishes the legal framework under which remote sensing space system operators (whether government, military, civil or commercial) must operate. Generally, the RSSSA accomplishes its objectives by requiring operators to obtain remote sensing licenses prior to operating their satellite systems, through which Global Affairs Canada (GAC).[6] As a whole, the RSSSA and its Regulations are meant to establish restrictions related to the operation of remote sensing satellites and the collection and distribution of data gathered by remote sensing space systems.

Given the sensitivity of the data collected by remote sensing systems, the Minister of Global Affairs (formerly the Minister of Foreign Affairs and hereinafter referred to as Minister) has special powers to request priority access to data collected by a remote sensing space system or to order an interruption of service if necessary to protect national security, national defense, foreign policy interests and/or upholding Canada's international obligations.[7] In granting licenses, the Minister of Global Affairs has the authority to impose conditions or restrictions on the operation of remote sensing satellite systems, as well as the reception, storage and dissemination of data collected by such systems.[8] Further, the RSSSA permits the imposition of certain record-keeping obligations[9] and the Minister has the authority to inspect, monitor and audit remote sensing space system operators.[10]

Developments in the technologies associated with optical and radar remote sensing systems continuously push the established boundaries in new and unexpected ways. Satellites are becoming smaller, more capable and more numerous; their ground-based reception stations are expanding, their coverage area is increasing and their revisit rates are improving. These developments have been spurred on by commercial growth, and the increasing availability and quality of commercial remote sensing products – in Canada and around the world – undoubtedly will

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[6] Remote Sensing Act, *supra* note 1 at § 5 ("No person shall operate a remote sensing space system in any manner, directly or indirectly, except under the authority of a licence [sic].").

[7] *Id.* § 15.

[8] *Id.* § 8.

[9] *Id.* § 20(1)(g).

[10] *Id.* § 17.

impact the Canadian licensing and regulatory system. Aside from the ever-increasing capabilities of traditional remote sensing systems, new developments may challenge the flexibility of Canada's regulatory framework, including: (1) improved spectral and spatial resolutions of hyperspectral imaging systems; (2) space-based space situational awareness optical systems; (3) radio-frequency spectrum survey and radio frequency collection systems; and (4) space-based air and space traffic management systems. The proliferation of technological development and novel application constantly shifts the RSSSA's regulatory target and justifies questioning whether its established legal framework remains up-to-task in this advanced age of space activity.

Section 45.1 of the RSSSA requires the Minister to cause an independent review of the provisions and operation of the Act every five years.[11] The first and last independent review was carried out by the Institute of Air and Space Law (IASL) of McGill University's Faculty of Law in 2012, five years after the RSSSA came into force. As per section 45.1 of the RSSSA, the 2012 Review assessed the impact of the RSSSA "on technological development and on the implementation of international agreements and treaties."[12] In carrying out the 2012 Review, the IASL drew a number of conclusions and made a number of recommendations. The final Report of the 2012 Review, which was tabled in Parliament in April 2012, was published by its authors.[13] This Review has been conducted using the same criteria as the 2012 Review, with greater focus on what has developed in the five-year period since the last review.

In undertaking this legislatively-mandated independent review of the RSSSA, we analyzed the provisions of the Act and its Regulations independently as well as in limited comparison to the regulatory remote sensing frameworks of other States. This method was used largely to analyze the efficacy of the remote sensing framework to determine how the RSSSA and its Regulations impact technological development and whether the framework sufficiently upholds Canada's international obligations.

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[11] *Id.* § 45.1.

[12] Remote Sensing Act, *supra* note 1, § 45.1.

[13] Ram Jakhu, Catherine Doldirina & Yaw Otu Mankata Nyampong, *Findings of an Independent Review of Canada's Remote Sensing Space Systems Act of 200*5, 37 ANNALS OF AIR AND SPACE L. 399 (2012).

Additionally, we prepared a detailed online questionnaire, seeking insight on particular provisions of the Act, the Regulations and the general legal framework established by these two legislative documents. We requested various members of industry, government representatives and retired government officials to respond to the questionnaire. The participants to the questionnaire were notified that the information they provided in their responses would be used for the purposes of completing the 2017 Review but that their answers would be anonymized and not specifically attributed to them. In some cases, we followed up participants' answers with in-person interviews or through telephone conversations. We used the information we gathered through the questionnaire and interview stages to supplement our own analyses of the Act.

II. THE IMPACT OF THE RSSSA AND REGULATIONS ON TECHNOLOGICAL DEVELOPMENT

It is worth noting at the outset that neither the RSSSA nor its regulations have been amended at any time, including after the 2012 Review. In particular, the 2012 Review highlighted specific oversights and shortcomings of the RSSSA that came to light after carefully analyzing the regulatory framework and by entering into discussions with industry operators at that time. The 2012 Review was received by what-was-then the Department of Foreign Affairs and International Trade and tabled before Parliament as per § 45.1(2) of the Act. Many of the highlighted issues, comments and suggestions made in the 2012 Review remain applicable today, some with increased urgency. As such, we believe many of the issues presented five years ago ought to be considered again, without the need to significantly reframe or update the language.

Overall, while the RSSSA still carries the capability to effectively regulate remote sensing operations, it is more often utilized to play the role of a pseudo-general space law, for which it is not optimized. As the discussion that follows will demonstrate, the RSSSA and its Regulations are very much designed to govern remote sensing operations, as was intended when the legislation was drafted and enacted to oversee the operation of RADARSAT-2 by a private company; in the ensuing decade, technological development has advanced at such a pace that the established legal framework is addressing questions and dealing with activities that it was clearly not contemplated to address when initially designed.

A. Applicability of the Act

The applicability of the RSSSA depends on how one interprets and understands the language of the Act, particularly the definitions of the words and phrases used therein. The particular manner in which they have been defined under the RSSSA has led to general confusion about the application and/or non-application of the Act. The single most prevalent issue has been the lack of clarity and consistency in the RSSSA's language such that, in certain circumstances, it is difficult to predict the applicability of the legislation to specific activities. This poses a problem to industry when considering the importance of stability and clarity so that long-term plans (business, financial, operational, personnel, etc.) can be established and relied upon.

i. Remote Sensing

Generally speaking, the concepts of "remote sensing" and "Earth observation" are similar but not identical. The RSSSA uses the language of "remote sensing" to describe the activities that would fall under its purview. Several international instruments often use the language of "Earth observation." Based on our review, it is clear that while the language is often used interchangeably in common discourse, pinpointing a conclusive definition for what amounts to remote sensing and what amounts to Earth observation, and how they may differ, is more difficult. Based on the gathered responses to the questionnaire, there is quite clearly some discrepancy in what these two terms encompass, which of the two is more broad, and what the RSSSA covers.

Some responses considered Earth observation to apply only to imaging (such as optical or radar) whereas remote sensing would apply more broadly to include other types of sensing such as radio frequency or detecting atmospheric properties. Other participants stated that remote sensing applies only to sensing the surface of the Earth (with a particular emphasis on "taking pictures") whereas Earth observation is more broad and covers activities other than those that sense the Earth but nonetheless "observe." Yet another respondent illustrated the distinction as remote sensing being the act by which the Earth is observed, whereas Earth observation is simply the act of observing the Earth.

There is also the issue of the RSSSA including the phrase "capability of sensing the surface of the Earth"[14] when defining a remote sensing

[14] Remote Sensing Act, *supra* note 1, § 2.

satellite. The notion of capability is important because it brings within the Act's purview any satellite that, by all accounts, is engaged in non-Earth-related activities but still has the capability, if so desired, to sense the Earth (for example, telescopes intended for observing distant galaxies that can be turned around and pointed at the Earth).

While a particular respondent's interpretation may not seem valid in and of itself, the different interpretations lead to confusion over what kind of activities the RSSSA covers. This kind of uncertainty undermines commercial operations insofar as operators are unsure whether their activities ought to be regulated under the RSSSA, some other legal framework (for example, telecommunications) or whether they are currently free from regulatory oversight. This uncertainty leads to hesitation, and hesitation undermines technological development and business growth. For example, the 2012 Review addressed the issue of whether satellite automatic identification systems (S-AIS) would require licensing under the RSSSA and, if so, whether such licensing would be appropriate.[15] The technology involved in S-AIS operations are unique in that satellites pick up radio transmissions that are emitted from marine vessels of a certain size (an action mandated by international maritime law) and utilize those signals to plot the location, direction, speed, etc. of vessels on a map. Importantly, the radio transmissions required by automatic identification systems are emitted by marine vessels with the intention of being received by other ships and port authorities, rather than for the purpose of being picked up by satellites. Since the satellite system is merely receiving (or 'listening' for) such intentionally transmitted signals (in the same way that terrestrial receivers are receiving such signals) and not itself actively *sensing* the Earth, the question of whether these satellite systems are conducting remote sensing operations remains a live question. Does receiving intentionally emitted signals constitute remote sensing? What if the signals were emitted by hikers carrying personal tracking devices – would such activities constitute remote sensing? While it is true that Canadian regulators currently license S-AIS systems under the Act, an investigation into whether the RSSSA is the appropriate regulatory regime is still warranted.

Some argue that since S-AIS satellite systems have the *capability* to sense the Earth (insofar as the information they receive may be used

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[15] Jakhu et al., *supra* note 13, at 415.

to make other determinations) or do, in fact, sense the Earth (if one believes ships are on the surface of the Earth), the satellites ought to be licensed under the RSSSA. One way of addressing such arguments is to ask, what is the pith and substance of the RSSSA? Is it the regulation of all satellite systems that can sense the Earth or is it the regulation of satellite systems that have the unique capability of sensing potentially sensitive data for security reasons? The main concern for private operators of S-AIS technology in Canada is that other jurisdictions either do not view S-AIS as remote sensing (and the activity is therefore unregulated) or simply do not have any remote sensing regulations (where, again, the activity would be unregulated) and thus are put at a competitive disadvantage to their competitors.

The importance of this discussion is less the fact that various actors involved in remote sensing may have a confused understanding of remote sensing, and more the fact that the legislation intended to directly address this activity leaves quite a bit of room for interpretation. Of course, all laws are meant to be interpreted before they are applied and the RSSSA is no exception. What is important, however, is that the interpretation aligns as closely and as clearly to the drafter's intention as possible.

ii. Raw Data and Remote Sensing Products

The RSSSA differentiates between data and information through a two-tier system, namely "raw data" and "remote sensing product:" raw data consists of the sensed data that has not been transformed in any way whereas remote sensing product refers to any data or image that results from transforming raw data in any way.[16] Notably, the United Nations Principles on Remote Sensing (UNPRS) utilize a three-tier system, namely "primary data," "processed data" and "analysed information."[17] Although most public and private players believe in the value of harmonizing the Canadian definitions with those generally used in other countries and internationally, harmonizing for the sake of harmonizing provides no benefit if it results in over-regulation (in the sense that more tiers would mean that more *things* are regulated); utilizing a three-tier system whereby all three tiers would fall under the purview of

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[16] Remote Sensing Act, *supra* note 1, § 2.

[17] Principles Relating to Remote Sensing of the Earth from Outer Space, G.A. Res. 41/65, U.N. Doc. A/RES/41/65 (Dec. 3, 1986).

the RSSSA would complicate matters, create additional administrative burdens and overly broaden the intended scope of the legislative framework. The current methodology, although distinct from the United Nations model and that of other nations, sufficiently encapsulates the scope of activities that the RSSSA intends to regulate without the additional cost and complexity of creating new classes of information that may be regulated differently.

Regarding the distribution of information by Canadian remote sensing operators licensed under the RSSSA to third parties, the language used in section 8(6) and (7) generally prohibit the communication of "raw data" to third parties and generally permit the communication of "remote sensing products" to third parties (although the Minister may explicitly permit raw data dissemination or explicitly prohibit remote sensing product dissemination).[18] While the reason for prohibiting the dissemination of raw data is founded in the fact that it contains the potential to be used in many different ways, this rationale is undermined by other practical requirements. Although an entity in control of raw data has the ability to transform that data into a variety of different products – and while this, in and of itself, can be harmful in the wrong hands – the reality is that processing and transforming this raw data requires uncommon, technical expertise. Remote sensing products, on the other hand, are the result of transforming raw data into a useable form by adding new information and, unlike raw data, comprehending and using remote sensing products do not require special expertise.

In this sense, the potential risks associated with raw data (since without technical expertise they are significantly less useful) do not seem to justify the heightened layer of restrictions currently in place (such that a licensee must request system participant status for all entities to which it wishes to disseminate raw data). As has been demonstrated over the past decade, the current level of regulations applicable to remote sensing products are sufficient to safeguard Canadian interests. If it is possible to regulate raw data at the same level that remote sensing products are currently regulated (where a licensee would have the general permission to sell raw data unless the Minister explicitly prohibited it) without jeopardizing safety and security, commercial interests would be served positively by the reduction of administrative burdens currently associated with treating raw data and remote sensing

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[18] Remote Sensing Act, *supra* note 1, § 8(6) & (7).

products differently. Generally, any amendment that would reduce the restrictions of a license would provide more freedom to industry participants to carry out their business activities, expand their client base and continue developing new applications to increase their international competitiveness. Of course, this must always be balanced with the State's security interests.

iii. Transformation

The language in section 2 of the Act dealing with the transformation ("transform" in the text) of "data" or "raw data" into "product" is also unclear.[19] Industry participants interpret this language in varying ways, some stating that they understand a transformation as being a process of moving from raw data to a product while other view it as a simple step; in either case, there is no clear demarcation as to when one has moved from raw data to a product, as the term "substantially" can give way to any number of interpretations. The language seems to suggest that so long as a "remote sensing" product cannot be unraveled or deconstructed back into the "raw product", it has undergone a substantial transformation; as one industry participant noted, however, the "lack of clarity in legislation can lead to risk aversion and a chilling effect on industry activity."

Importantly, however, under section 20(1)(a) of the RSSSA the Minister has the authority to make regulations "prescribing a process or series of processes that is or is not to be considered to transform raw data"[20] and, in fact, has done so under sections 13(1) and (2) of the Regulations regarding "Single Look Complex" data.[21] While this process is effective in clarifying the definition as it relates to particular types of data transforming activities, its efficacy is limited to how often and in what circumstances the Minister decides to utilize this authority. Since

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[19] *Id.* § 2.

[20] *Id.* § 20(1)(a).

[21] *Id.* § 13. "Any process that retains the phase information of raw data, or that produces an output from which measurements can be taken to determine the phase response of a remotely sensed surface, including the process to produce the synthetic aperture radar output known as Single Look Complex, is not considered to transform the raw data." Conversely, "[a]ny process or series of processes operating on raw data that rectifies errors, distortions and other artifacts of the system by pixel aggregation, averaging or resampling are considered to transform the raw data if the process or series of processes also (a) radiometrically calibrates the data; or (b) geocodes the data with respect to features of the Earth by resampling." *Id.*

drafting the Regulations in April 2007, the Minister has not made such clarifications, notwithstanding the fact that many technological advances in the past decade may warrant explicit commentary. It remains possible that in the future, should the need arise, the Minister may make such clarifications.

B. Licensing

i. Operations in Canada

Under section 5 of the RSSSA, any and all space remote sensing activities taking place in Canada must be licensed appropriately prior to operation. Such licensing requirements apply to Canadian citizens, permanent residents and foreign nationals.[22] Therefore, an international entity conducting space remote sensing activities would require a Canadian license if their operations involve Canada in any way. This would apply even in situations where the only Canadian component to their operation is a bent-pipe ground-station that does not (or only in a limited fashion) store images, process data or distribute products but is used only to communicate with a foreign ground station. This requirement for a license applies even if the operation is fully licensed in another jurisdiction. In practice, Canadian regulators work alongside their foreign counterparts to prevent overlapping licensing conditions. Realistically, however, this process lengthens the amount of time needed to acquire a license and slows down an entity's operation. Canada's geographic location – especially its northern territories – make it particularly attractive to foreign operators to install ground stations; making the licensing process cumbersome and difficult, however, may have the effect of pushing potential operators to consider establishing their bent-pipe ground stations in other northern jurisdictions.

ii. Canadians Operating Outside Canada

Section 6 of the Act requires all Canadians involved in space remote sensing operations to be licensed, regardless of whether they are in Canada or abroad. This requirement extends to citizens, permanent resi-

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[22] *Id.* § 5 ("No person shall operate a remote sensing space system in any manner, directly or indirectly, except under the authority of a licence [sic].").

dents, corporations and "persons having a substantial connection to Canada."[23] While the language in section 5 (which is incorporated into section 6) is clear (insofar as "operate a remote sensing system in any manner, directly or indirectly"[24]), the standard is quite far-reaching. Since "operate" is not defined, under this language it may be possible that any Canadian working for any foreign remote sensing operator falls within the purview of this Act. In practice, however, it is likely that GAC will not require a license, for example, for a Canadian working in the human resources department of a French remote sensing company but it is less clear whether a Canadian systems engineer, flight control specialist, or space data processor working for a French remote sensing company would require a license, especially if they are not responsible for the operations. If the language of the Act is applied literally, Canadian citizens may be burdened with seeking licensing under the RSSSA simply because they work for a company that conducts remote sensing operations. Relinquishing this requirement, however, may have the adverse effect of encouraging Canadians to establish their remote sensing operations outside of Canada so as to avoid the licensing requirements altogether. It is indeed likely that these provisions were meant to combat individuals attempting to shirk their regulatory responsibilities. Nevertheless, the literal interpretation of the Act ensnares all Canadians, even those without the risks the Act intends to secure against.

iii. Term of License

Section 8(8) of the Act gives the Minister the discretion to award a license for a period that the Minister determines to be appropriate.[25] Most industry representatives were of the opinion that the longer a license was granted, the more favorable it was for their commercial interests. Their reasons included anticipating in the application stage that their activities would be licensed for a set number of years, removing the arbitrariness associated with the Minister choosing a time-period, improving justification for significant investment knowing that a system would be licensed long-term, reducing the administrative costs associated with a renewal once an original license expired and eliminating the uncertainty over whether a renewal would be granted. Ideally, a license

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[23] *Id.* § 6(d).

[24] Remote Sensing Act, *supra* note 1, § 5.

[25] *Id.* § 8(8) ("A licence [sic] is valid for the period that the Minister considers appropriate and specifies in it.").

for the duration of the expected life of a satellite system (so long as there are no material changes) would serve the purpose of all participants, including industry and government. Indeed, it seems as if internal policy has moved towards granting licenses for the length of a satellite system's life, thereby reducing the bureaucracy associated with licensing and authorizing the continued operation of remote sensing satellite systems.

iv. Application Processing Period for License

Industry representatives have noted that Canada's remote sensing licensing system is slower and less efficient than other jurisdictions. While outside the scope of this report, we considered empirical information to determine the veracity of such claims. It is worth noting that the regulatory agencies tasked with licensing and supervising remote sensing operations in other jurisdictions are staffed with more people and afforded more resources.

Analyzing the language of section 7 of the Regulations, the Minister has 180 days from the date the applicant provides all the necessary information to notify the applicant if there are any outstanding issues that need to be resolved.[26] It is possible, therefore, that the Minister may repeatedly request more information from the applicant, thereby resetting the 180-day clock although it is unclear how often, if ever, this has occurred. Although such delays would hamper the business interests of remote sensing operators, often times delays are caused not by individual GAC regulators but by non-remote sensing specialists required to provide input or a lack of resources required to facilitate consultations. Such delays risk putting Canadian entities at a competitive disadvantage. Notably, section 7 of the Regulations do not set a deadline by which the Minister must issue either an approval or refusal for a license – even if all the required information is provided with the initial application, the Minister is under no obligation to provide a license within a certain timeframe.

Importantly, it is equally vital that commercial entities apply for a remote sensing space system license as early as possible in the design

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[26] Remote Sensing Regulations, *supra* note 2, § 7 ("If an application to issue a licence [sic] has not been approved or refused within 180 days after the applicant has provided the required information and documents, the Minister shall, as soon as feasible, notify the applicant of any issues to be resolved and any action required to resolve them. In the case of an application to amend or renew a licence [sic], the period is 90 days after the applicant has provided the required information and documents.").

and development stages of their operations. Doing so offers two advantages: first, the regulator has more time to review the application and issue a license; and second, the regulator can make clear to the operator early on of potential issues that may be associated with issuing a license for that particular system. The first advantage serves to avoid the situation where a remote sensing satellite system is complete and ready for launch/operation but remains unlicensed because the regulator has not had enough time to perform its function. The second advantage serves to avoid the situation where a remote sensing satellite system is designed and built in such a way that requires a license to impose certain conditions or restrictions that could have otherwise been avoided if the regulator had had an opportunity to comment early in the process. It is likely that all applications for license would be processed well in advance of their operational deadlines if applicants and regulators worked together from the earliest possible date.

C. System Disposal Plans

Section 9 of the Act requires all applicants seeking a license to conduct space remote sensing operations to include a "system disposal plan" that provides for the protection of the environment, public health and the safety of persons and property.[27] Such system disposal plans often focus on how a satellite will be deorbited after it reaches the end of its useful life so as ensure the mitigation of space debris. Carrying out system disposal plans are often an added cost to operators as they require the implementation of deorbiting mechanisms in the planning stage of the operation as well as often require the use of propellant that could otherwise be used to lengthen the operational lifetime of the satellite. Since there are no binding international requirements on the de-orbiting of space objects or the mitigation of the creation of debris, many States are hesitant to institute such requirements on their private operators, fearing such measures would put them at a competitive disadvantage compared to operators from other States that do not have such requirements.

Cognizant of a crowded orbital environment and the growing effect and risks associated with space debris, most Canadian operators do not view the need for system disposal plans - or the actual implementation

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[27] Remote Sensing Act, *supra* note 1, § 9(1)(a).

of such systems - to be a serious hindrance to their activities or of undermining their competitiveness. Such an industry response is encouraging, as Canada will be viewed positively in the international community as implementing its 'soft-law' obligations under the United Nations Committee on Peaceful Uses of Outer Space (UNCOPUOS) and Inter-Agency Space Debris Coordination Committee's (IADC) Space Debris Mitigation Guidelines.

D. Interruptions of Service

Section 14 of the Act gives the Minister the authority to make an order interrupting or restricting an otherwise acceptable remote sensing operation if the Minister believes that that continued operation would be "injurious to Canada's conduct of international relations or inconsistent with Canada's international obligations."[28] This authority is unquestionably broad: there is no explanation as to what may constitute reasonable grounds, whether there is a maximum period of interruption or restriction, whether the Minister has to justify a restriction to the licensee (and if so, how) or whether a licensee affected by such an order has the opportunity to offer alternative solutions or mitigate the harm they are to suffer. As well, there is no mechanism in the Act or Regulations that would require the Minister to issue compensation or financial assistance to an operator that loses business because of a restrictive order; providing reasonable compensation would help private operators alleviate some of the consequences associated with satisfying a restrictive order.

Although an order interrupting or restricting remote sensing operations may be in place for a short period of time, they can have long-term consequences to the commercial operation of such services. Given the international competition between remote sensing service providers, an interruption of service to Canadian operators (that is not reflected by similar orders in other States) can put them at a disadvantage when it comes to serving their client's needs (which could have untoward efforts in retaining existing clients and/or acquiring new ones). Given that restrictions are often inevitable and justifiable when international relations/obligations are concerned, it would prove prudent for the Minister to issue restrictive orders in line with those of its allies or States with

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[28] *Id.* § 14(1). Section 14(2) provides this same authority to the Minister of National Defence [sic] if he believes such activity would be "injurious to the defence [sic] of Canada or the safety of Canadian Forces." *Id.* § 14(2).

similar foreign interests. If, for example, Canada and the US are dealing with the same international relations issue and are addressing it for the same reasons, it would not make commercial sense for Canada to issue a restrictive order to its operators if the US does not also – otherwise, Canadian operators will lose business and possible clients to their US (or other) competitors.

E. Priority Access

Section 15 of the RSSSA gives the Minister the right to order priority access to the data collected by a remote sensing space system.[29] However, since the Minister has never requested priority access from a remote sensing operator, some questions remain unanswered. Given the broad nature of the Act, the rather broad nature of the provisions granting the Minister priority access and the limited responsibility associated with such a request, some remote sensing operators are uneasy about the potential consequences flowing from such an order. Section 15(7) provides that although an order made by the Minister for priority access may take effect immediately if the Minister so desires, the licensee has 15 days to make representations.[30] Unfortunately, the Act does not specify or explain what kinds of representations licensees may make, how those representations would be considered by the Minister or whether they need to be considered at all.

Generally, so long as operators are reimbursed for the costs associated with such priority access (for which section 22(2) of the Act and section 14 of the Regulations provide potential payment guidelines),[31] and the requests are made under strict and specific legislative authority, most industry representatives claimed to have no difficulty providing the

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[29] *Id.* § 15 (1). Sections 15(2) and (3) provide similar authority to the Minister of National Defence [sic] if desirable "for the defence [sic] of Canada or the safety of Canadian Forces," and to the Minister of Public Safety and Emergency Preparedness to support the Royal Canadian Mounted Police, the Canadian Security Intelligence Service, or if it is deemed desirable for "critical infrastructure protection or emergency preparedness." *Id.* § 15(2) & (3).

[30] *Id.* § 15(7).

[31] Section 22(2) of the Act allows that "[a] minister may pay a licensee and amount determined in accordance with the regulations for the service provided as a result of a" Section 15 priority access order. *Id.* § 22(2). The Regulations in turn allow for an agreement to be reached between the minister and the licensee, provided that "if there is no agreement, an amount that is proportionate to an amount received by the licensee for a comparable service provided on a priority basis to any person during the 12 months prior to providing of the service." Remote Sensing Regulations, *supra* note 2, § 14.

Minister with such access. In this regard, there is no reason for industry to expect that they would not be compensated for providing the Minister with priority access if, in fact, it is requested at some point in the future.

IV. THE IMPACT OF THE RSSSA AND REGULATIONS ON CANADA'S IMPLEMENTATION OF ITS INTERNATIONAL OBLIGATIONS

As referenced in the 2012 Review, the RSSSA does a commendable job of upholding Canada's international obligations.[32] Without reiterating the clear and thorough statements made in the 2012 Review in detail, it is worth noting that the implementation of the Act over the last five years has not changed in such a way as to jeopardize or undermine Canada from fulfilling its international obligations. There have not been any new, binding international obligations applicable to Canada in the past five years.

In short, as a party to the Outer Space Treaty[33] Canada must authorize and supervise all space activities; the Act satisfies this obligation by establishing the remote sensing licensing process as well as by conducting inspections and audits. Regarding the Liability Convention[34], the Act itself does nothing to either improve or put at risk Canada's obligation to uphold its international obligations – if one of its private entities causes damage in space, Canada will likely be held liable as a State that procured the launch. As will be explored below, it would be in Canada's best interests to insert an indemnification clause to protect itself from being liable for the activities of a private entity that cause damage to another State or its public or private entities. Regarding the Registration Convention[35], Canada ought to require private entities to provide specific information in their application for a remote sensing license that can be used to complete the registration of the satellite with the United Nations; otherwise, it seems Canada is upholding its obligations under this treaty.

Similarly, the conclusions drawn in the 2012 Review regarding Canada's status as a cooperating member of the European Space Agency

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[32] Jakhu et al., *supra* note 13, at 418.

[33] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and other Celestial Bodies, Jan. 27, 1967, 610 U.N.T.S. 205.

[34] Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 961 U.N.T.S. 187.

[35] Convention on Registration of Objects Launched into Outer Space, June 6, 1975, 1023 U.N.T.S. 15.

(which will remain so until at least 2020) and as a member of the World Meteorological Organization remain so,[36] as do the determinations made regarding Canada's involvement in the North Atlantic Treaty Organization (NATO) and the North American Aerospace Command (NORAD).[37] Finally, the non-binding, soft law principles associated with debris mitigation (both through UNCOPUOS and the IADC) seem to be implemented properly by the RSSSA regarding remote sensing operations.[38]

For more detail regarding these international instruments, please see "Section III. The Impact of the Act and Regulations on Canada's Implementation of International Agreements and Treaties" of the 2012 Review.[39]

V. ACHIEVING THE OBJECTIVES OF THE ACT AND FUTURE DEVELOPMENTS

A. Achieving the RSSSA's Objectives

Based on the above discussions, it is worth questioning whether the RSSSA accurately provides an environment whereby the regulatory framework adequately achieves and addresses its twin objectives of securing Canadian security and foreign relations interests and promoting Canadian industry. Naturally, achieving these objectives relies on balancing both, as any purely secure system would stymie industry and any purely competitive system would jeopardize security. As stated in the 2012 Review:

It is important to recognize that, since any regulatory process in and of itself has the potential to dampen innovation, a key challenge in adopting any such regulatory regime is to aim at striking a correct balance between the national security concerns sought to be addressed by the regime and the need to create an enabling regime that permits the achievement of business objectives with a reasonable degree of ease.[40]

This next section will consider the extent to which the RSSSA has been able to reach an appropriate balance between these two goals.

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[36] Jakhu et al., *supra* note 13, at 413-14.
[37] *Id.* at 415-16.
[38] *Id.* at 416-17.
[39] *Id.* at 411-17.
[40] *Id.* at 410-11.

i. Canada's Security Interests

Given the sensitive nature of the information captured and produced by remote sensing space systems, the RSSSA does a relatively good job of ensuring such data is managed appropriately. By requiring every entity undertaking remote sensing activities to hold a license, by placing restrictions and conditions on the sorts of remote sensing activities that are permitted, by monitoring the operations of such systems and inspecting the ground stations associated with such systems and by retaining the authority to request priority access or restrict operations in times of emergency, the regulatory framework pertaining to security is rather thorough.

One of the overriding methods by which to secure Canada's interests (whether it is national security, the defense of Canada, the safety of Canadian Forces or Canada's conduct of international relations, which are cited throughout the Act) is to prevent sensitive information acquired by remote sensing satellites from falling into the wrong hands. Given today's reality, the "wrong hands" not only include ideologically-opposed and traditional rogue States but also non-State actors harboring malicious intent. The provisions of the Act and Regulations meant to prevent the potentially-dangerous dissemination of such information will need to be reconsidered in the near future. With advances in technology, powerful decryption processes, non-traditional storage solutions, complicated business dealings, etc., the current framework established by the RSSSA and its Regulations will face new challenges, as described below. The difficult task will be addressing these new challenges in such a way that does not unduly inhibit the operations of commercial enterprise.

ii. Promoting Commercial Interests

Although the language of the Act that provides the mandate for this independent review explicitly references an assessment of the Act's "impact on technological development,"[41] technological development is best measured by evaluating the state of commercial operations. In this way, we consider the impact of the RSSSA on promoting or preventing the development of commercial interests. To this end, the RSSSA and its Regulations have been mediocre.

Although the operational requirements and license conditions have not, generally speaking, been onerous (such as mandating certain levels

[41] Remote Sensing Act, *supra* note 1, § 45.1.

of encryption, instituting record-keeping obligations, etc. that are generally inherent to the industry and would likely be implemented regardless of legislative requirement), the framework has not actively induced positive industry growth. In particular, the framework does not provide a clear regulatory scope or set of parameters, nor does it progressively relieve commercial operators from unnecessary administrative burden (e.g. avoidance of double or multiple regulatory requirements at the international level, where applicable). Arguably, neither the Act nor the Regulations are strong, commercial activity-inducing pieces of legislation and therefore have a relatively limited impact on the positive development of technology in the near future. Importantly, appropriate regulation should encourage and facilitate commercial interests, establish a level playing field and espouse the predictability of expected operational requirements.

To the contrary, the current regulatory framework makes it difficult for new and emerging technologies to easily determine whether their activities will fall within the purview of the RSSSA. As discussed above, the various possible interpretations of certain key terminology make it difficult for private industry, particularly less-established entities, to plan their course of action or fully develop their business models without awareness of the applicability of the regulatory regime. Legal certainty (in the sense that a private entity would know, before acquiring a license, that their activities would be licensed appropriately) is extremely important, especially when considering the costs associated with developing and testing long-term space projects. When coupled with the other issues highlighted below (the responsibilities of the regulators, the lack of consultation procedures, the lack of awareness among unsophisticated users, new technology development, international disparity in regulation, etc.), the lack of clarity within the Act becomes more pronounced.

B. Implementation of the RSSSA Licensing Regime

Acknowledging that the RSSSA and its Regulations are drafted and intended to govern remote sensing operations in a certain way, the actual implementation of this framework by the regulator is equally important, if not more so. As will be described below, the implementation of remote sensing laws in Canada have significant room for improvement.

i. Responsibilities of Implementing Organization

The implementation of the RSSSA is carried out by regulators within GAC. In total, there are two permanent licensing officers and a one rotational licensing officer responsible for administering, monitoring, updating and enforcing every remote sensing space system license. Importantly, the role of the licensing officer is not simply limited to granting or denying a license; instead, licensing officers are intimately connected with applications, administration of the license, inspection of ground sites, amendments to licenses, monitoring adherence to conditions, etc. In the past decade of licensed remote sensing operations in Canada, the number of applications and the number of licenses has steadily increased, with all signs suggesting this trend will continue.

As the number of applications have increased, so too has the complexity of the space systems seeking a license: satellite hardware has grown more sophisticated, sensors are more sensitive, software programs are more capable and applications are more numerous. Keeping up with all of these changes demands that licensing officers are knowledgeable of all technical aspects, informed about industry changes, cognizant of policy directions, familiar with international developments and trends and balanced in the application of their responsibilities. The capability to carry out such expectations requires a great deal of time and resources. In fact, having licensing officers that are not up to date on these topics makes the licensing process less efficient and more prone to over/under regulation. Especially when it comes to new technological developments and applications, a regulator cannot be expected to regulate a system they know very little or nothing about – a regulator is as good as what they know.

Ensuring regulators are well-versed in such topics will no doubt require considerable resources. Aside from expected operating costs, a regulatory body charged with administering the RSSSA will be required to periodically retrain its officers on the technical features of remote sensing systems, seek training to update their knowledge, undertake internal evaluations of policy to ensure the applicability of the RSSSA remains accurate, meet regularly with counterparts in other countries to maintain balance of industry competitiveness, attend industry functions to interact with licensees, conduct outreach activities to educate on the applicability of the RSSSA, conduct inspections of space systems to en-

sure compliance with licenses, etc. The current office in charge of regulating remote sensing activities is underfunded, under-staffed and not fully prepared to address impending challenges.

The current contingent of three licensing officers and a manager cannot possibly be expected to undertake and accomplish all of these varied roles, especially considering the increasing number of applications and applicants. If Canada wants to move forward as a leader in the field of remote sensing it must contribute adequate resources to re-establish and maintain this status. The current personnel and resource limitations undermine the RSSSA's objectives of ensuring protecting Canada's national security and foreign policy interests as well as promoting commercial interests: increased activity in the regulator's office will have direct effects on both of these objectives.

ii. Organization in Charge of Implementation

When the RSSSA was enacted in 2007, its primary operation was the licensing, management and supervision of the RADARSAT-2 satellite. As described in the introduction above, the regulatory framework that emerged was, at its core, a response to Canada's relationship with the US; the RSSSA was an embodiment of an agreement between the two States to ensure that remote sensing operations in both countries were regulated similarly to protect and promote mutual interests. Given this international scope, the Department of Foreign Affairs and International Trade (now GAC), as noted earlier, was tasked with implementing the regulatory regime in Canada. A significant component of this regulatory process was ensuring regulators and their international counterparts met on a consistent basis to ensure comity in their remote sensing operations.

Given this background, GAC remains charged with managing the application process for licensing remote sensing space systems, conducting inspections of space systems owned or controlled by a licensee, monitoring record-keeping obligations, investigating non-licensed remote sensing activities, conducting outreach initiatives, undertaking training programs and consulting with their international counterparts. Over the past decade, the responsibilities associated with a remote sensing licensing office have morphed from one that prioritized international relations and comity to one that revolves around more technical and administrative matters. Although GAC has done a commendable job administering the RSSSA over the past decade, given that the international focus is

now on par with its other responsibilities, it is worth considering whether a new office, with particular expertise in remote sensing operations rather than diplomacy, would be more suitable.

Given the increasing number of applicants, applications and interested parties, it may prove wise to establish an independent office, at arm's-length from established government departments, to implement the Act. This office would be able to focus on remote sensing issues, including in-house security expertise, technical application experts, knowledgeable administrators, outreach specialists, inspectors, etc. The impact this would have on private industry would be important, as applications would be processed faster, regulators would ensure licensees are keeping up with their licensing conditions and competitors would know that everyone is playing by the same rules. Furthermore, a significant component of any remote sensing regulatory framework is the hands-on inspection and monitoring of ground stations and other license conditions. If government representatives do not make sure that operators are conducting themselves as they should, there is little use in dissecting the Act's language or debating the value of international harmonization. The current rate of inspection and overall monitoring is deficient.

Further, ensuring that the government is aware of all remote sensing space systems (in reality, all space systems) is in its best interests considering as a party to the Outer Space Treaty and the Liability Convention, Canada would be held responsible and accountable for damage caused by a Canadian space system, even if it was operated privately. For that reason, Canada ought to have a fully-functioning regulatory authority to ensure all licensed activities are operating in accordance with their licenses and any unlicensed activity is discovered and brought into conformity with acceptable practice. As new technologies develop and new space activities become a reality, this independent regulatory body can assume regulation of such activities as well. The desire of independence from GAC is meant to ensure that foreign relation-based decisions become less influential in the commercial application of remote sensing and other future space activities.

iii. Licensing Fee

Although section 7 of the Act states that a fee may be prescribed for an application,[42] GAC has never imposed such a fee for an applicant seeking a remote sensing license. This is unlike most other jurisdictions in which the regulator does, in fact, require an application fee. Most industry participants were indifferent to the imposition of a fee, so long as it was reasonable. Considering that a satellite system can range in cost from tens of thousands of dollars (for a single small satellite) to tens of millions of dollars or more, it is unlikely a nominal fee would unduly restrict an entity desiring to engage in remote sensing operations from pursuing such activities.

Imposing a fee, however, does bring certain benefits. By requiring applicants to pay for the processing of their applications, it establishes the regulator as a service provider and the applicant as a client, where the client expects a certain standard in how the service is performed and provided. It is worth noting that all industry participants commented positively on their interactions with the regulator, with the exception of the speed and uncertainty associated with some applications. A suggested fee is not meant to overhaul the regulatory process but rather re-incentivize the regulator to perform its functions as efficiently as possible and for the commercial entity to expect a certain level of service.

As well, depending on how the fee is structured, there is a very real possibility that the regulator can use the money to fund internal programs that would make the licensing process more robust and efficient, such as establishing a fund for training licensing officers in new and emerging technologies, conducting outreach initiatives at industry and academic events or hosting international counterparts to better harmonize domestic regulatory regimes. Suggestions on how to structure a fee include: the complexity of a system, the expected duration of a system, the development cost of the system, the number of clients served by the system or a combination of the above. So long as the fees are reasonable and the accumulated funds are put to further improving the regulatory body – whether it remains a part of GAC or becomes independent – commercial applicants and licensees will likely be in favor of paying fees that support the regulatory authority.

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[42] *Id.* § 7 ("An application to the Minister to issue, amend or renew a licence [sic] must . . . be accompanied by any prescribed application fee.").

iv. Consultations Regarding Licensing

The current remote sensing licensing process involves an applicant submitting required information to the regulator where, after considering the presented information, licensing officers make determinations on what conditions to place on the license. Neither the Act nor the Regulations provide for a formal consultation process either before or after the issuance or denial[43] of a license. Therefore, once an applicant submits their application to the regulator, the fate of the license is out of their control. Although licensing officers and regulators informally discuss the progress of an application throughout the application process, there is no formal mechanism for an applicant or a licensee to request a review or reconsideration of a license after a determination has been made. For example, a license may have a condition that prevents the licensee from disseminating data collected over the Middle East for a period of one week every year (for whatever reason). Even if there is a valid scientific, technical, commercial or operational reason as to why this condition should not apply – a reason that may have been overlooked or misunderstood by the regulator –, once the license has been granted there is no formal process for a licensee to request to have that condition reviewed. It is worth noting that while an applicant may, under section 7, put forth an application to amend their license, it is unclear what this process would entail or how it would differ from filing an application for an original space system.

C. Awareness of the RSSSA

The utility of a law such as the RSSSA is grounded in its application; if it is not being applied to remote sensing operations, it matters not what its object, purpose or intention is. For the Act to be applied meaningfully, there must be awareness of its existence by all individuals undertaking space remote sensing operations. In this sense, awareness ought to be understood in two ways: first, awareness that remote sensing space systems must be licensed; and second, awareness of what the Act considers a remote sensing space system. Similarly, awareness between industry and the regulator in terms of understanding the interests of each is equally important. In many instances, the stated intentions of industry and the objectives of the regulator are aligned, but neither is

[43] Although GAC has never refused or denied a license, the Minister has the authority to do so and as such, this remains a live issue.

aware of the other's position leading to reduced efficiency and increased confusion; awareness and constant communication between these symbiotic groups can reduce security concerns and improve commercial interests.

For someone or some entity to know that a remote sensing space system must be licensed, that person or entity must know of the existence of the RSSSA. Aside from the legal requirement that all laws and regulations be promulgated in the Canada Gazette, very few individuals actually peruse the Gazette on a regular basis to remain aware of all laws. Considering space systems, generally, and remote sensing, specifically, are very niche and emerging activities, knowledge of the Act by those just entering the field is likely low. It is entirely possible, in fact probable, that Canadians are currently operating remote sensing systems without a license, simply because they are unaware of the need for such a license. The likelihood of such private unlicensed actors will increase as small satellites continue to decrease in cost and the number of hobbyists or academics increase in number as unsophisticated operators rarely seek out detailed legal opinions. Aside from the potential security concerns associated with unlicensed remote sensing operations, Canada remains internationally responsible for and could be held internationally liable for any damage caused by such space systems to another State or its public or private entities.

As such, it is in Canada's best interest to ensure that all space activities, including remote sensing activities, are appropriately licensed and operated within the confines of a license. To prevent such unlicensed activity, the regulator ought to engage the local space community through public outreach initiatives to ensure everyone engaged in remote sensing operations is aware that their activities must be licensed. Since the space community in Canada is small (in comparison to other jurisdictions), it is reasonable to assume that public outreach can be achieved by having a licensing officer attend a few space conferences a year – remote sensing or otherwise – and interact with large industry, small businesses, start-ups, public institutions and students. In addition, drafting, circulating and posting online client procedural circulars in "layman's terms" would make the information contained within the Act more accessible to non-lawyers and lawyers alike.

The second aspect of awareness centers on ensuring that everyone knows what kinds of activities fall within the definition of "remote sensing" under the RSSSA. As described above, the definition remains open

to a significant degree of interpretation and for non-commercial space users (such as university space clubs, research organizations, etc.), even if they are aware of the RSSSA, they may not consider their activities to fall within its purview. The key is understanding how a satellite system works and whether it has "the capability to sense the Earth"[44] rather than whether it actually senses the Earth. For this reason, many non-remote sensing space systems that are intended to conduct non-remote sensing operations could potentially be classified as a system capable of remote sensing and therefore require a license. Outlining the kinds of activities or the kinds of sensors that may bring a system within the purview of the RSSSA in everyday language that a student, scientist, engineer or lawyer can understand would make the Act more accessible and bring more awareness to the need for potential licensing. Again, this can be achieved through active outreach initiatives or by posting information online in an accessible manner.

D. Liability Indemnification

As a party to the Liability Convention, Canada could be held liable for any damage caused in space or on Earth by an object for which Canada is a launching State. By virtue of also being a party to the Outer Space Treaty, Canada is responsible – and therefore liable – for any Canadian space object, public or private. This is distinct from most other areas of international law, where a State is not generally responsible and cannot be held liable for the actions or omissions of its private entities. Therefore, if the space object of a private Canadian entity – be it commercial, a start-up, academic or a hobbyist – causes damage in outer space, Canada would most likely be considered a launching State (by way of procuring a launch) and another victim State would be capable of claiming against Canada for damage.

Under current domestic law, including the RSSSA and its Regulations, there does not seem to be a legislative basis upon which Canada would be capable of being indemnified by a private entity for paying damages as a result of that entity's space activities. Considering the potential extent of damage that may be caused, the liabilities for which Canada may be required to pay to another State can be substantial. To enable Canada to recoup at least some of the damage, it will need a legal

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[44] Remote Sensing Act, *supra* note 1, § 2.

basis upon which to proceed. While such an indemnification ought to apply to all space activities, Canada does not currently have a general space act under which a provision on indemnification can be included (and where it would be most appropriate). Nevertheless, being indemnified against some activities is better than none. Therefore, the existing remote sensing framework ought to include a provision that indemnifies Canada for any liabilities it may face as a result of a private entity causing damage. In addition, the Act should impose obligation, as a condition of license, on the licensee to procure appropriate levels of insurance to cover liability risks both internationally and nationally. By doing so, Canada would join the ranks of other States to have enacted similar provisions such as Article 10 of the UK's Outer Space Act 1986[45] or Article 14 of France's *Loi no 2008-518 du 3 juin 2008*.[46]

E. New Technological Developments

Although the RSSSA has proven flexible enough to adapt to new technologies, it is only a matter of time before the rate of advancement outpaces the reach of the Act. Although the "capability to sense the Earth" has demonstrated a unique ability to capture many activities – and is likely broad enough to ensnare most future developments of sensors and traditional remote sensing systems – it is likely the technology that implements the collected data that will fall outside the definition's grasp. As new methods of communication, storage, distribution, etc. develop, the decade old language will not apply or be able to control certain aspects of remote sensing activities.

While initially developed for the RADARSAT-2 system, the RSSSA has been utilized to regulate dissimilar remote sensing activities ever since. In particular, given the lack of a general Canadian Outer Space Act, combined with the desire to regulate space activities generally (whether for reasons of national security, foreign policy, liability, international obligations, etc.), the RSSSA has evolved to become *the* legislation under which space activities are regulated. S-AIS are a perfect example: while, in a somewhat distorted manner, S-AIS *can* sense the Earth (insofar as the signals it detects are being transmitted from the

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[45] Outer Space Act 1986, c. 38, (Eng.) at Art. 10.

[46] Loi 2008-518 du 3 juin 2008 relative aux operations spatiales [Law 2008-518 of June 3, 2008 Relating to Space Operations] JOURNAL OFFICIEL DE LA REPUBLIQUE FRANCAISE [J.O.][Official Gazette of France] Jun. 3, 2008 at Art. 14.

Earth) it would much more efficiently be regulated under a discrete Outer Space Act.

As well, as a harkening back to the RADARSAT-2 system days, the Act focusses on raw data and remote sensing products as two distinct *products* when in reality, they are the poles at either extreme of a fine gradient of possible *products* that are the result of different degrees of transformation. Even more important is the coming data revolution and the non-physical storage of information – including "raw data" and "remote sensing products" – "in the cloud,"[47] making them more accessible to many users. The potential benefits of cloud computing are numerous in terms of cost-saving, computing power, processing time, accessibility, ease of dissemination, etc. and many clients (as well as licensees themselves) seek to take advantage of this technological revolution. The problem of "cloud computing" is that it is difficult to determine its precise origin and ownership and even more difficult to contain – concerns that are of particular importance in the context of remote sensing information. Currently, if a remote sensing system operator transfers their raw data to a client cleared as a system participant, that client is prohibited from putting the raw data they now possess on the cloud. Another potential issue may appear when a client mixes the raw data they receive from a Canadian operator with the raw data (or other information) received from a non-Canadian provider and put the resulting product in the cloud – does Canada have the authority to regulate such material?

There is a noticeable trend that both producers and purchasers of raw data want to take advantage of the benefits afforded by a cloud-based platform. Even though the cloud has physical, Earth-bound servers, there is no way for the government to track or restrict the individuals that access the cloud (if it is to be used in any meaningful way). Addressing such concerns now, before the commercial incentives become too significant to ignore, would be a wise decision and may require a paradigm shift that treats raw data in the same manner as remote sensing products are currently treated.

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[47] *See* Jim Blasingame, *Cloud Computing is Awesome. But Not Always*, FORBES (May 10, 2019), https://www.forbes.com/sites/jimblasingame/2019/05/10/cloud-computing-is-awesome-but-not-always/#6de2310272ec ("'In the cloud,' is a reference that has established itself in the marketplace vernacular as the interaction and delivery point between providers of "cloud-based" digital applications and customers. Cloud computing is the availability of incremental processing power that resides on an application provider's servers, instead of your hard drive.").

F. International Harmonization

Given the impending technological advances, there is no question the activities of remote sensing operators will become more international. With new satellites, new sensors, new applications, etc. individual remote sensing operators will find more demand from more clients in more countries seeking more data in more sophisticated formats for more diverse applications. To appropriately conduct such cross-border operations, operators will likely require licenses from more than one jurisdiction – acquiring and coordinating licenses between States can be a difficult and time-consuming process. As mentioned above, the remote sensing regulators of various allied nations have in the past coordinated their efforts with Canada in terms of aligning priorities, interests and specific licensing conditions; such coordination should be expanded and regularized.

Aside from the fact that Canadian regulators ought to regularly engage and discuss topical issues with their foreign counterparts as a matter of sound governance, as the growing trend of technological sophistication and internationalization of operations continues, Canada ought to consider the value in harmonizing its national remote sensing laws and regulatory processes with those of other like-minded countries. In a way, the UNPRS attempted to create such a harmonized framework for remote sensing activities from the public (in the sense of public international law) perspective. Much of the remote sensing activities of the time were carried out by government entities and so the UNPRS were focused more on establishing bases upon which international cooperation and harmonization of remote sensing activities could take place: current trends suggest there is a need for a more detailed and precise harmonization of private activities as well.

Given that a significant proportion of remote sensing activities today are conducted by private entities, the benefit of international harmonization amongst domestic regulatory frameworks is such that competition amongst operators would be fair regardless of place of incorporation and licensing. The challenges associated with dual- or triple-licensing would be alleviated for applicants as well as regulators and concerns over data-security in the coming cloud computing and quantum computer age can be addressed collectively. With increasing internationalized operations, the importance of combatting potential threats increases correspondingly; there is a need to work together to ensure remote sensing activities are conducted in a manner that benefits industry,

protects the public and is conducive to further technological development. Canada should take this opportunity to engage with other nations in multilateral fora, such as NATO, the Organization for Economic Co-operation and Development and UNCOPUOS, as well as the Committee on Earth Observation Satellites,[48] to spearhead new campaigns for the better harmonization of remote sensing activities.

G. Need for a New General Outer Space Act

As demonstrated throughout this review, aside from certain areas that can be improved, the RSSSA has proven capable of establishing a regulatory framework regarding Canadian remote sensing space systems thus far. Notwithstanding this fact, when looking at space remote sensing activities in the context of overall space activities, it becomes obvious that the RSSSA is so far playing the role of Canada's "general space law" in addition to playing its intended role as Canada's "remote sensing law."

When considering the RSSSA as a whole, including its objectives, its methodology and its application, it becomes obvious that it is, in fact, undertaking two distinct responsibilities: first, as a regulator of remote sensing data and products and second, as a regulator of space systems and ground systems that happen to facilitate remote sensing activities. While it is clear why the RSSSA is needed to regulate data, it is less clear why the RSSSA is needed to specifically regulate space hardware. As the only truly regulated space activity it may make sense to regulate application and hardware together, but the real problem emerges when new space activities develop and new pieces of legislation are enacted to regulate each new activity, with each new activity having its own regulations regarding application and hardware.[49] Ensuring that numerous pieces of legislation dealing with distinct space activities all align in

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[48] Canada, through the Canadian Space Agency, is a member of this committee. However, Global Affairs Canada, as the department that implements the RSSSA, ought to have a more involved role.

[49] This point is clearer when considering the impending need for the regulation of other space activities. Suppose tomorrow that Canadian entities undertake on-orbit servicing or space mining operations, whereby they launch space objects capable of servicing other space objects or mining celestial bodies. To effectively regulate such activities, Canada will need to pass legislation that addresses first, the physical processes by which such activities will be carried out using space objects and second, a framework to address the complications associated with such activities (e.g., in the case of on-orbit servicing, damaging the serviced space object and in the case of space mining, how to deal with the resources brought back to Earth).

terms of their hardware requirements seems unnecessarily onerous and ripe for confusion.

To avoid this potential problem, Canada should enact a single piece of legislation that addresses the hardware-side of space systems uniformly across activities and allows different legislation and/or regulations to deal with the application-side of the activities. Canada's lack of a general Outer Space Act means that when a new space activity arises for which there is no legislation through which to regulate that activity, the RSSSA becomes the default mechanism to regulate that activity even though it does not fit squarely within the confines of the RSSSA. For example, S-AIS services do not as clearly fall within the RSSSA's ambit to the same extent as traditional SAR remote sensing activities, yet both are governed by, and licenses are issued through, the RSSSA because there is no other legal framework for S-AIS to work with. One of the objectives of the RSSSA is to control the dissemination of sensitive data; for all intents and purposes, the role of AIS as a maritime safety and traffic management tool is not, in and of itself, sensitive nor is the unintended collection of such signals by satellites.

Most space-faring States have dedicated space legislation that help address this issue: Norway was the first in 1969,[50] Sweden in 1982,[51] the US in 1984,[52] the UK in 1986,[53] Russia and South Africa in 1993,[54] Ukraine in 1996,[55] Belgium in 2005 (updated in 2013),[56] France in

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[50] Act on Launching Objects from Norwegian Territory etc. into Outer Space, (Jun. 13, 1969) (Nor.).

[51] Lag om rymdverksamhet (Svensk författningssamling [SFS] 1982:963) (Swed.).

[52] *See* Commercial Space Launch Act, 51 U.S.C. §§ 50901-23 (2012).

[53] Outer Space Act 1986, c. 38, (Eng.).

[54] Zakon o kosmicheskoy deyatel'nosti [Law of the Russian Federation on Space Activities] Aug. 20, 1993, No. 5663-I; The Space Affairs Act 84 of 1993 (S. Afr.).

[55] Ordinance of The Supreme Soviet of Ukraine, On Space Activity, Nov. 15, 1996 (Ukr.).

[56] Loi relative aux activites de lancement, d'operation de vol ou de guidage d'objets spatiaux [Law on the Activities of Launching, Flight Operations or Guidance of Space Objects] of Sept. 17, 2005, Moniteur Belge [M.B.] [Official Gazette of Belgium], Mar. 19, 2008, 19520. The consolidated text of the law, as updated in 2013, can be found at http://www.belspo.be/belspo/space/beLaw_en.stm.

2008[57] and Indonesia in 2013[58] These laws generally provide a legal basis to regulate new activities as they emerge rather than develop independent legislation for each new technology that finds a commercial application. Canada would benefit tremendously from the enactment of new legislation that can be used to govern all forms of space commercial activities, like on-orbit serving, active debris removal, private space stations, sub-orbital and orbital flights, exploration and exploitation of space natural resources, etc. One general Outer Space Act would establish Canada's position on regulating space activities and provide industry with the clarity necessary to plan and develop their business practices with knowledge of the regulatory processes.

VI. CONCLUSION, FINDINGS AND RECOMMENDATIONS

In this Review, we have attempted to demonstrate, the RSSSA and its Regulations have, for the past ten years, done a relatively good job of regulating remote sensing space systems in Canada. Notwithstanding, as technology progresses, new applications are developed, operations become internationalized and foreign relations grow ever more complex, the RSSSA will face increasing difficulty in maintaining its hold on properly regulating remote sensing activities. As per the mandate in section 45.1 of the Act, we aimed to analyze the RSSSA on its impact on the technological development of remote sensing space systems in Canada as well as the implementation of Canada's international agreements and treaties. We have attempted to highlight the current shortcomings of the Act in terms of its provisions, its implementation and its application and have attempted to indicate our thoughts (recommendations) on how the system can be improved to best serve the dual purposes of the Act: maintaining national security and foreign policy interests as well as promoting the development of the Canadian commercial remote sensing industry.

The significant findings of this Review are as follows:

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[57] Loi 2008-518 du 3 juin 2008 relative aux operations spatiales [Law 2008-518 of June 3, 2008 Relating to Space Operations] JOURNAL OFFICIEL DE LA REPUBLIQUE FRANCAISE [J.O.][Official Gazette of France] June 3, 2008.

[58] Law of the Republic of Indonesia on Space Activities, (2013); Loi relative aux activités de lancement, d'opération de vol ou de guidage d'objets spatiaux [Law on the Activities of Launching, Flight Operation or Guidance of Space Objects] of Sep. 17, 2005, MONITEUR BELGE [M.B.] (As revised by Loi du 1er décembre 2013 [Law of December 1st 2013] MONITEUR BELGE, Jan. 15, 2014.).

1. Although the objective of the Act is to balance the public interests of Canada with the private interests of commercial remote sensing operators, the Act leans more in favor of protecting Canadian national security interests at the expense of technological development and commercial interests.

2. The Act does a commendable job of upholding Canada's international obligations and allowing Canada to respond to changing international situations.

3. The Act has had some difficulty keeping up with the pace of technological change over the past decade and will continue having difficulty in the future; thus far, the flexibility of the Act has allowed for continued regulation but may soon extend past its functional limits.

4. While the Act succeeds, for the most part, in appropriately regulating Canadian remote sensing activities, many of the key definitions remain unclear; consequently, the Act is being used to regulate activities that are not, strictly speaking, remote sensing.

In view of these findings, we make the following recommendations:

1. The GAC office in charge of implementing the Act is underfunded and under-staffed; additional resources are required to maintain the proper implementation of the Act, especially as remote sensing space system applications increase.

2. Aside from sophisticated entities, there is little awareness of the Act or its application; there should be more accessible information on the topic of remote sensing activities in Canada.

3. There is little international harmonization on the topic of remote sensing activities; to best serve public and private interests, the Act should be harmonized with foreign and international rules and practices.

4. There is no cost associated with applying for a license under the Act; a licensing fee, on a cost-recovery basis, should be implemented to establish a standard level of service and help offset some of the licensing office's costs.

5. Make the language of the Act more clear regarding remote sensing, Earth observation and whether the latter falls within its purview. Alternatively, issue a Client Procedural Circular, in "layman's

terms", to outline the intended interpretation of the Act's various phrases.

6. Consider whether removing the distinction between raw data and remote sensing products, so that both are treated as remote sensing products currently are (permitted distribution unless specifically prohibited by the Minister), is feasible from a security standpoint.

7. Investigate whether there are more appropriate ways of addressing the seeming difficulties associated with the definition of "transform." Similarly, utilize the authority granted under section 20(1)(a) to denote specific activities as either transforming or not transforming raw data.

8. If possible, streamline the licensing process for bent-pipe ground stations that do not store, process or distribute any data/products within Canada.

9. Define the scope of "operate" in section 5 to determine who must be licensed for their activities related to the operation of a remote sensing space system or, alternatively, establish an exemption process for persons acting as employees or agents of remote sensing satellite operators from procuring a license where reasonable to do so.

10. Amend the Act so that the default term of a license is for the lifetime of the satellite system. Conversely, issue a Client Procedural Circular or similar document that communicates the official position of the regulator on this position.

11. Consider implementing a deadline by which the Minister must provide a decision on an application for license. Additionally, applicants seeking a remote sensing space system license should begin to involve the regulator as early as possible in the design and development stages of their operation.

12. Engage with licensees affected by a section 14 restriction order to determine whether alternative courses of action may reach the same objective without hindering commercial operations or whether there are ways to mitigate the harm caused to the commercial operator (such as compensation for loss of business).

13. Ensure proper compensation for priority access (as made available in the Regulations) and clarify what kinds of representations

may be made by an operator and what effect such representations would have on the priority access order.

14. Monitor remote sensing security strategy to ensure Canada's security interests are maintained despite changing international players and evolving and divergent interests.

15. Embed within the Act different ways of stimulating commercial interest so that the balance between security and technological development is regained.

16. Provide the regulatory office in charge of remote sensing with significantly more resources and more personnel.

17. Establish an independent regulatory body that is tasked with overseeing the RSSSA from the perspective of reviewing applications, granting licenses, conducting inspections, monitoring compliance, etc. The independent body should be provided with sufficient financial resources, technical expertise, a broad mandate to regulate (in consultation with other key departments and agencies) and should aim to facilitate commercial space remote sensing activities.

18. Implement a reasonable fee in the application and licensing process that will establish a certain level of expected service and, if implemented on a cost-recovery basis, will alleviate the resource shortages currently associated with the regulator's office.

19. Implement a formal process whereby the licensee and the regulator have an opportunity to discuss and review a license (before and after it is issued), such that any disagreements regarding conditions or restrictions can be resolved or mitigated as best as possible without needing to undertake the license amendment process.

20. Engage community stakeholders by attending industry and academic conferences, publishing client information circulars and establishing an easily and intuitively-accessible online presence to explain clearly and candidly what kinds of activities fall within the scope of remote sensing as defined in the Act.

21. Include a provision that would allow Canada to be indemnified by a private entity for damages it is required to pay internationally as a result of a private entity's space activity causing damage as well as a provision that requires all operators to procure insurance to cover the liability risks associated with space activities.

22. Enter discussions that harmonize international rules related to the cloud so that anyone operating in the cloud, regardless of physical location, is subjected to the same regulations and/or operating procedures since attempting to unilaterally address issues related to the cloud will cause severe consequences to private industry.

23. Engage foreign allies in high- and low-level discussions in an attempt to harmonize the various rules, procedures, standards, methods and strategies by which remote sensing operations are regulated.

24. Enact a general Outer Space Act that would apply to new and emerging space activities as they become a reality.

HERE A SPACEPORT, THERE A SPACEPORT, EVERYWHERE A SPACEPORT?

Michelle L.D. Hanlon[*]

ABSTRACT

Arguably, the first location that can be considered a spaceport is located on an island in the Baltic Sea. Peenemünde, Germany was the launch site of the first human-made object to reach space: a German V-2 rocket. Developed as a weapon, the first successful test flight of the V-2 in 1942 nevertheless heralded the birth of space travel. It was not long before the Soviet Union and the United States were testing launch systems from sites like Baikonur, Kazakhstan and the White Sands Missile Range in New Mexico, respectively. In the decades since that first launch, space has come to play an integral, if not vital, role in the daily lives of humans. More and more nations have become spacefaring, and more and more commercial entities are investing or engaged in space activities. Commercial spaceports are literally popping up all over the world. In seeking to appreciate this phenomenon, this article provides an overview of the current status of the commercial spaceport industry in the United States. It commences with a review of the federal regulatory framework which has supported the genesis and growth of spaceports. It evaluates the development progress and success of existing spaceports as well as new legislation designed to sustain this growth. Ultimately, it offers recommendations to nations and entities and encourages communities to welcome the construction of a spaceport as a first sustainable step to the future.

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> Space is no longer the jurisdiction of little men in funny suits, Star Trek movies or the Shuttle. The international commercial space industry is our highway into the 21st century and holds the promise of enormous economic benefits to our entire [world].
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> —United States Congresswoman Andrea H. Seastrand, 3 February 1995

I. INTRODUCTION

In July 1994, a "shattered comet" with an explosive force "400 times the power of the world's entire nuclear arsenal" struck Jupiter "leaving a scar . . . greater than the size of the entire planet earth"[1] Thankfully, the good citizens of Green River City, Wyoming, rolled out their welcome mat and, in the weeks before the collision, dedicated the dirt and gravel runway seven kilometers from the city center as the Greater Green River Intergalactic Spaceport.[2] The publicly stated purpose was to welcome Jovians fleeing the carnage on their planet.[3] Whether the result of a tongue-in-cheek ploy to attract tourists, a nascent – and prescient – effort to attract aerospace business, or simply the brainchild of over-excited science fiction aficionados, the Federal Aviation Administration (FAA) accepted the grandiose appellation. As such, the location the FAA identifies as "48U" remains formally known as an intergalactic

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[1] *"A Big Hit: Shoemaker-Levy Comet Bombards Jupiter"* (NBC Nightly News broadcast July 18, 1994) *available at* https://archives.nbclearn.com/portal/site/k-12/browse/?cuecard=42582.

[2] Kaushik, *The Greater Green River Intergalactic Spaceport*, AMUSING PLANET (Oct. 1, 2015), http://www.amusingplanet.com/2015/10/the-greater-green-river-intergalactic.html.

[3] Eric Grundhauser, *The Greater Green River Intergalactic Spaceport*, SLATE (July 30, 2015), http://www.slate.com/blogs/atlas_obscura/2015/07/30/wyoming_s_greater_green_river_spaceport_was_built_to_welcome_refugees_from.html.

spaceport.[4] Sadly, the spaceport has never been developed, and reports suggest even the spaceport's sign is now gone.[5] However, all is not lost for intrepid interstellar travelers. There are eleven fully-licensed and at least seven in-the-process of being licensed commercial spaceports around the United States (US) alone, and the trend is going global. Canada, Sweden, the United Kingdom, the United Arab Emirates, New Zealand, Malaysia, the Netherlands, Italy and Curaçao, among others, either have or are considering the development of commercial spaceports as well.

Are these states and nations throwing good money at fanciful illusions of galactic tourism and trade only to end up, like Greater Green River, just a landing strip without even a sign? Or are they truly on the threshold of the future, assuring that they are better-prepared than their neighbors to welcome the space age? This paper reviews the current status of the commercial spaceport industry in the US commencing with the federal regulatory framework which has supported its genesis and growth. It will evaluate the development process and success of existing spaceports and offer recommendations for newcomers. It will review the Comstock Amendment[6] to the FAA Reauthorization Act of 2018[7] and within that rubric, propose regulatory revision and implementation designed to promote the proliferation of spaceports. Because, ultimately, whether to anchor an aerospace tenant, welcome sub-orbital transport vehicles, or support future space tourism or resource utilization efforts, a carefully planned spaceport development project can only reap long-term rewards.

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[4] As of March 30, 2017, a search of the FAA database of airports in Wyoming returns a page for "GTR Green River Intergalactic Spaceport" at Location ID 48U. *See Airports Contacts Information*, FED. AVIATION ADMIN., https://www.faa.gov/airports/airport_safety/airportdata_5010/menu/contacts.cfm?Region=&District=&State=WY&County=&City=GREEN%20RIVER&Use=&Certification (last visited Mar. 18, 2019).

[5] *See Greater Green River Intergalactic Spaceport*, ATLAS OBSCURA, http://www.atlasobscura.com/places/greater-green-river-intergalactic-spaceport (last visited Mar. 18, 2019).

[6] FAA Reauthorization Act of 2018, Pub. L. No. 115-254, § 580, 302 H.R. (132 Stat. 3186) 209 (2018) [hereinafter Comstock Amendment].

[7] FAA Reauthorization Act of 2018, Pub. L. No. 115-254, 132 Stat. 3186 (2018).

II. HOW DID WE GET HERE - A BRIEF HISTORY

A. Responding to Market Forces

The US government has "built, operated, and maintained a space launch infrastructure"[8] since the 1950s. Indeed, from "1963 to 1980, the US government . . . launched 100 percent of the western world's commercial satellites."[9] During this time, launch vehicles and their components were "nearly all expendable" [10] and coastal locations– namely US government-operated launch sites at Cape Canaveral Air Force Base in Florida and Vandenberg Air Force base in California, became dominant hubs of space launch activity.

In the 1970s, when the European Space Agency developed its Expendable Launch Vehicle (ELV), Ariane, it became "the first competitor to NASA for commercial launches."[11] Coincidentally, as Europe entered the ELV market, the US seemed intent on abandoning it. In the late 1970s, the US decided to shut down ELV production and implement "a policy to launch all satellites, both government and commercial on the Space Shuttle."[12] However, it soon became apparent "that the flight schedule of the shuttle could not meet all of the U.S. security, civil, and commercial launch requirements."[13]

Recognizing this reality, in July 1982 then US President Ronald Reagan issued a directive affirming the government's commitment to the Shuttle program, but also promoting the expansion of US "private-sector investment and involvement in civil space and space-related activities.[14] In 1983, President Reagan issued the Na-

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[8] Licensing and Safety Requirements for Operation of a Launch Site, 65 Fed. Reg. 62,812, 62,813 (Oct. 19, 2000) (to be codified at 14 C.F.R. pt. 400).

[9] John W. Raymond, Airports and Spaceports: A Historical Comparison (Mar. 1997) (unpublished research paper, Air Command and Staff College) at 1.

[10] G. Wayne Finger, David L. Keller & Brian S. Gulliver, Public-Private Spaceport Development (paper delivered at American Institute of Aeronautics and Astronautics SpaceOps 2008 Conference May 2008) at 1, *available at* https://arc.aiaa.org/doi/pdf/10.2514/6.2008-3584 (last visited May 6, 2019).

[11] *Id.*

[12] Raymond, *supra* note 9, at 2; *see also Origins of the Commercial Space Industry*, FED. AVIATION ADMIN., https://www.faa.gov/about/history/milestones/media/Commercial_Space_Industry.pdf (last visited Mar. 18, 2019) [hereinafter FAA History].

[13] FAA History, *supra* note 12.

[14] NAT'L SEC. COUNCIL, National Security Decision Directive 42, National Space Policy (1982).

tional Security Decision Directive on the Commercialization of Expendable Launch Vehicles, formally reiterating the resolve of the US government to "encourage[] domestic commercial exploitation of space capabilities, technology and services for U.S. national benefit." [15] The Directive did not address the establishment of commercial launch sites but rather "encourage[d] the use of [U.S.] national ranges for U.S. commercial ELV operations."[16]

The President used his third State of the Union address, in January 1984, to highlight his administration's strong commitment to a commercial space industry. Predicting that the market for space transportation would surpass the government's capacity to develop it, he pledged that his administration would implement a number of executive initiatives to "promote private sector investment in space."[17] One month later, he issued an executive order which, among other things, formally designated the Department of Transportation (DoT) as the steward of the fledgling commercial space industry and assigned to the DoT the responsibility for "expediting . . . the establishment and operation of commercial launch ranges."[18]

The US Congress followed up in October with the Commercial Space Launch Act. One of the stated purposes of the Act is "to encourage the United States private sector to provide launch vehicles, re-entry vehicles, and associated services." [19] The Act defines "launch" to mean "to place, or attempt to place, a launch vehicle and any payload or human being from Earth in a suborbital trajectory; in Earth orbit in outer space; or otherwise in outer space."[20] Similarly, a "launch site" "means the location on Earth from which a launch takes place . . . . "[21] Pursuant to the Act, a "license is required for . . . a person to . . . operate a launch site . . . in the United States

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[15] NAT'L SEC. COUNCIL, National Security Decision Directive 94, Commercialization of Expendable Launch Vehicles, at 1 (1983).

[16] *Id.*

[17] Ronald Reagan, President of the United States of America, Address Before a Joint Session of the Congress on the State of the Union (Jan 25, 1984) [hereinafter Reagan SOTU].

[18] Commercial Expendable Launch Vehicle Activities, Exec. Order No. 12465, 3 C.F.R. § 2 (Feb. 21, 1984).

[19] 51 U.S.C. § 50901(b)(2) (2012).

[20] § 50902(7)(A).

[21] § 50902(10).

[and] for a citizen of the United States . . . shall operate a launch site . . . outside the United States."[22]

The Congress urged a light touch, calling for "stable, minimal, and appropriate regulatory guidelines that are fairly and expeditiously applied"[23] and regulations "only to the extent necessary . . . in order to ensure compliance with international obligations of the United States and to protect the public health and safety, safety of property, and national security interests and foreign policy interests of the United States."[24] In response, the DoT created the Office of Commercial Space Transportation (AST) to oversee the licensing process.[25]

B. Tragedy Becomes a Catalyst

Despite this federal encouragement, the "commercial space launch industry remained small"[26] due to the difficulties associated with competing against the "government subsidized space shuttle."[27] This changed after the Space Shuttle Challenger broke apart 73 seconds into its flight on 28 January 1986.[28] In August 1986, when President Reagan announced that a fourth Space Shuttle would be built, he also announced that he expected the private sector to play "an increasingly important role in the American space effort." [29] He predicted that "[f]ree enterprise corporations will be-

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[22] § 50904(a)(1) & (2). In addition to assuring that the Government is able to assure the safety of launch sites, this provision addresses the US's obligation pursuant to Article VI of the Outer Space Treaty to bear "responsibility for national activities in outer space" whether carried out by governmental or nongovernmental agencies. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. VI, Jan. 29, 1967, 610 U.N.T.S. 205.

[23] § 50901(a)(6).

[24] § 50901(a)(7).

[25] *Office of Commercial Space Transportation - About the Office*, FED. AVIATION ADMIN, https://www.faa.gov/about/office_org/headquarters_offices/ast/about/ (last visited Mar. 18, 2019).

[26] Michael M. Hale, The Effect of the Commercial Space Launch Act on Department of Defense Contract Administration (1990) (unpublished thesis School of Systems and Logistics of the Air Force Institute of Technology), *available at* http://www.dtic.mil/dtic/tr/fulltext/u2/a229497.pdf.

[27] FAA History, *supra* note 12, at 3.

[28] *Id.*

[29] Ronald Reagan, President of the United States of America, Statement on the Building of a Fourth Shuttle Orbiter and the Future of the Space Program (Aug. 15,

come a highly competitive method of launching commercial satellites" [30] and determined that "private firms [were] essential in clearing away the backlog" [31] that had built up while the shuttles were being modified.

In the December following the Challenger disaster, President Reagan decreed, pursuant to another National Security Decision Directive, that the Space Shuttles "shall no longer provide launch services for commercial and foreign payloads unless those spacecraft have unique, specific reasons to be launched aboard the Shuttle."[32] Although the Directive authorized the governmental redevelopment of ELVs, the administration recognized that there would be a significant gap in launch services. Thus, in early 1988, President Reagan issued a revised National Space Policy which, among other things, directed government agencies to "encourage and not preclude the commercial use and exploitation of space technologies and systems for national economic benefit."[33] Perhaps realizing that a thriving commercial space industry could also be a boon to the domestic economy, the President tasked his government to "work cooperatively to develop and implement specific measures to foster the growth of private sector commercial use of space."[34]

C. The Regulatory Foundation

The first formal commercial launch regulations[35] were issued on 4 April 1988 with an acknowledgement that "the United States private sector would have to assume a new and significant role

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1986), *available at* https://www.reaganlibrary.archives.gov/archives/speeches/1986/081586f.htm.

[30] *Id.*

[31] *Id.*

[32] NAT'L SEC. COUNCIL, National Security Decision Directive 254 (1986).

[33] *Presidential Directive on National Space Policy, 11 February 1988 -Unclassified Summary*, NASA, https://www.hq.nasa.gov/office/pao/History/policy88.html.

[34] *Id.*

[35] Interim regulations were published by the Office of Commercial Space Transportation on February 26, 1986. Open for public review, the interim regulations on licensing received only 13 comments. Of those 13 comments, only one offered by the House Committee on Science and Technology covered the licensing of launch sites; that one comment regarding the licensing of launch sites focused on how the Office would complete an *ad hoc* review within the statutory time limit of 180 days. Commercial Space Transportation; Licensing Regulations, 53 Fed. Reg. 11004-06 (Apr. 4, 1988) (to be codified at 14 C.F.R. pt. 400).

alongside the government in assuring the nation's access to space."[36] In this first set of regulations, launch site operation was included in the definition of "[l]aunch activity."[37] While not providing a separate definition, it was anticipated that the AST would issue specific licenses authorizing the operation of a launch site. Requests for such licenses would be "reviewed on the basis of the applicant's capability to operate a facility where safety operations are conducted on a continuing basis as support for the launching of a specified class of launch vehicles."[38] As the AST explained in its supplemental guidance, it proposed to review launch site license applications "on an *ad hoc* basis relying, as an interim measure, on existing governmental launch expertise, experience, and safety practices as reference."[39]

Under this regulatory rubric, the development of a privately run launch site still failed to gain traction. Initially, private companies focused on developing ELVs which were being launched from government launch sites. However, in 1993, the US Department of Defense (DoD) was appropriated $10 million "for grants to be made for the development of dual use space launch facilities to support Department of Defense and commercial space launch requirements."[40]

In 1995, the AST issued guidelines describing the information that the office would require from an applicant seeking a launch site operator license. As directed by the Commercial Space Act, the key concerns for the AST were threefold: public health and safety, the safety of property, and the national security or foreign policy interests of the US." [41] With these goals in mind, the office would

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[36] *Id.* at 11,004.

[37] *Id.* at 11,013.

[38] *Id.* at 11,015.

[39] *Id.* at 11,006.

[40] Raymond, *supra* note 9, at 15 (citing Briefing, Assistant Secretary of the Air Force (Space) Subject: FY 93 & 94 Dual Use Space Launch Infrastructure Grant Program, 30 May 1996). Emerging spaceport projects in California, Florida, Alaska and New Mexico received a total of $13.94 million in federal grants in 1993 and 1994. *Id.*

[41] Licensing and Safety Requirements for Operation of a Launch Site, 64 Fed. Reg. 34,316, 34,317 (June 25, 1999) (to be codified at 14 C.F.R. pt. 400). The Office of Commercial Space Transportation of the Federal Aviation Administration now implements licensing responsibilities. At the time the guidelines were initially developed, the Office of Commercial Space Transportation was considered part of the Department of Transportation, but not within the structure of the FAA.

perform three distinct reviews covering: launch site location; environmental matters; and national security/foreign policy.

i. Launch Site Location Review

The AST, naturally, sought information regarding a launch site's geographic characteristics including "location, size, and shape, . . . topographic and geological characteristics."[42] From a public safety standpoint, it was also important to describe the sites "proximity to populated areas, and any local commercial and recreational activities that may be affected by launches such as air traffic, shipping, hunting, and offshore fishing."[43] As part of the ground safety review, applicants were required "to perform a hazard analysis and develop a comprehensive ground safety plan and a safety organization"[44] which included a discussion of explosive safety. Significantly, the AST noted, "little or no launch site location review would be needed if the applicant proposed to locate a launch site at a federal launch range."[45]

The potential licensee also had to describe "possible flight paths and general impact areas designated for launch."[46] Among other things, if it was intended that flight paths overfly land, the applicant had to "provide flight safety analyses for generic sets of launch vehicles and describe, where applicable, any arrangements made to clear the land of people prior to launch vehicle flight."[47]

Finally, the applicant was required to describe the so-called meteorological environment and provide "data regarding temperature, surface and upper wind direction and velocity, temperature inversions, and extreme conditions that may affect the safety of launch site operations."[48] The license-seeker also had to indicate "the frequency (average number of days for each month) of extremes in wind or temperature inversion that could have an impact on launch."[49]

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[42] *Id.* at 34,318.
[43] *Id.*
[44] *Id.*
[45] *Id.*
[46] *Id.*
[47] *Id.*
[48] *Id.*
[49] *Id.*

ii. Environmental Review

In addition, potential launch site operators had to supply information to allow the AST to meet its environmental impact requirements under the National Environmental Policy Act (NEPA). NEPA's goal is to assure that "the federal government to use all practicable means to create and maintain conditions under which man and nature can exist in productive harmony."[50] Since issuing a license for the operation of a launch site is considered a federal action, the DoT was required to prepare an environmental impact statement "assessing the environmental impact of and alternatives to"[51] the issuance of such license. Assessing "environmental impact" includes reviewing, among other things:

> Air quality, Land use, Biological resources . . . , Natural resources and energy supply, Noise and compatible land use, Climate, Coastal resources, Socioeconomics, environmental justice, and children's environmental health and safety risks, . . . Farmlands, Visual effects . . . Hazardous materials, solid waste, and pollution preventions, Water resources . . . [and] Historical, architectural, archeological, and cultural resources.[52]

The entire environmental review process typically takes at least twelve to twenty-four months.[53]

iii. Policy Review

Finally, the license application was also reviewed "to determine whether operation of the proposed launch site would jeopard-

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[50] National Environmental Policy Act, 42 U.S.C §§ 4321-70 (2012).

[51] *What is the National Environmental Policy Act?* ENVTL. PROT. AGENCY, https://www.epa.gov/nepa/what-national-environmental-policy-act#NEPA (last visited Mar. 18, 2019).

[52] Presentation, Pam Underwood & Stacey Zee, Fed. Aviation Admin., EIS for Spaceport Camden, Camden County Georgia (Dec. 7, 2015) at 10, https://www.faa.gov/about/office_org/headquarters_offices/ast/environmental/nepa_docs/review/documents_progress/camden_spaceport/media/Spaceport_Camden_EIS_ScopingPresentation_v1_508.pdf.

[53] *See id.* Spaceport Camden commenced the EIS review with a public meeting on December 7, 2015. The public comment period closed on January 16, 2016 and remains listed as work in progress on the FAA website.

ize national security, foreign policy interests, or international obligations of the United States."[54] In conducting this review, the AST would coordinate with the DoD, the Department of State and "other federal agencies that have responsibility for national and international interests."[55]

D. The First Generation Spaceports – Taking Advantage of Federal Infrastructure

The establishment of a spaceport generally requires significant infrastructure investment as well as competitive subsidy support to woo launch service providers. Developing and running a spaceport requires much more than simply the existence of a launch site. Significant infrastructure requirements include payload processing facilities, range assets, ground control centers, and convenient intermodal connections.[56] Moreover, in the early 1990s, the vast majority of launch vehicles were government-developed vertically integrated ELVs. Thus, pre-existing government infrastructure and proximity to the water were beneficial. Not surprisingly, then, each of the first three private spaceports licensed by the FAA—California Spaceport, Spaceport Florida Authority and Virginia Spaceflight Center—were co-located at a pre-existing federal launch range. Indeed, the regulations "envisioned that most commercial launches would take place from federal launch ranges."[57] In so doing, the launch operator "must comply with the rules and procedures of [that] federal launch range,"[58] rules and procedures that had already been assessed and approved by the government.

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[54] Licensing and Safety Requirements for Operation of a Launch Site, 64 Fed. Reg. 34,316, 34,320 (June 25, 1999) (to be codified at 14 C.F.R. pt. 400).

[55] *Id.*

[56] *See generally* Florida Spaceport System Plan 2013 (April 2013) at 4, *available at* https://spacecoasttpo.com/wp-content/uploads/2014/06/florida-spaceport-systems-plan-2013_final1.pdf (providing general background regarding the necessary components of a spaceport system).

[57] 64 Fed. Reg. at 34,317.

[58] *Id.*

As such, a large part of the licensing conditions were almost automatically met.[59] This, however, did not demonstrably hasten the licensing process on these first spaceports.

i. The Pioneer: California Spaceport

It had been expected, prior to the Space Shuttle Challenger explosion, that Vandenberg Air Force Base would host its own shuttle launch. Unfortunately, after the disaster, the Air Force cancelled the Vandenberg Shuttle Program,[60] costing the state four thousand jobs, and calling into question the $5 billion that had been invested in Vandenberg to develop a manned-space facility. In 1993, the state of California stepped in. It created a California Spaceport Authority to "to foster the development of activities in California related to space flight including, but not limited to, space vehicle launches, space education and job training infrastructure and research launches, manufacturing, academic research, applied research, economic diversification, business development, tourism, and education."[61] The Authority's mission was "to develop the commercial space industry in California and to assist with defense conversion efforts."[62] The first project was the development of a commercial spaceport at Vandenberg Air Force Base.[63]

In addition to state support, the proposal required both a federal grant and private funding. The project received "a $30 million investment by ITT"[64] and was granted $3 million from the Department of Defense.[65] In 1994, the United States Air Force announced its intention to lease space at Vandenberg to the California Space

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[59] In fact, in 1997, the FAA entered into a Memorandum of Understanding with the Department of Defense and the National Aeronautics and Space Administration "regarding safety oversight of licensed launch site operators located on federal launch ranges. *Id.* at 34,318.

[60] *Id.*

[61] A.B. 1475, 1997 State Assemb. Reg. Sess. (Cal. 1997).

[62] *Id.*

[63] See Raymond, *supra* note 9, at 16.

[64] Andrea H. Seastrand, "Commercial Space Activities on California's Central Coast," *Congressional Record* Volume 141, Issue 22, H11195 at 1196 (Feb. 3, 1995).

[65] Andrea H. Seastrand, "Western Commercial Space Leasing Center Lease Signing," *Congressional Record* Volume 141, Issue 53, H3529 at 3530 (Mar. 22, 1995).

Authority.[66] The project underwent three review processes, pursuant to the DoT's "case-by-case approach to evaluation" [67] of launch site operator license applications. Since the US Air Force was expected to play a "significant role in California Spaceport's safety process," AST was "able to review . . . the application expeditiously because the applicant certified its intention to observe the safety requirements currently applied."[68]

Finally, in September 1996, the AST granted "the first license to operate a launch site to Spaceport Systems International to operate California Spaceport."[69] Today, the California Spaceport is run by Harris Spaceport Systems and maintains a license for both government launches "and licensed launches of small payload weight class . . . of orbital expendable vehicles."[70] It purports to "offer one-of-a-kind facilities and services with the ability to support a wide variety of satellite customers' processing configurations and specialty requirements."[71] According to its marketing content, it remains the "only continental U.S. complex from which customers can launch their rockets directly at a pole without flying over any land masses while inside Earth's atmosphere."[72] It is also, according to the FAA, "the only exclusively commercially operated launch site in the United States, receiving no federal or state taxpayer funds to operate.[73]

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[66] *Id.*

[67] Licensing and Safety Requirements for Operation of a Launch Site, 64 Fed. Reg. 34,316, 34,317 (June 25, 1999) (to be codified at 14 C.F.R. pt. 400).

[68] *Id.* at 34,318.

[69] Licensing and Safety Requirements for Operation of a Launch Site, 65 Fed. Reg. 62,812, 62,814 (Oct. 19, 2000) (to be codified at 14 C.F.R. pt. 400). Note that the AST was transferred to the FAA in 1995.

[70] Harris Corp., FAA Order No. 01-005 (Rev 2) (Sept. 16, 2016).

[71] HARRIS CORP., https://www.harris.com/what-we-do/spaceport-operations (last visited Mar. 18, 2019).

[72] Dan Gillen, *A Spaceport for Smallsats*, HARRIS CORP. (Apr. 3, 2017), https://www.harris.com/perspectives/harris-for-tomorrow/a-spaceport-for-smallsats.

[73] Fed. Aviation Admin, The Annual Compendium of Commercial Space Transportation 2018, at 26 [hereinafter FAA Compendium 2018]. *See also* Andrew Tarantola, *8 Spaceports That Are America's Gateway to the Stars*, GIZMODO (Sept. 26, 2013), http://gizmodo.com/8-spaceports-that-are-americas-gateway-to-the-stars-1257821819.

ii. Two More: Virginia and Florida

The next two spaceports to be licensed by the FAA followed a similar path as California Spaceport. They took advantage of pre-existing federal launch ranges, were developed using a combination of federal, state and private sector funds, and commenced with the creation by the state legislature of a space authority.

The Spaceport Florida Authority was created as a state government space agency in 1989.[74] The mission of the Authority – which has since become Space Florida – was "to retain, expand and diversify Florida's space-related industries."[75] The Authority commenced with the idea of operating a spaceport at Launch Complex 46 at Cape Canaveral Air Station. The Authority initially received $4.89 million in federal funds and an additional $7.2 million in state and private funds. It was licensed by the FAA in 1997 to support both orbital and suborbital launches.[76] Spaceport Florida became the first commercial spaceport to host a launch when NASA's Lunar Prospector launched "aboard Lockheed Martin's new Athena-2 in January 1998."[77] After hosting one more launch in 1999, the spaceport was "largely abandoned."[78] However, with an additional investment of $6.6 million from Federal, state and local coffers,[79] the spaceport has been refurbished and has entered into an agreement with Orbital ATK, Inc. to launch Orbital's Minotaur IV from its site.[80] The first such launch occurred on August 26, 2017.[81] Additionally, it has been reported that British aerospace firm Orbital

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[74] *See* FLA. STAT. § 331.301 (2018).

[75] FLA. DEP'T OF STATE, SPACE AUTHORITY - RECORD GROUP 000795, *available at* http://archivescatalog.info.florida.gov/default.asp?IDCFile=/fsa/DETAILSG.IDC,SPECIFIC=487073,DATABASE=GROUP(date of report unknown).

[76] Raymond, *supra* note 9, at 18-19 (internal citations omitted).

[77] Assoc. Admin. for Commercial Space Transp., "1997 Year in Review," (Jan. 1998), at 1.

[78] James Dean, *Cape Canaveral Pad Revived for Minotaur Rocket Launch*, FLORIDA TODAY (Feb. 12, 2017), http://www.floridatoday.com/story/tech/science/space/2017/02/12/cape-pad-revived-summer-launch-minotaur-rocket/97692258/.

[79] Marco Santana, *Orbital ATK Launch Injects New Life in Long-Dormant Florida Launch Pad*, ORLANDO SENTINEL (Aug. 26, 2017), https://www.orlandosentinel.com/news/space/os-bz-orbital-atk-launch-20170825-story.html.

[80] Dean, *supra* note 78; *see also* Orbital Sciences Corporation, FAA Order No. LLO 17099 (Feb. 10, 2017).

[81] Santana, *supra* note 79.

Access Limited is planning on establishing "a principal operating base" at the spaceport.[82]

The Virginia Commercial Space Flight Authority (VCSFA) was created by the commonwealth in 1995 to, among other things, "disseminate knowledge pertaining to scientific and technological research and development among public and private entities, including but not limited to knowledge in the area of commercial space flight."[83] In 1997 the VCSFA entered into an agreement with NASA to use NASA's Wallops Island, and the Virginia Spaceflight Center was granted a license by the FAA in 1998. While originally licensed for "government launches and licensed launches of small, and medium payload weight class (less than or equal to 11,100 pounds) and of orbital expendable launch vehicles . . . on launch azimuths from 90 degrees east to 160 degrees southeast,"[84] the license has been broadened to include any "U.S. Government or FAA-licensed or permitted launches."[85]

In July 2003, Virginia entered into a joint governance, and financing, agreement with Maryland and VCSFA became the Mid-Atlantic Regional Spaceport (MARS).[86] MARS received $90 million from the Commonwealth of Virginia, $60 million from NASA, and $10 million from Orbital ATK."[87] Maryland now also contributes to the operating budget. A total of eleven missions have launched from MARS since its establishment.

iii. The First New Location: Alaska

The Kodiak Launch Complex, now known as the Pacific Spaceport Complex, also found its genesis in a state-owned entity. The

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[82] Kendall Russell, *Orbital Access Limited to Establish Operations Hub at Cape Canaveral Spaceport*, SATELLITE TODAY (Feb. 22, 2017), http://www.satellitetoday.com/launch/2017/02/22/orbital-access-limited-establish-operations-hub-cape-canaveral-spaceport/.

[83] Virginia Commercial Spaceflight Center Authority Act, 2199, Gen. Assemb. Reg. Sess. (Va. 1994).

[84] Va. Commercial Spaceflight Auth., FAA Order No. 02-007A (Rev 3) (Dec. 18, 2002).

[85] Va. Commercial Spaceflight Auth., FAA Order No. 02-007A (Rev 4) (Aug. 19, 2014).

[86] *Mid-Atlantic Regional Spaceport (MARS) Implementation Plan*, (Joint Md. & Va. Working Grp. on Reg'l Spaceport Implementation, 2004), http://dls.virginia.gov/commission/Materials/MARSReport2004.pdf.

[87] FAA Compendium 2018, *supra* note 73, at 27.

Alaska Aerospace Corporation (AAC), created in 1991, is an independent political and corporate entity located within the Alaska Department of Military and Veterans' Affairs intended to develop a high technology aerospace industry in the state.[88] Located on Kodiak Island in Alaska, it operates the nation's first commercial spaceport not co-located on a federal range. According to the AAC, this provides the added benefit of "allowing customers the flexibility to schedule the support they need without a lot of government red-tape."[89] Nevertheless, the AAC received $1.85 million from the federal government to fund necessary environmental studies, and an additional $25 million from the state,[90] though the state ceased all funding in 2014.[91]

The AAC is currently licensed to "operate a launch site . . . for government launches and licensed launches of small payload weight class (less than or equal to 300 lbs) of orbital expendable launch vehicles . . . on launch azimuths between and including 100 degrees and 220 degrees.[92] Launch Pad 1 (LP-1) is designed to launch intermediate-class payloads to low Earth or polar orbits and Launch Pad 2 (LP-2) is designed for suborbital missile testing. A third launch pad is being developed intended to allow the facility to support launches of satellites in under twenty-four hours.[93]

The AAC has launched twenty rockets since receiving its license in 1998,[94] all but one of which have been for the US government. In 2018, Astra Space, a company seeking to develop small satellite launch capabilities, attempted to carry out an extremely secretive suborbital launch from the site. The Pacific Spaceport

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[88] ALASKA STAT. § 26.27.050 (2018).

[89] *Alaska Aerospace FAQ*, AK AEROSPACE, http://akaerospace.com/frequently-asked-questions (last visited Mar. 18, 2019).

[90] Raymond, *supra* note 9, at 20.

[91] Joanne Snoderly, *AAC Looking for New Launch Site Nearer Equator*, KODIAK DAILY MIRROR (Jan. 31, 2017), http://akaerospace.com/news/aac-looking-new-launch-site-nearer-equator.

[92] Alaska Aerospace Corp., FAA Order No. LSO 03-008 (Apr. 13, 2015).

[93] FAA Compendium 2018, *supra* 73, at 29.

[94] *First Commercial Launch Scheduled for Alaska Aerospace Complex*, THE ASSOC. PRESS (Mar. 20, 2018), https://www.juneauempire.com/news/first-commercial-launch-scheduled-for-alaska-aerospace-complex/.

Complex has confirmed that the launch did occur on its third attempt in July 2018.[95] The AAC has also entered into contracts with Vector Space Systems and Rocket Lab.

Interestingly, the AAC is also now considering expanding its operations and has indicated an interest in developing a second launch site "capable of equatorial launches."[96] The corporation, which is looking at sites in Hawaii and Saipan believes that it will be a "tremendous competitive advantage over anybody else, because there's no other launch site that can do both equatorial and polar in the United States of America."[97]

III. THE NEXT GENERATION: FORMAL RULES

A. The Formal Rules

With the experience of four licenses under its belt, and the realization not only that more site launch operator applicants were coming, but also that these newer applicants would not, for the most part, be co-locating on federal sites and thus able to easily share and adopt their safety protocols, the FAA, in 1999, abandoned its *ad hoc* approach and drafted formal, and vastly more specific, rules. The regulations now include a specific definition of "launch site,"[98] and as a general matter, do not deviate markedly from the original guidelines except to provide detailed requirements for the gathering and analysis of information.[99] The focus of the rules remains safety and public health.

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[95] Jeff Foust, *Alaska Launch Shrouded in Secrecy*, SPACENEWS (July 27, 2018), https://spacenews.com/alaska-launch-shrouded-in-secrecy/.

[96] Snoderly, *supra* note 91.

[97] *Id.* (quoting Alaska Aerospace CEO Craig Campbell).

[98] The definition of launch site parallels the definition offered in the original Commercial Space Act, namely that "Launch site means the location on Earth from which a launch takes place . . . and necessary facilities at that location." 14 C.F.R. § 401.5 (2016). The regulations also define "Operation of a launch site" as "the conduct of approved safety operations at a permanent site to support the launching of vehicles and payloads." *Id.*

[99] This Article provides only a brief glance at the specifics required by the rules. For a more detailed and systematic walk through the regulations, the author recommends Michael C. Mineiro, *Law and Regulation Governing U.S. Commercial Spaceports: Licensing, Liability, and Legal Challenges*, 73 J. OF AIR L. & COM. 759 (2008).

i. Launch Site Location Review

Rather than generally describing the launch site's geographic, flight and meteorological characteristics, the regulations now require that an applicant "use specified methods to demonstrate the suitability of the launch site location for launching at least one type of launch vehicle, including orbital, guided sub-orbital, or unguided sub-orbital expendable launch vehicles, and reusable launch vehicles." [100] Moreover, "each proposed launch point on the launch site must be evaluated for each type of launch vehicle that the applicant wishes to have launched from the launch point."[101] The regulations exactly stipulate minimum launch site boundary distances based on the debris dispersion radius of a worst-case scenario[102] and detail how an applicant shall define its flight corridor.[103] Among information required to submitted are:

> "[a] map or maps showing the location of each launch point proposed, and the flight azimuth, IIP, flight corridor, and each impact range and impact dispersion area for each launch point; . . . Trajectory data; . . . Wind data, including each month and any percent wind data used in the analysis; . . .Each populated area located within a flight corridor or impact dispersion area;. . .The estimated casualty expectancy calculated for each populated area within a flight corridor or impact dispersion area; . . .and . . .If populated areas are located within an overflight exclusion zone, a demonstration that there are times when the public is not present or that the applicant has an agreement in place to evacuate the public from the overflight exclusion zone during a launch.[104]

If a flight corridor does not "encompass populated areas, no additional analysis would be required."[105] Otherwise, a risk analysis must be prepared and approved by the FAA.[106] The regulations also have added requirements for "the submission of an explosive

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[100] 14 C.F.R. § 420.19.
[101] *Id.*
[102] *Id.* § 420.21.
[103] *Id.* § 420.23.
[104] *Id.* § 420.27.
[105] Licensing and Safety Requirements for Operation of a Launch Site, 64 Fed. Reg. 34,316, 34,318 (June 25, 1999) (to be codified at 14 C.F.R. pt. 400).
[106] *Id.*

site plan"[107] and completed agreements with the US Coast Guard and the FAA Air Traffic Control office with "jurisdiction over the airspace through which launches will take place."[108]

The regulations continue to stress safety and delineate a number of affirmative, ongoing and specific ground safety responsibilities for launch site operators including:

> Preventing unauthorized public access to the site; properly preparing the public and customers to visit the site; informing customers of limitations on use of the site; scheduling and coordinating hazardous activities conducted by customers; and arranging for the clearing of air and sea routes and notifying adjacent property owners and local jurisdictions of the pending flight of a launch vehicle.[109]

ii. Environmental Review

The regulations continue to require that the aspiring launch site operator provide all necessary information to prepare an environmental impact statement as required by NEPA. The FAA acknowledges that the environmental review may precede or be concurrent with the licensing process.[110]

iii. Policy Review

The regulations require that an applicant supply information relevant to the FAA's policy approval, "including, for example, identification of foreign ownership of the applicant" and indicates that it will derive other information from the application to make its policy determination.[111] As added protection, the regulations also require licensees to control access to the launch site "through the use of security personnel, surveillance systems, physical barriers, or other means approved as part of the licensing process."[112]

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[107] *Id.*
[108] 14 C.F.R. § 420.31.
[109] 64 Fed. Reg. at 34,319.
[110] *Id.* at 34,319-20.
[111] *Id.* at 34,320.
[112] 14 C.F.R. § 420.53.

iv. The Process

Despite the formal regulations, and recognizing the continued uniqueness of the spaceport business, the launch site operator licensing process retains an organic flavor. The FAA requires that all applicants submit to a "pre-application consultation" pursuant to which the administrators will work with the applicant on preparing a proposal. Not only will the FAA review draft application submissions, but it will help the applicant identify – and presumably work through – distinct issues.[113]

v. Exclusive Use Exemption

Notably, the regulations do not require a launch site operator to obtain a launch site operator license if it does not plan on offering its launch platform to others for launch.[114] Launches from such "exclusive use"[115] sites are covered by the launch license. "Exclusive use" launch sites include the Blue Origin launch site in Van Horn, Texas; the SpaceX site in McGregor, Texas; and the Odyssey Launch Platform, the Sea Launch site in the Pacific Ocean.[116]

B. The Next Generation Spaceports

Six more launch site operators have been licensed by the FAA since the formal regulations were promulgated. These next-generation spaceports are an illustration of the diversifying use of space. The most significant trends are the move to develop reusable launch vehicles, thereby reducing the cost of entry into space, and the genesis of realistic space tourism and suborbital adventurism. These two industry expansions have changed the face of spaceports. First, the advancement of reusable and recoverable launch vehicles

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[113] *Id.* § 413.5. *See also*: *Launch Site Licenses -Pre-Application Consultation*, FED. AVIATION ADMIN., https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/launch_site/preapp_consult/ (last visited Mar. 18, 2019).

[114] *See* 65 Fed. Reg. 207 at 63,923.

[115] Brian Gulliver, Commercial Spaceports: Where We Are and Where We Are Going (paper delivered at International Conference on Transportation and Development, 2016).

[116] FAA Compendium 2018, *supra* note 73, at 21. There is also a launch site located about 30 miles northeast of Fairbanks, Alaska. The Poker Flat Rocket Range is the only U.S. launch facility owned and operated by a not-for-profit organization, the University of Alaska, Fairbanks.

means that a spaceport does not need to be located close to water. Secondly, suborbital vehicles are more likely to require horizontal, rather than vertical takeoff, requiring different design and area considerations. Finally, the space tourism industry will need the ability to launch quite frequently in order to achieve financial success. With these trends in mind, the last sixteen years have seen the construction and licensing of what one design firm has coined "Mixed and Customized Spaceports."[117]

i. Mojave Air & Space Port – Imagination Flies Here

The earliest of the next generation spaceports, the Mojave Air & Space Port in California, boasts many firsts. It is the first US facility to be licensed "to support reusable launch vehicle missions,"[118] the first inland spaceport and the "only private airport in the US with a commercial spaceflight license."[119] Originally a "small rural airfield serving the local gold and silver mining industry,"[120] the airport is owned by Kern County and has been run by the county-formed East Kern Airport District since 1972. It was granted a license to operate as an aerospace test center and launch and reentry site in 2004. Famously the test site for Virgin Galactic, which celebrated a successful test flight of its VSS Unity from the air and space port in February 2017,[121] sixty companies currently operate out of Mojave, including Scaled Composites, XCOR Aerospace, Masten, Orbital ATK, and Interorbital Systems.[122] Truly diversified, the air and space port includes an industrial park, the National Test Pilot School and an upgraded rail infrastructure with "34 daily rail car shipments" to support the onsite manufacturers, fabricators, and researchers.[123]

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[117] Finger et al., *supra* note 10, at 2.

[118] No. LSO 04-009 Mojave Air & Space Port, FAA Order No. LSO 04-009 (June 13, 2014).

[119] *America's First Inland Spaceport*, MOJAVE AIR & SPACE PORT, http://www.mojaveairport.com/history.html (Mar. 18, 2019).

[120] *Id.*

[121] Tariq Malik, *Virgin Galactic's SpaceShipTwo Aces 3rd Glide Test Flight*, SPACE.COM (Feb. 25, 2017), http://www.space.com/35834-virgin-galactic-spaceshiptwo-unity-3rd-glide-test.html.

[122] FAA Compendium 2018, *supra* note 73, at 28.

[123] *Id.*

ii. Oklahoma Spaceport – Gateway to Space

The Oklahoma Space Industry Development Authority (OSIDA) was created by the state of Oklahoma in 1999 with "the vision to create a commercial spaceport that will expand and economically develop the space frontier with advanced spacecraft operating facility and concentrations of specialized industry in Oklahoma."[124] One of its delineated missions was to "create a licensed commercial spaceport in southwest Oklahoma to include facilities necessary for space launch operation and associated industries in specialized space-related fields."[125] OSIDA was granted a launch site operator license in June 2006 "to support suborbital reusable launch vehicle missions [and] . . . to operate at Clinton-Sherman Industrial Airport,"[126] which conducts approximately 35,000 flight operations annually.[127] It is the only spaceport with an FAA-approved spaceflight corridor that is strictly assigned to the OSIDA and not in restricted airspace or Military Operation Areas, and it has one of the longest and widest runways in the US.[128] Rocketplane Global "had planned to operate a commercial spacecraft that would take travelers to space," from Oklahoma, but "failed to deliver" and went bankrupt in 2009.[129] Although the spaceport has yet to launch any orbital or suborbital flights, "Oklahoma lawmakers voted to give OSIDA $372,887 for 2015 operations costs."[130] It is estimated that the state has spent $30 million on the spaceport initiative.[131] In a further effort to attract aerospace business, the state has joined California, Colorado, Florida, New Mexico, Texas, and Virginia by passing space flight liability and immunity legislation

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[124] Okla. Space Indus. Dev. Auth., Business Development Plan FY 2015-2016 (July 9, 2015) at 4, *available at* http://airspaceportok.com/wp-content/uploads/2015/01/OSIDA-Business-Plan-FY15_16_UNCLASSIFIED.pdf.

[125] *Id.*

[126] Okla. Space Indus. Dev. Auth., FAA Order No. LSO 06-10 (June 12, 2006).

[127] FAA Compendium 2018, *supra* note 73, at 28.

[128] *More Investment Needed for Multi-Million Dollar Oklahoma Space Agency to Lift-off*, NEWS ON 6 (Nov. 12, 2012), http://www.newson6.com/story/20074343/state-invests-nearly-30-million-in-space-venture-more-money-needed-for-liftoff.

[129] Jennifer Palmer, *No Spaceships at Oklahoma's Spaceport, but they Are Welcome*, NEWSOK (Jan 17, 2010), http://newsok.com/article/3432669.

[130] FAA Compendium 2018, *supra* note 73, at 28.

[131] NEWS ON 6, *supra* note 128.

which confirms the binding legality of informed consent to spaceflight risks.[132] Today the spaceport largely supports itself with, among other things, a contract from the US Air Force,[133] but has yet to launch a vehicle.

iii. Spaceport America – The World's Invitation to Space

Spaceport America "is the world's first purpose-built, commercial spaceport."[134] The New Mexico Office of Space Commercialization introduced the project to the FAA in 1997 when the State optimistically predicted that the project "would enhance space-related economic development with the state."[135] Entirely financed by the taxpayers of New Mexico at a cost of $209 million,[136] the spaceport includes:

> a central control facility for administrative functions; an airfield capable of handling aircraft and launch vehicles that land horizontally; a maintenance and integration facility for payload-processing and space vehicles; a launch/landing complex with three launch/landing pads; a flight operations control center; and a cryogenic fuel plant to manufacture and store liquid hydrogen and liquid oxygen.[137]

Operated by the New Mexico Spaceport Authority, it received a launch site operator license authorizing it to "support suborbital launches"[138] in 2008. And in 2009, it entered into a Memorandum of Understanding with Spaceport Sweden to align as "Sister Spaceports."[139] Virgin Galactic, the anchor tenant, signed a twenty-year lease agreement[140] immediately after issuance of the license. Initial

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[132] *See* OKLA. STAT. tit 3, §§ 351-53 (2019).

[133] Jesse Pound, *The Space Wait Continues for Oklahoma Town*, NEWSOK (Aug. 1, 2016), http://newsok.com/article/5511901.

[134] FAA Compendium 2018, *supra* note 73, at 29-30.

[135] Southwest Regional Spaceport, NM, 62 Fed. Reg. 40,133, 40134 (July 25, 1997).

[136] *Id.*

[137] *Id.*

[138] N.M. Space Auth., FAA Order No. LSO 08-011A (Rev. 2) (Dec. 9, 2013).

[139] *Spaceport Sweden and Spaceport America Announce Sister Agreement*, SPACEPORT SWEDEN (Jan. 29, 2009), http://www.lsespace.com/?id=9504&cid=14260&Year=2009.

[140] Facilities Lease between Virgin Galactic, LLC and New Mexico Spaceport Authority, *available at* http://nmpolitics.net/index/wp-content/uploads/2017/08/Executed-VG-Lease.pdf (last visited May 7, 2018).

rent was $1 million per annum for the first five years and recently increased to about $3 million per annum, still just a fraction of the state's "nearly $220 million" investment.[141] The spaceport's first FAA licensed launch took place in October 2012. However, the delays in the development of suborbital launch providers like Virgin Galactic have left the Spaceport largely empty and inspired the New Mexico Spaceport Authority to explore alternative means of generating revenue."[142] Efforts included hiring a marketing firm to woo potential tenants and sponsors. At present, Spaceport America remains mostly vacant.[143] In early 2015, a disgruntled state senator introduced a bill to "advertise and promote the sale of Spaceport America to potential national and international buyers."[144] While the bill did not pass, state citizens remain unhappy with the spaceport, urging the state legislature to "unload the white elephant."[145]

This pessimism notwithstanding, Virgin Galactic's Richard Branson recently announced that the company would be moving all operations to Spaceport America by the end of the summer 2019.[146] SpaceX also hopes to use Spaceport America to launch, recover, and reuse Falcon 9 v1.1 boosters and has spent over two million dollars on "infrastructure improvements."[147]

iv. Cecil Field Spaceport

In 2010, after four years of feasibility and development studies, the FAA issued a license to Florida's Cecil Field Spaceport, a former naval air station, for "supporting suborbital reusable launch vehicle missions."[148] Owned and operated by the Jacksonville Aviation Authority, an independent state government agency, it is the

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[141] Andrew Oxford, *Spaceport Officials to Seek More Funding*, Santa Fe New Mexican (Sept. 1, 2017), https://www.lcsun-news.com/story/news/local/spaceport/2017/09/01/spaceport-officials-seek-more-funding/627237001/.

[142] FAA Compendium 2018 *supra* note 73, at 29.

[143] *Id.*

[144] S. 267, 52nd Leg., 1st Sess. (N.M. 2015) (introduced by George K. Munoz).

[145] Dowd Muska-Rio Grande Found., *'Spaceport America': 0 for 2016*, KRWG PUB. MEDIA (Jan. 6, 2017), http://krwg.org/post/spaceport-america-0-2016.

[146] Christian Davenport, *Virgin Galactic is Finally Moving to New Mexico's Spaceport America for Tourist Flights to Space*, WASH. POST (May 10, 2019), https://www.washingtonpost.com/technology/2019/05/10/virgin-galactic-is-finally-moving-new-mexicos-spaceport-america-tourist-flights-space/?utm_term=.f530c4e8f392.

[147] FAA Compendium 2018 *supra* note 73, at 29.

[148] Jacksonville Aviation Auth., FAA Order No. LSO 09-012 (Jan. 11, 2010).

only horizontal launch commercial spaceport on the East Coast. It is specially designed with a 12,500-foot-long runway, to launch and recover space vehicles that take off and land horizontally. The Authority explicitly seeks to become a hub for space tourism, noting that at least initially, "operations will be for your upper-end leisure traveler, the person who wants an exciting ride . . . [at] about $200,000 each."[149] The Authority even went so far to predict that a first launch could occur by 2011 – a prediction that did not come to fruition. At the time of this writing, Cecil Spaceport revealed that it is working with Generation Orbit and planning a commercial launch in late 2018 or early 2019.[150] Officially designated a "Space Territory" by the state, the Florida Department of Transportation now has legal authority to fund spaceport-related transportation facilities within Cecil to better accommodate horizontal launch space travel.[151]

v. Midland International Airport – The Sky is No Longer the Limit

A project promoted by the Midland Development Corporation, city-owned Midland International Air and Space Port, located in Texas, is the first primary commercial service airport to be licensed as a commercial launch site by the FAA. Its broad license permits all "U.S. government or FAA-licensed or permitted launches."[152] The air and space port, which is located on the same site as the original airport developed in 1927[153] currently has two tenants. XCOR Aerospace, which is moving its headquarters from Mojave Air and Space Port to Midland, and Orbital Outfitters, a company that specializes in space suits and space vehicle mockups.[154] Orbital Outfitters is constructing the Midland Altitude Chamber Complex,

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149 James Dean, *Florida Airport is Newest U.S. Spaceport*, SPACE.COM (Jan. 18, 2010), http://www.space.com/7789-florida-airport-newest-spaceport.html.

150 Melissa Ross, *First Launch at Jacksonville's Cecil Spaceport Could Come Before Year's End*, WJCT PUB. MEDIA (Feb. 14, 2018), http://news.wjct.org/post/first-launch-jacksonville-s-cecil-spaceport-could-come-year-s-end.

151 *Former Jacksonville, FL Master Jet Base Wins State Approval as 'Space Territory'*, AERO NEWS NETWORK (June 15, 2011), http://www.aero-news.net/index.cfm?do=main.textpost&id=aea6182b-598d-46e8-b69d-e8b1a7316875.

152 Midland Int'l Airport, FAA Order No. LSO 14-015 (Sept. 15, 2014).

153 FAA Compendium 2018, *supra* note 73, at 27-28.

154 *Id.*

a facility that will include three hypobaric chambers for scientific and human high-altitude testing and training.[155]

vi. Ellington Airport

The FAA issued a launch site operator license to the Houston Airport System in 2015 for "U.S. Government or FAA-licensed or permitted launches" from Ellington Airport.[156] Billing itself as "the world's first truly urban spaceport,"[157] the Houston Spaceport remains a work in progress. It is owned by the City of Houston and operated by the Houston Airport System (HAS). "Already, committed partners to the program include the Houston Airport System, NASA, the Greater Houston Partnership, The Sierra Nevada Corp., the City of Houston, Rice Space Institute, Texas A&M Aerospace Technology, University of Houston College of Architecture, Bay Area Houston Economic Partnership, U.K.-based Catapult Satellite Applications, and Intuitive Machines."[158] Sierra Nevada Corporation, in particular, won "a piece of a multibillion-dollar NASA contract, making it one of three companies charged with resupplying the International Space Station starting in 2019."[159] Sierra Nevada hopes to use Houston Spaceport to land its Dream Chaser space plane. A feasibility study estimated costs to properly outfit Ellington as a spaceport will require approximately $170 million.[160] In October 2015, the Houston City Council approved the $6.9 million purchase of a building, adjacent to the Ellington Airport, to be used as an incubator for early-stage space industry companies.[161] And in December 2016, Houston Spaceport signed a Memorandum of Understanding with Glasgow Prestwick Airport Spaceport "that will allow both parties to share best practice for commercial space

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155 *Id.*

156 Houston Airport Sys., FAA Order No. LSO 15-016 (June 26, 2015).

157 HOUSTON SPACEPORT, http://fly2houstonspaceport.com/ (last visited Mar. 18, 2019).

158 *Houston Spaceport Named 'Deal of the Year' by Houston Business Journal*, HOUSTON SPACEPORT (Jan. 22, 2016), http://fly2houstonspaceport.com/news/houston-spaceport-named-deal-of-the-year-by-houston-business-journal.

159 *Id.*

160 FAA Compendium 2018, *supra* note 73, at 26.

161 *Id.*

launch activities, operation, safety and environmental standards."[162]

vii. Colorado Air and Space Port

Adams County, Colorado received a license, in August 2018, to "operate certain portions of Front Range Airport as a launch site."[163] The newly monikered Colorado Air and Space Port hopes to operate a horizontal launch facility and a "hub" for suborbital transport[164] at the airport which is just eighteen minutes from Denver International Airport.[165] At least one company, British Reaction Engines, is already building a facility at the site to test its hypersonic engine technology.[166] However, there are no launches planned at this time.

viii. In the Wings

There are many more spaceports under consideration in the US. The projects below are in various stages of the licensing process with the FAA:

- World View Enterprises, Inc. is working with the County of Pima in Arizona to obtain a license to operate a launch site at what will be Spaceport Tucson.[167] If authorized, it "would be the closest to a commercial airport than any of the 10 current FAA-approved space launch sites." The project, which is being funded with $15 million in county bonds is being sued by the Goldwater Institute for "violating the Arizona constitution's

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[162] *Agreement Signed in Prestwick Spaceport Bid*, BBC NEWS (Dec. 6, 2016), http://www.bbc.com/news/uk-scotland-glasgow-west-38229169.

[163] Adams County, Colo., FAA Order No. LSO 18-107 (Aug. 17, 2018).

[164] Leonard David, *Proposed Colorado Spaceport Could be Suborbital Spaceflight Hub*, SPACE.COM (Oct. 20, 2012), http://www.livescience.com/24150-colorado-spaceport-suborbital-private-spaceflight.html.

[165] Spaceport Colo., *Technical Issues,* FRONT RANGE AIRPORT, *available at* http://www.ftg-airport.com/pdffiles/spaceport__oct_2015.pdf (last visited Mar. 18, 2019).

[166] Jeff Foust, *Colorado Airport Receives FAA Spaceport License*, SPACENEWS (Aug. 21, 2018), https://spacenews.com/colorado-airport-receives-faa-spaceport-license/.

[167] David Wichner, *Airport Board Mulls Plans for Spaceport Tucson*, TUCSON.COM (July 9, 2016), http://tucson.com/business/tucson/airport-board-mulls-plans-for-spaceport-tucson/article_88b32f6b-c62e-5c44-b3ea-0123dadfd6a2.html.

gift clause [which] bars state government entities from giving their 'credit in the aid of any company or corporation.'"[168]

- The FAA is currently preparing an environmental assessment for the state-proposed Hawaii Air and Space Port, which intends to use the existing runway at Kona International Airport for only horizontal launches.[169]

- Florida's Space Coast Regional Spaceport filed paperwork with the FAA in July 2012 to obtain a launch site operator license. The primary impetus for this effort was to lure Rocket Crafters Inc. and its $72 million investment in a 400,000-square-foot-facility to Titusville. Rocket Crafters, which has indeed moved to Titusville, hopes to transport passengers from Melbourne, Florida (close to Titusville) to Melbourne, Australia in two hours.[170]

- Brownsville, Texas will be the site of SpaceX's second exclusive use launch platform. The company broke ground on the site in October 2014 and has talked about launching both cargo and humans from the spaceport.[171]

- In Georgia, the Camden County Board of Commissioners is working to "create the premier spaceport" on the US East

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[168] Murphy Woodhouse, *Space Balloon Firm to Pay County Rent of About $1.2M Yearly for Facility*, TUCSON.COM (June 18, 2016), http://tucson.com/news/local/govt-and-politics/space-balloon-firm-to-pay-county-rent-of-about-m/article_808edc24-9b99-5ce9-b620-ee07472bc02d.html.

[169] HAW. AIR & SPACEPORT, http://hawaiiairandspaceport.com/project-information.html (last visited Mar. 18, 2019).

[170] *Rocket Crafters Planning New Spaceport in Titusville*, WFTV (July 10, 2012), http://www.wftv.com/news/local/rocket-crafters-planning-new-spaceport-titusville/287805912.

[171] Rick Jervis, *Texas Border Town to Become Next Cape Canaveral*, USA TODAY (Oct. 5, 2014), https://www.usatoday.com/story/money/business/2014/10/05/spacex-brownsville-spaceport/16584729/.

coast.[172] The FAA's environmental impact analysis was completed in January 2016,[173] and Vector Space Systems has indicated an interest in making Spaceport Camden its hub.[174]

Globally, commercial spaceports are in various stages of planning and development in Sweden,[175] Abu Dhabi,[176] Malaysia,[177] Italy,[178] Curacao,[179] Canada,[180] the Netherlands,[181] and the United Kingdom.[182] And Rocket Lab's Launch Complex 1, located on New Zealand's Mahia Peninsula was completed in September 2016.[183] Because Rocket Labs is a US entity, it must obtain a license from the FAA to operate this site. Currently, the Rocket Labs website

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[172] SPACEPORT CAMDEN, http://spaceportcamden.us/about.php (last visited Mar. 18, 2019).

[173] Dave Williams, *Spaceport Camden Bill Gains Passage in General Assembly*, ATLANTA BUS. CHRONICLE (Mar. 23, 2017), http://www.bizjournals.com/atlanta/news/2017/03/23/spaceport-camden-bill-gains-final-passage-in.html.

[174] Urvaksh Karkaria, *Georgia's Space Industry Gets Ready to Blast Off*, WABE (Apr. 14, 2017), http://news.wabe.org/post/georgias-space-industry-gets-ready-blast.

[175] *Spaceport Sweden Seeks to Become Europe's Gateway to Space*, SPACEPORT SWEDEN, http://www.spaceportsweden.com/ (last visited Mar. 18, 2019).

[176] Richard Branson had "vowed" to build a spaceport in Abu Dhabi by 2016. Frank Kane, *Branson Vows to Build Abu Dhabi Spaceport in Two Years*, THE NATIONAL (Feb. 10, 2014), http://www.thenational.ae/business/industry-insights/aviation/branson-vows-to-build-abu-dhabi-spaceport-in-two-years.

[177] SPACEPORT MALAYSIA, http://spaceportmalaysia.com/V3/ (last visited Mar. 18, 2019).

[178] Doug Messier, *Virgin Galactic, ALTEC Sign MOU to Study Italian Spaceport*, PARABOLIC ARC (Dec. 16, 2016), http://www.parabolicarc.com/2016/12/16/virgin-galactic-altec-sign-mou-study-italian-spaceport/.

[179] SPACEPORT CURAÇAO, http://www.spccuracao.com/the-space-advantage-series-an-introduction-to-spaceport-curacao/ (last visited Mar. 18, 2019).

[180] Marc Montgomery, *Update: Canada Chosen for a New Spaceport*, RADIO CAN. INT'L (Mar. 14, 2017), http://www.rcinet.ca/en/2017/03/14/updatecanada-chosen-for-new-spaceport/.

[181] *Schipol Gears Up for Space Travel*, THE STAT TRADE TIMES (Mar. 31, 2017), https://www.stattimes.com/index.php/schiphol-gears-up-for-space-travel-aviation

[182] James Vincent, *UK Selects Scottish Site for First Spaceport*, THE VERGE (July 16, 2018), https://www.theverge.com/2018/7/16/17575268/uk-spaceport-site-selected-scotland-sutherland-satellites.

[183] Calla Cofield, *Rocket Lab Opens Private Orbital Launch Site in New Zealand*, SPACE.COM (Sept. 26, 2016), http://www.space.com/34195-rocket-lab-opens-private-launch-site-new-zealand.html.

indicates that the site is "FAA compliant"[184] but no license authorization is indicated by the FAA.[185]

IV. IS THERE A RECIPE FOR SUCCESS?

Writing in 2010, Jeff Foust wondered if an "oversupply of spaceports" is a bad thing.[186] Foust answered his own question with a guarded "no," pointing out the benefits of competition and diversity.[187] He does, however, warn of "overselling" and overpromising the benefits a spaceport can provide to a community. Using the struggling Oklahoma Spaceport and Spaceport America as examples, Foust warns that return on what is sure to be significant investment may not be swift or complete. This is fair warning in any industry or new business. Nevertheless, it fails to take into account the transformative nature of commercial space transportation.

The fact is, we are in the midst of a space revolution. Certainly, the media focuses attention on the billionaires who promise to send wealthy passengers to orbit for what are exorbitant sums to most. What must be recognized is that space tourism is not a fad but a facilitator. The technologies that will catapult the financial elite beyond the atmosphere for minutes at a time are also the foundation for a revolution that will result in deep reductions in the cost to access space. The heavens will be open for use. And there are myriad ways in which to harness the resources of space. In addition to space tourism, the satellite launch market will continue to grow with payloads of both conventional and small satellites covering everything from remote sensing to navigation to telecommunications. Several companies are planning asteroid or Moon mining missions while others are contemplating the development of private

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[184] *Our Launch Sites*, ROCKET LAB, https://www.rocketlabusa.com/launch/launch-sites/ (last visited Mar. 18, 2019).

[185] In fact, search of the FAA website turns up no information about the licensing of Rocket Labs' New Zealand launch site which leaves open the question of how the agency would conduct an extra-territorial environmental assessment.

[186] Jeff Foust, *The Spaceport Glut*, THE SPACE REVIEW (Jan 18, 2010), http://www.thespacereview.com/article/1545/1.

[187] *Id.* "Having a wide range of spaceports to choose from can be beneficial to vehicle operators, who can use that competition to win concessions from spaceports and local governments to get their business. As the industry matures, having a large number of spaceports to choose from can also support vehicle operators, allowing them to get closer to potential customers and offer a wider range of services and experiences to them." *Id.*

space stations, manufacturing depots, and power generators. Indeed, United Launch Alliance "wants to operate a fleet of 'space trucks' that would ferry cargo and people between Earth and the moon to create a $3 trillion economy in space."[188] At the sub-orbital level, a most promising application is time efficient point-to-point travel, like the proposed Melbourne to Melbourne flight from Florida's Space Coast Regional Spaceport,[189] for cargo and human passengers. All of these activities must start at a spaceport. Thus, though there is risk involved, the growth potential is, literally, infinite.

A. Local Nurturing and Global Reach

While there is no conclusive recipe for success, the experience of the US's spaceport pioneers offer valuable guidance.

i. Government Support

All of the spaceports currently licensed or in the process of being licensed are the result of local development initiatives. This local support is key both in terms of obtaining financial incentives or tax breaks and with respect to creating the intermodal infrastructure needed to make the spaceport relevant. Local support can also be of a regional nature, just as Virginia and Maryland collaborate on MARS, one can imagine a multistate authority bringing a spaceport to New England.

ii. Purpose

Existing spaceport missions run the gamut from spaceport as destination, like Spaceport America, to specific purpose, like the proposed Florida Space Coast Regional Spaceport. At the development phase, the mission must be set out as specifically as possible. While use will largely be determined by geography, the proposed spaceport must determine, among other things, whether it will host ELVs as well horizontal launches, whether it will cater to human

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[188] *United Launch Alliance Chief Says He Wants to Develop a Fleet of "Space Trucks" to Ferry People Between Earth and Moon*, THE DENVER POST (April 7, 2017), http://www.denverpost.com/2017/04/07/united-launch-alliance-space-trucks/.

[189] *See supra* note 170.

passengers or cargo shipments and whether it will be a tourist destination or transport hub. Offering full services and varied launch opportunities will require considerable space, both for runway and launch platforms as well as necessary facilities for vehicle maintenance and payload processing. While destination spaceports can afford to be remote, they must still be accessible, so transportation infrastructure – like a railway or adequate roads – is a must. These spaceports will also require training facilities for space tourists, medical facilities and tourist attractions for Earth-bound curiosity seekers.

A transportation hub, like the proposed Colorado Spaceport and Houston Spaceport, will benefit most from being close to a conventional airport so cross-continent travelers can connect to their final destination with ease.

The proposed Hawaii Spaceport offers an interesting investment risk analysis as the islands seem to be counting on two factors for success: first, the ability to offer space tourism to buttress their existing tourism industry; and second, the ability to accommodate point-to-point suborbital travel, facilitating the voyages of people seeking to vacation in the Aloha State.

iii. Anchor Tenant

Given the experience of the Oklahoma Spaceport, it would be wise to work closely, from the beginning of the development of a project, with multiple anchor tenants. States can help promote such joint business ventures by, among other things, offering tax incentives and passing space liability immunity legislation to help promote the nascent industry.

iv. Global Ties

Finally, in anticipation of point-to-point travel, and also in order to facilitate technology sharing, proposed spaceports should develop relationships with non-US spaceports. US spaceports can offer much in terms of experience and also create synergies for sharing of services. Thus, for example, an ELV launch capable spaceport can partner with a horizontal launch spaceport and thus offer dual services to clients. Moreover, gaining an early partner can help as-

sure point-to-point service. Currently such relationships exist between Spaceport America and Spaceport Sweden and between Houston Spaceport and Glasgow Prestwick Airport Spaceport. Similarly, though not working through a joint venture, the Pacific Spaceport Complex is looking for a non-US site to complement its current orbital launch capabilities.

B. How Can the Government Help?

Thus far, the FAA has done an admirable job reviewing spaceport proposals. The regulations promulgated by the agency are clear and specific, and the pre-application consultation process an invaluable resource for project developers. However, it must be recognized that as point-to-point suborbital flight develops, more and more existing airports are going to seek spaceport status in order to take advantage of what will become an entirely common form of transportation. This is not to suggest that spaceports be treated like airports. Indeed, quite the opposite.

The temptation to equate spaceports with airports is nearly irresistible. The United States Congress has opined that "space transportation may evolve into airplane-style operations."[190] And Diane Howard draws upon the history and evolution of the airport system in proposing to adopt an international regime for spaceport regulation.[191] Perhaps not surprisingly, then, some scholars, notably Ram Jakhu and Yaw Nyampong recommend that spaceports be treated like airports and international regulation thereof be subsumed in the very successful International Civil Aviation Organization.[192] This is quite tempting, and, the need for harmonized international regulation of space transport is a necessary goal. However, we must recognize that space transport is fundamentally different from air transport. While much may be borrowed, the space industry requires and deserves to be viewed and regulated as its own creature, and not as a wild stepchild of air law.

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[190] Commercial Space Transportation Competitiveness Act of 2000, Pub. L. No. 106-405, § 2(3), 114 Stat. 1751 (2000).

[191] *See* Diane Howard, *Points of Connection: Relating ICAO Annex 14 to Spaceports*, 38 ANNALS AIR & SPACE L. 281 (2013).

[192] *See* Ram S. Jakhu & Yaw Otu M. Nyampong, *International Regulation of Emerging Modes of Space Transportation*, in ANGIE BUKLEY & WALTER PEETERS, "PRIVATE HUMAN ACCESS TO SPACE VOLUME 1: SUBORBITAL FLIGHTS (Amsterdam: Elsevier Ltd. 2010).

Putting aside the question of international regulation, which is beyond the scope of this paper, a domestic regulatory regime must build on its current success and continue to balance risk and innovation. In the US, this means that the government must recognize that the utilization of space is a unique endeavor that offers unique problems and issues – and tremendous earning potential. For this reason, the AST should be removed from the auspices of the FAA and be treated – and funded – as an independent agency. As Joshua Hampson notes, the

> FAA generally deals with the mature airline industry, and focuses on safety. Space transportation is not yet a mature industry, and so the government agency that manages has to strike a more delicate balance between public safety and industry growth and development. Unlike the rest of the FAA, the FAA AST has a legislative mandate to promote commercial space.[193]

i. The Comstock Amendment

And it seems the US Congress is at least part way there. In August 2018, the legislative branch of the US government passed the FAA Reauthorization Act of 2018. The Act, which was ultimately enacted in October 2018, includes an amendment ("Comstock Amendment"), sponsored by Representative Barbara Comstock, which among other things directs the FAA to establish an Office of Spaceports within the AST.[194]

ii. The Preamble

The preamble to the Comstock Amendment articulates a welcome recognition of the importance of commercial spaceports and the many benefits they provide. It is noted that "State government-owned and -operated spaceports have contributed hundreds of millions of dollars in infrastructure improvements to the national space launch infrastructure, providing the United States Government and commercial customers with world-class space launch and

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[193] Joshua Hampson, *The Future of Space Commercialization*, NISKANEN CTR. RESEARCH (Jan. 25, 2017), at 25.

[194] 51 U.S.C. § 51501(a) (2012).

processing infrastructure."[195] Indeed, it is further recognized that "State spaceports play a critical role in providing resiliency and redundancy in the national launch infrastructure to support national security and civil government capabilities, and should be recognized as a critical infrastructure in Federal strategy and planning."[196]

The amendment goes on to point out that there is "currently no Federal infrastructure investment program funding or encouraging State and local government investment in spaceport infrastructure."[197] This despite that fact that "all other modes of transportation, including aviation, highways, ports, and rail"[198] benefit from such federal programs. This is an incredible breakthrough for spaceports and for the development of a space economy in general. In the minds of Congress (or at least the staff tasked with transportation issues in the individual offices of the US Representatives), space transportation should be afforded the same support as other, more traditional, types of transportation. In short, the federal government has been directed by Congress to embrace space as a vital element in the US transportation network and encourage, support and, it seems, enhance investment strategies that will build the "multi-modal networks needed for robust space transportation that support national security, civil, and commercial launch customers."[199]

iii. Office of Spaceports

In working to sanctify this objective, the Comstock Amendment requires the establishment of an Office of Spaceports that will:

> (1) support licensing activities for operation of launch and reentry sites;
>
> (2) develop policies that promote infrastructure improvements at spaceports;

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[195] Comstock Amendment, *supra* note 6, at (a)(1).
[196] *Id.* at (a)(2).
[197] *Id.* at (a)(4).
[198] *Id.*
[199] *Id.* at (a)(5).

> (3) provide technical assistance and guidance to spaceports;
>
> (4) promote United States spaceports within the Department; and
>
> (5) strengthen the Nation's competitiveness in commercial space transportation infrastructure and increase resilience for the Federal Government and commercial customers. [200]

Moreover, it requires that the Secretary of Transportation to "recognize the unique needs and distinctions of spaceports that host (1) launches to or re-entries from orbit; and (2) are involved in sub-orbital launch activities."[201] also directs the Department of Transportation to submit a report to Congress that "proposes policies and programs designed to ensure a robust and resilient orbital and sub-orbital spaceport infrastructure to serve and capitalize on"[202] national security and civil space launch demands. The report is due one year from the enactment of the FAA Reauthorization Act.

C. Recommendations

The Comstock Amendment is an opportunity. An opportunity to create policies and guidelines that will promote the development of successful spaceport operations, while dissuading opportunistic gimmickry. It is also an opportunity for states and local governments to think seriously about whether their communities are appropriate venues for a spaceport. In determining how to create and maintain a properly balanced regulatory regime, the following considerations must be considered.

i. Private Enterprise

While most current air and spaceports are operated by state or local governments, the regulations must offer guidelines, opportunities, and incentives for private operations. Space infrastructure projects will best be enabled not just through federal/state partnerships, but also private/public partnerships.

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[200] 51 U.S.C § 51501(b (2012).
[201] *Id.* § 51501(c).
[202] *Id.*

ii. Environmental Streamline

The environmental tests and requirements are vital. Not only do they protect the community, but they can also generate neighborhood trust and support. The FAA must work with the Council on Environmental Quality to streamline the review process while maintaining both its integrity and its reliability. The agency should implement transparent ongoing requirements that will keep the community apprised of assessment reports and allow for updates based on the development of new technologies and safety measures.

iii. Coordinated Tax and Insurance Benefits

The federal government can subsidize local spaceports by offering federal tax breaks or credits and insurance benefits. The Director of the Office of Spaceport Operations should carefully assess the cost-benefit analysis of the credits and benefits offered to other transportation modes and seek to replicate the most successful. These benefits should work in parallel to any credits or subsidies given to commercial launch service providers, with the optimum benefits distributed to US launch service providers and payloads who utilize – preferably on a wholesale platform – US spaceports.

iv. Bilateral Agreements

One of the key forward-looking benefits of a spaceport is the potential for point-to-point travel. The Director of the Office of Spaceport Operations must assist the growth of the industry by working with the Department of State and reaching out to foreign States and non-US spaceports to promote bilateral agreements for future point-to-point suborbital travel. It is recommended, too, that the AST commence a rulemaking process that will address national security issues that may arise from joint venture agreements, anticipate the needs of point-to-point passengers in respect of customs and immigration. This type of outreach has the added benefit of starting to create a set of international standards to regulate spaceport standards. The FAA must be clear that US spaceports will not be permitted to operate flights to or from air and spaceports that do not meet the exacting standards of US regulations – including US environmental regulations. In this respect, too, the Director of the Office of Spaceport Operations will have to work closely with the

Department of Defense and intelligence organizations in order to create protocols that will streamline national security reviews.

v. Space Traffic Management

As the cost of launches continues to decline, the number of launches increases. The promulgation of efficient, reasonable and international space traffic management guidelines is a vital prerequisite to a sustainable space economy. The problem embraces a broad swath of distinct issues from sharing the skies with traditional air transport to the tracking of satellites on-orbit to the mitigation of orbital debris. The Office of Spaceport Operations will be uniquely posed to assist in management efforts as spaceport operators must also take responsibility for any items their facility helps to place in orbit. The new Director must coordinate with the Federal Communications Commission, the Department of Commerce and the Department of Defense to help implement and enforce regulations that will – hopefully – prevent a future on-orbit disaster.

vi. Independent Agency

These recommendations demonstrate the tremendous responsibility being placed on the FAA, its AST and its newly formed Office of Spaceport Operations. While Congressional recognition of the importance of spaceport infrastructure development is welcome, it is just a baby step in the right direction. Safe and sustainable access to space is a fundamental requirement for our human existence. Simply maintaining our status quo inarguably relies upon a continuing presence in low Earth orbit. Attempting to harness space resources, and achieving the utopian dream of moving heavy industry off Earth and into space, will require continued and increased access to orbit and beyond. Balancing safety, public health, environmental protection, national security concerns, diplomacy, and both air and space traffic is a responsibility that should not be spread across multiple departments and agencies. The AST must be treated and funded as an independent agency, and a precursor to a cabinet-level Department of Space.

V. CONCLUSION

When Green River City introduced its Intergalactic Spaceport in 1994, it straddled the line between science and science fiction. Today the idea of a spaceport, while *intra*galactic rather than *inter*-galactic, is not just science, it is reality. It is not a trend, it is the future. Naysayers and fiscal conservatives may argue that the proliferation of spaceports today is excessive, and can point to the Oklahoma Spaceport and Spaceport America as indications of failure. There are, however, many more stories of success. The commercial space industry is still in its infancy but evolving swiftly. And the US Congress has demonstrated its interest in providing federal support for spaceport development and maintenance. Communities that want to remain connected should think seriously about embracing the spaceport trend and take advantage of the newly-formed Office of Spaceport Operations to obtain guidance and advice. Spaceports are the foundation of our new space ecosystem. And, as President Reagan said, "[o]pportunities and jobs will multiply as we cross new thresholds of knowledge and reach deeper into the unknown."[203]

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[203] Reagan SOTU, *supra* note 17.

THE TIMES WE LIVE IN – REMOTE SENSING AND THE EVOLUTION OF THE NATIONAL SECURITY SEARCH EXCEPTION

Christian J. Robison[*]

ABSTRACT

The national security exception to the Fourth Amendment allows a warrantless search for the sake of national security if the primary purpose is to purely gather foreign intelligence. Though this exception has been exclusively applied in the context of wiretaps, current concerns regarding national security have many courts and legal scholars to deem national security a part of the special needs doctrine of the Fourth Amendment, and thus have allowed for other search methods within the national security context. The advancement of remote sensing technologies in outer space may also continue to broaden the scope of the national security exception in light of the special needs doctrine. Therefore, this Article will explore whether the advancement of remote sensing technologies and the changing societal norms regarding privacy and security may erode the foundations of the national security exception based upon the "pure intelligence rule" and push the national security exception to special needs. This Article will also discuss the implications of this potential shift in the development of the national security exception within the context of remote sensing.

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I. INTRODUCTION

In the United States, the topic of national security is subject to constant debate. Many times, the debate of national security has been contained within the context of foreign affairs, revolving around military spending or deployment. But in the days after the events of September 11th, the debate of national security has made a monumental shift towards the domestic sphere.[1] Headline after headline has discussed how American intelligence agencies and law enforcement have used a variety of methods to conduct warrantless searches and seizures in the name of national security, much to the chagrin of many Americans. For example, the Transportation Security Administration has gradually increased its use of more invasive screening methods at American airports[2] while the National Security Administration (NSA) has long been scrutinized for hacking into the devices of ordinary American citizens.[3] In short, the current debate involving national security in the domestic context is squarely centered upon the delicate balance between maintaining national security and protecting individual privacy.

At the same time, new and advanced technologies that could aid government agencies and law enforcement in the preservation of national security have become much more prevalent. In particular, government entities such as the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the Department of Defense have launched remote sensing satellites into outer space in order to

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[1] *See, e.g., Creation of the Department of Homeland Security*, HOMELAND SEC., https://www.dhs.gov/creation-department-homeland-security (last visited May 7, 2017) (noting the Department of Homeland Security was not created until after the events of September 11th).

[2] *See, e.g.*, Charisse Jones & Thomas Frank, *Backlash Grows Over Pat-Downs, Scanners*, USA TODAY, Nov. 18, 2010, at 1A (acknowledging that the general public has deemed such security measures to be unreasonable and a gross intrusion upon individual privacy); *see also* Elec. Privacy Info. Ctr. v. U.S. Dep't of Homeland Sec., 653 F.3d 1, 3-4 (D.C. Cir. 2011) (describing how airport scanners use "advanced imaging technology" to "produce a crude image of an unclothed person" in order to detect security threats).

[3] *See, e.g., In-house Newsletters by NSA Published from Snowden Leak*, CBS NEWS (May 17, 2016), http://www.cbsnews.com/news/in-house-newsletters-by-nsa-published-from-snowden-leak/ (describing various documents leaked by the infamous hack of the NSA conducted by former government contractor Edward Snowden). For more detail regarding the NSA's domestic surveillance program, see *NSA Surveillance Exposed*, CBS NEWS, http://www.cbsnews.com/feature/nsa-surveillance-exposed/ (last visited May 7, 2017).

carry out a variety of objectives.[4] Remote sensing in outer space is not a new phenomenon. In fact, the ability of satellites to sense the Earth's surface via aerial photography or radar from miles away in orbit has existed for quite some time.[5] However, the amount of remote sensing satellites in orbit and the various capabilities of such satellites have increased in an age of great technological progress.[6] Ultimately, the debate of national security at home coincides with rapidly progressing remote sensing technology and intersects at a crucial point within the context of Fourth Amendment jurisprudence.

The Fourth Amendment protects against unreasonable searches and seizures and thus often requires government entities to obtain a warrant before conducting a search. But, as almost any student or practitioner of the law would know, this foundational aspect of the Fourth Amendment is subject to a number of exceptions. One such exception not often discussed is known as the national security exception. This particular search in years past has essentially allowed Federal intelligence agencies to collect "foreign intelligence" at home and abroad for the preservation of national security. However, this exception has only been narrowly applied in the context of wiretaps used to detect foreign espionage.[7] And, because of the intrusive nature of wiretapping, the limited number of judicial opinions and executive correspondence regarding the exception have held that such a search is reasonable, and thus constitutional, as the search is premised on maintaining national security.[8] This basic principle of the national security exception is known to some legal scholars as "the pure intelligence rule."[9]

But as alluded to above, the nature, and maybe even the exact definition, of national security is rapidly changing in the face of shifting attitudes towards privacy and the emergence of new technology. Consequently, the national security exception has the potential to be unfettered by the constraints of the pure intelligence rule that only allows for the collection of foreign intelligence. That

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[4] *See infra* notes 23-27 and accompanying text.

[5] *See infra* notes 15-17 and accompanying text.

[6] *See infra* notes 23-27 and accompanying text.

[7] *See infra* Part I.C.1.

[8] *See id.*

[9] *See* L. Rush Atkinson, *The Fourth Amendment's National Security Exception: Its History and Limits*, 66 VAND. L. REV. 1343 (2013).

is, despite many complaints that the methods employed by the government to protect national security are unreasonable,[10] many members of the public have been willing to sacrifice privacy for the sake of security in light of recent events.[11] The judiciary has even responded in kind by classifying national security as a "special need" within the context of the Fourth Amendment.[12]

Under the special needs doctrine, a court will evaluate the constitutionality of a warrantless search by balancing a special government interest apart from ordinary criminal wrongdoing against the degree of intrusion upon individual privacy. The special needs doctrine has justified a variety of special government searches such as border searches and DUI checkpoints, and with the changing attitudes towards privacy, may later justify warrantless searches in the name of national security.[13] With that said, the advancement of less intrusive remote sensing technologies in outer space alongside changing attitudes towards privacy may broaden the scope of the national security exception. Or more simply, this phenomenon may "push" the national security exception away from the confines of the pure intelligence rule and to the special needs doctrine in which the scope and application of the national security exception could drastically change.

Therefore, this Article will explore whether the advancement of remote sensing technologies and the change of societal norms regarding privacy and security may erode the foundations of the national security exception based upon the pure intelligence rule and push the national security exception to the special needs theory. This Article will also discuss the implications of this potential shift in the development of the national security exception within the context of remote sensing.

Part I of this Article will describe the evolution and development of remote sensing technologies, recount essential Fourth Amendment jurisprudence, and relay the history and development

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[10] *See supra* notes 2-3 and accompanying text.

[11] *See infra* notes 142-43 and accompanying text.

[12] *See infra* Part I.C.2.

[13] City of Indianapolis v. Edmond, 531 U.S. 32 (2000) (justifying DUI checkpoints by holding that maintaining the safety of mass transportation mediums such as trains, airplanes and highways is a special governmental need); United States v. Montoya de Hernandez, 473 U.S. 531, 537 (1985) (justifying searches at the border by classifying border security as an administrative special need).

of the national security exception under both the pure intelligence rule and the special needs doctrine. Part II will then describe how the capabilities of remote sensing alongside changing societal norms towards privacy and national security may allow the national security exception to further depart from the basic constructs of the pure intelligence rule. Essentially, this Part will also demonstrate how the foundations of the national security exception under the pure intelligence rule would be weakened by the advent of remote sensing and changing norms towards national security and expectations of privacy. Such discussion will lead us to Part III in which we will analyze how the pure intelligence rule and the special needs doctrine would limit or expand the use of remote sensing technologies to conduct warrantless searches for the sake national security.

II. THE HISTORY AND DEVELOPMENT OF REMOTE SENSING, THE FOURTH AMENDMENT, AND THE NATIONAL SECURITY EXCEPTION

A. Remote Sensing

Remote sensing is defined as the "science of obtaining information about objects or areas from a distance, typically from aircraft or satellites."[14] The science of remote sensing began with the invention of the camera in the mid-19th century and continued to develop with the progression of flight.[15] Remote sensing by the way of orbiting satellites began with the testing of V-2 rockets that were acquired from Nazi Germany after the Second World War.[16] Though these rockets did not reach orbit, the rockets "contained automated still or movie cameras that took pictures as the [rocket] ascended."[17]

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[14] *What is Remote Sensing?* NAT'L OCEAN SERV., http://oceanservice.noaa.gov/facts/remotesensing.html (last visited May 7, 2017); *see also* Robert A. Schowengerdt, REMOTE SENSING: MODELS AND METHODS FOR IMAGE PROCESSING 2 (3d ed. 2007) (remote sensing is "an attempt to measure something from a distance, rather than in situ").

[15] *Remote Sensing – Introduction and History*, NASA EARTH OBSERVATORY, https://earthobservatory.nasa.gov/Features/RemoteSensing/ (last visited May 7, 2017) ("[T]he idea and practice of looking down at the Earth's surface emerged in the 1840s when pictures were taken from cameras secured to tethered balloon for purposes of topographic mapping.").

[16] *Id.*

[17] *Id.*

Since that time, remote sensing capabilities have spanned much beyond mere aerial photography. Remote sensing satellites in outer space are able to gain information actively[18] through the use of lidar, radar, and sonar.[19] These same satellites are also able to collect information passively[20] through thermal imaging, and of course, through high resolution aerial photography.[21]

Much of the American public is well aware of the benefits that remote sensing technology can provide from outer space. From weather forecasts and GPS assistance[22] contained on portable electronic devices, the American public indirectly interacts with remote sensing on a daily basis.[23] But what many may forget to realize that remote sensing technology has steadily improved from its inception and has become more advanced than ever before. For example, NOAA and NASA's joint GOES-R satellite uses a near-infrared optical transient detector to map lightning strikes all over world in real time, all while orbiting miles above the Earth's surface;[24] cameras used on remote sensing satellites have such clear resolution that many national governments have used satellite imagery to collect information on unclaimed luxury tax items such as swimming

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[18] Active remote sensors use their own energy (i.e. provide its own source of illumination) in order to sense an object on the Earth's surface. *See Passive vs. Active Sensing*, NAT. RESOURCES CAN., http://www.nrcan.gc.ca/node/14639 (last visited May 7, 2017).

[19] David Camacho, Guest Lecturer, Univ. of Miss. School of Law, Remote Sensing Principles for Space Law (Feb. 1, 2017) (presentation on file with author). Lidar is "high resolution scanning using ultraviolet, visible or near infrared lasers to measure physical features" of the object being sensed. *Id.* Radar or "radio detection and ranging" uses particular bands of the electromagnetic spectrum to sense an object. Different bands are used for "different conditions and applications." *Id.*

[20] "Passive instruments detect natural energy that is reflected or emitted from the observed scene. Passive instruments sense only radiation emitted by the object being viewed or reflected by the object from a source other than the instrument. Reflected sunlight is the most common external source of radiation sensed by passive instruments." *Remote Sensing – Remote Sensing Methods*, NASA EARTH OBSERVATORY, https://earthobservatory.nasa.gov/Features/RemoteSensing/remote_08.php (last visited May 7, 2017).

[21] *See* Camancho, *supra* note 19.

[22] GPS is not necessarily classified as a remote sensing technology, but it is nonetheless closely related to remote sensing and also has the potential to influence Fourth Amendment jurisprudence when it comes to changing technology. *See infra* notes 182-85 and accompanying text.

[23] *See 100 Earth Shattering Remote Sensing Applications & Uses*, GIS GEOGRAPHY, http://gisgeography.com/100-earth-remote-sensing-applications-uses/ (Jan. 21, 2017) [hereinafter GIS].

[24] *Geostationary Lightning Mapper*, GOES R, http://www.goes-r.gov/spacesegment/glm.html (last visited May 7, 2017).

pools[25] and to detect crop insurance fraud;[26] commercial companies have even used satellite imagery to count cars in parking lots in order to predict earnings, conversion rates, and market shares for auto dealers and manufacturers.[27]

In terms of national security, many know that remote sensing is vital to its preservation. Even has far back as the American Civil War, primitive cameras attached to hot air balloons were used to spy on the enemy, and in modern times, remote sensing technology in outer space has utilized infrared and other thermal imaging technology to detect enemy bunkers hidden deep underground in foreign lands.[28] In the domestic context of national security, remote sensing satellites have been used to detect matters pertaining to homeland security such as illegal migration and narcotic trade routes.[29] Such methods used by intelligence agencies and law enforcement alike have been much more invasive than just high resolution aerial photography. For instance, government entities have used infrared and other mechanisms to detect illegal drug production and smuggling.[30] Such technology allows one to peer into buildings, households, and even moving vehicles that might be involved in the production or transportation of such substances.[31] Again, the American public may be aware of the technologies used to protect national security or to simply detect ordinary criminal wrongdoing, but still may be unaware of exactly how far these technologies have advanced in prevalence and precision.[32]

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[25] GIS, *supra* note 23.

[26] *See id.*

[27] *Id.*

[28] Alex Vissotzky, *Military Applications of Remote Sensing*, http://remotesensing.montana.edu/documents/lres-426/Vissotzky.pdf.

[29] Alice B. Kelly & Nina Maggi Kelly, *Validating the Remotely Sensed Geography of Crime: A Review of Emerging Issues* (ISSN 2072-4292), *available at* http://www.mdpi.com/2072-4292/6/12/12723/htm (discussing the vast capabilities of remote sensing technology to detect and prevent dangerous crime along the United States border with Mexico).

[30] *See id.*; *see also infra* notes 177-81 and accompanying text (discussing the Supreme Court's decision in *Kyllo v. United States*).

[31] *See* Kelly & Kelly, *supra* note 29.

[32] In fact, it has often been a policy of the Federal government to *not* reveal the capabilities of remote sensing satellites, especially when it comes to matters of reconnaissance. *See* R. Cargill Hall, *The Evolution of U.S. National Security Space Policy and Its Legal Foundations in the 20th Century*, 33 J. SPACE L. 1, 21 (2007) ("The U.S. should not, at this time, publicly disclose the status, extent, effectiveness or operational character of

B. The Fourth Amendment

The Fourth Amendment is of central importance to the American legal system, though its exact interpretation is the subject of incessant debate. The Fourth Amendment reads:

> The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue, but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.[33]

In strict accordance with the words of the Fourth Amendment, the Supreme Court formerly held that a search was unreasonable, and therefore unconstitutional, if there was some sort of "physical invasion" of the person's home or person.[34] Later on, the Supreme Court developed a doctrine of "constitutionally protected places" that could not be searched without a warrant based upon probable cause.[35]

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its reconnaissance program." (quoting space policy directives of President John. F. Kennedy)).

[33] U.S. CONST. amend. IV.

[34] Essentially, before the last third of the twentieth century, the right to be free from searches and seizures without a warrant was of little importance in English or early American jurisprudence. *See* THOMAS K. CLANCY, THE FOURTH AMENDMENT: ITS HISTORY AND INTERPRETATION 27-31 (2008) (providing a brief overview of the development of the Fourth Amendment). However, with the rising tensions that came with the English Crown's treatment of the American colonies in the first half of the eighteenth century, the Framers of the Constitution became much more concerned about suspicionless searches and seizures. *See id.* at 31. Suspicionless searches and seizures were often conducted through British military officers via "writs of search" in order to enforce customs regulations for the purposes of taxation. *See id.* at 32. The primary effect of such practice led the Framers to prevent suspicionless searches in seizures within the context of property law rights. *See id.* at 51. This notion is squarely rooted in the Supreme Court's first case concerning the Fourth Amendment, *Boyd v. United States* in which the Court ultimately held that production of private papers without a warrant supported by probable cause was an unreasonable search and seizure. *See* 116 U.S. 616, 634-35 (1886).

[35] *See* Olmstead v. United States, 277 U.S. 438 (1928). In this case, a man was convicted for crimes relating to the illegal sale of liquor after law enforcement were able to record several of the defendant's phone conversations. *Id.* at 455-56. The recordings were obtained without a warrant. *Id.* The Court held:

The [Fourth Amendment does not forbid [the wiretapping that] was done here. There was no searching. There was no seizure. The evidence was secured by the use of the sense of hearing and that only. There was no entry of the houses or office of the defendants. By

However, the progressive and transformative Warren Court of the mid-20th century greatly modernized Fourth Amendment jurisprudence.[36] This great modernization, and the subsequent foundational principles of current Fourth Amendment interpretation, began with the seminal case of *Katz v. United States*.[37] The Court in *Katz* essentially dispensed the former doctrines centered upon physical invasions and protected places and focused upon individual privacy by determining whether a particular law enforcement activity constituted a search.[38] "A 'search' takes place when (i) a person's subjective expectation of privacy is invaded, as long as (ii) society is prepared to recognize that expectation as reasonable."[39] Consequently, if the action taken by the government constitutes a search, it is presumed unreasonable unless it is accompanied by a warrant based upon probable cause.[40]

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the invention of the telephone fifty years ago, and its application for the purpose of extending communications, one can talk with another at a far distant place.

Id. at 464-65. With this holding, the Court basically established that there be a physical invasion of the home or person in order for a warrant to be required.

[36] "The professors who write for the law reviews are convinced that the Warren Court has gone further than any before it in altering the rules of American law and revolutionizing the traditional system of checks and balances among the Court, the Congress and the President . . . . Some like the result and some deplore it - but all are agreed that the Warren Court is making history and will profoundly affect the future of the U.S., for better or for worse, at least for many years to come and possibly forever." Justin Driver, *The Constitutional Conservatism of the Warren Court*, 100 CALIF. L. REV. 1101, 1102 (2012) (quoting Ernest Havemann, *Storm Center of Justice*, LIFE, May 22, 1964, at 108, 110 (internal quotations omitted)).

[37] 389 U.S. 347 (1967). In *Katz*, the defendant was convicted for transmitting gambling information via a payphone in violation of Federal law after the government introduced evidence of the defendant's telephone conversations that were collected by FBI wiretapping. *Id.* at 348.

[38] In short, the Supreme Court found that an individual has a reasonable expectation of privacy in telephone conversations, and therefore, such conversations are constitutionally protected by the Fourth Amendment. *Id.* at 352. Ultimately, the Court held that the FBI agents had violated the Fourth Amendment by not obtaining a warrant based upon probable cause. *Id.* at 357 ("[S]earches conducted outside the judicial process, without prior approval by judge or magistrate, are *per se* unreasonable under the Fourth Amendment—subject only to a few specifically established and well delineated exceptions.")

[39] Katherine Stein, Comment, *Search and Seizure at Cruising Altitude: An Analysis of the Re-Born Federal Air Marshals and Fourth Amendment Complications in the Twenty-First Century*, 70 J. AIR L. & COM. 673, 685 (2005) (citing *Katz*, 389 U.S. at 361 (Harlan, J., concurring)).

[40] *See* Illinois v. Gates, 462 U.S. 213 (1983); Payton v. New York, 445 U.S. 573 (1980); Mincey v. Arizona, 437 U.S. 385, 393-94 (1978) ("Warrants are generally required to search a person's home or his person unless the exigencies of the situation make the

As time has passed, this basic principle of the Fourth Amendment has been eroded by subsequent cases that have come before the Supreme Court. Essentially, there are many times in which a government activity indeed constitutes a search, but yet is constitutional because, as espoused in *Katz*, the constitutionality of a search hinges upon *reasonableness*.[41]

In *Smith v. Maryland*,[42] the Supreme Court made clear that reasonableness was based upon a case-by-case consideration of subjective and objective expectations of privacy.[43] With this foundation, the Supreme Court has gone on to analyze individual cases and determine whether a search was reasonable in light of the attendant circumstances. From dog sniffs of an automobile[44] to searches of a garbage can,[45] the Court has analyzed reasonableness in order to determine whether there was a search and thus a need for a warrant.[46]

In this determination of reasonableness, the Court has carved out clear and concise exceptions to the warrant requirement. These exceptions must meet certain requirements in order to make such a search constitutional without a warrant. There are a variety of well-defined search exceptions with very specific requirements known by simple names such as the border search exception,[47] the

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needs of law enforcement so compelling that the warrantless search is objectively reasonable under the Fourth Amendment." (internal quotations omitted)). Technology has a great impact on what constitutes a search under the Fourth Amendment. *See infra* notes 177-86 and accompanying text.

41 *See supra* notes 33, 39 and accompanying text.

42 44 U.S. 735 (1979).

43 *See id.* at 740.

44 *See* Rodriguez v. United States, 135 S. Ct. 1609 (2015) (holding that a dog sniff of an automobile after a traffic stop was reasonable as the officer observed evidence of drug use).

45 California v. Greenwood, 486 U.S. 35 (1988) (holding that a warrantless search of a garbage can was reasonable).

46 The Court has of course analyzed reasonableness within the context of new technologies that may enhance the government's ability to conduct a search. This particular aspect of law surrounding the Fourth Amendment will be reserved for analysis later in this Article as remote sensing in relation to reasonableness is of central importance. *See infra* Part III.A.

47 *See* United States v. Montoya de Hernandez, 473 U.S. 531, 537 (1985); United States v. Ramsey, 431 U.S. 606, 616 (1977).

automobile exception,[48] the administrative search exception,[49] and of course, the national security exception, the subject of this Article.

C. The National Security Exception

Unlike other Fourth Amendment search exceptions, the development of the national security exception mainly occurred outside the courtroom. Because of this unique development, the national security exception does not necessarily fall within the confines of the traditional exclusionary rule.[50] But nonetheless, the national security exception is indeed recognized as a legitimate and "well-delineated"[51] Fourth Amendment search exception,[52] despite the fact that the exception is not so-well defined in concrete application.[53] As alluded to above, this is due to the fact that the traditional notion of the exception based upon what is known as the pure intelligence rule is subject to recent developments regarding the special needs doctrine. Therefore, we will explore the development of the national security exception and its basic constructs by first discussing the traditional national security exception based upon the pure intelligence rule. We will then discuss the special needs doctrine and how such doctrine has been applied to matters regarding national security.

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[48] *See* Pennsylvania v. Labron, 518 U.S. 938 (1996).

[49] *See* Camara v. Municipal Court, 387 U.S. 523 (1967).

[50] The purpose of many definitive search exceptions is to ensure that evidence that may have been collected without a warrant may still be admissible at trial. *See* Weeks v. United States, 232 U.S. 383 (1914) (establishing the exclusionary rule in which unlawfully obtained evidence is inadmissible at trial). The national security exception not only allows for the admission of evidence, but can also justify national security investigations in themselves.

[51] Katz v. United States, 389 U.S. 347, 357 (1967) (citing Carroll v. United States, 267 U.S. 132, 153, 156; McDonald v. United States, 335 U.S. 451, 454-456; Brinegar v. United States, 338 U.S. 160, 174-177; Cooper v. California, 386 U.S. 58; Warden v. Hayden, 387 U.S. 294, 298-300).

[52] *See* United States v. U.S. District Court (Keith), 407 U.S. 297 (1972).

[53] *See* Christian J. Robison, *Not Up In The Air: A Federal Air Marshal's Administrative Search Privileges in Flight,* 84 MISS. L.J. 1375, 1391 ("While this exception is generally broad, it has been applied narrowly, mainly in cases involving warrantless wiretapping. This narrow application has led the national security exception to be largely undeveloped and undefined in other spheres.").

i. National Security and the Pure Intelligence Rule

As somewhat mentioned above, maintaining national security is not just done through participating in armed conflict. Rather, the modern method of maintaining national security is centered upon complex networks of international diplomacy and intelligence.[54] The United States is well known for collecting intelligence abroad, but it also known for collecting intelligence within its own borders via certain agencies like the Federal Bureau of Investigations ("FBI") that have both intelligence-gathering and law enforcement responsibilities.[55] These domestic intelligence agencies conduct "national security investigations" in order to detect particular threats to national security including but not limited to, "(1) international terrorism, (2) espionage and other intelligence activities, sabotage, or assassination, conducted by, for, or on behalf of foreign powers, organizations, or persons, and (3) foreign computer intrusions."[56]

As one can infer from this short list of potential threats to national security, "[national] security investigations are not necessarily premised on suspicion of criminal activity"[57] because the main goal of many security operations is to prevent threats from coming to harmful fruition. This is very much unlike the world of criminal justice in which ordinary criminal investigations conducted by law enforcement are premised upon collecting evidence for the purpose of subsequent prosecution.[58] But despite the main goals of national security investigations and ordinary criminal investigations, domestic investigations for the sake of national security are subject to Fourth Amendment limitations due to the fact that many national security investigations are (1) coordinated by government entities that are involved in law enforcement, (2) use investigation methods that are commonly employed in ordinary

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[54] *See* Katherine J. Strandburg, *Freedom of Association in a Networked World: First Amendment Regulation of Relational Surveillance*, 49 B.C. L. REV. 741, 749-50 (2008).

[55] *About*, FBI, https://www.fbi.gov/about (last visited May 7, 2017).

[56] Atkinson, *supra* note 9, at 1348 (quoting U.S. Dep't of Justice, The Attorney General's Guidelines for Domestic FBI Operations 7 (2008) (internal quotations omitted)).

[57] *Id.* at 1351.

[58] *See id.* at 1349 ("Law enforcement's ultimate goal . . . is almost always prosecution").

criminal investigations, and (3) at times, reveal evidence of ordinary criminal wrongdoing.[59]

This relationship between investigation and national security has led the Federal government to inadvertently create a Fourth Amendment search exception in order to conduct efficient and effective national security investigations unhampered by warrant requirements. Beginning with the Second World War, the FBI was given intelligence responsibilities and began to "bug" rooms and households used by suspected enemy spies.[60] With this search technique, the FBI utilized small microphones planted in private rooms to listen and record conversations in hopes of collecting evidence of espionage.[61] Such a practice ran afoul of Supreme Court doctrine created through important cases such as *Olmstead v. United States*[62] and *Goldman v. United States*[63] as bugging constituted a physical invasion of a constitutionally protected place.[64]

Upper echelons of the FBI recognized this dilemma early on but nonetheless persisted in the use of warrantless investigative techniques.[65] But ironically, the FBI and other intelligence agencies recognized that some compromise needed to be had after realizing that much of its evidence collected through warrantless searches were not admissible in court, therefore allowing dangerous individuals that were considered to still be threats to national security to

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[59] *See infra* notes 60, 64, 74-75 and accompanying text.

[60] Atkinson, *supra* note 9, at 1359.

[61] See Dalia v. United States, 441 U.S. 238, 240 n.1 (1979) (providing a description of the bugging search technique).

[62] 277 U.S. 438 (1928) (holding wiretapping to be unconstitutional unless accompanied by a warrant).

[63] 316 U.S. 129 (1942) (holding the use of a bugging device planted in a private office constituted an invasion of a constitutionally protected area).

[64] *See* Atkinson, *supra* note 9, at 1361. ("Alexander Holtzoff, Special Assistant to the Attorney General, wrote to Hoover about physical searches, explaining that 'the secret taking or abstraction of papers or other property from the premises without force is equivalent to an illegal search and seizure . . . . Consequently, such papers or other articles are inadmissible as against a person whose rights have been violated.'" (quoting Memorandum from Alexander Holtzoff, Special Assistant to Att'y Gen., U.S. Dep't of Justice, for J. Edgar Hoover, Dir., FBI (July 4, 1944) (quoted in S. Rep. No. 94-755, at 366-67))).

[65] *See id.* at 1632.

avoid conviction.[66] This prompted the FBI to enter into persistent negotiations with officials from the Department of Justice.[67]

In prior discussions with Justice officials, particular individuals such as then-Attorney General Howard McGrath made clear that FBI practices were strictly forbidden by the Fourth Amendment.[68] But after years of discussion, the FBI was finally able to find an ally in the Justice department during the Eisenhower administration.[69] Then-Attorney General Herbert Brownell strongly believed that agencies like the FBI would be unduly compromised if a warrant was required to conduct a fully effective investigation.[70] Therefore, after much discussion between the Justice Department and the FBI, Brownell explicitly stated in a memorandum to J. Edgar Hoover, "The Department [of Justice] should adopt that interpretation which will permit microphone coverage by the FBI in a manner most conducive to our national interest . . . . Considerations of internal security and the national safety are paramount and, therefore, may compel the unrestricted use of this technique in the national interest."[71]

Ultimately, Brownell justified his approach by deeming "trespassory bugging constitutionally permissible so long as it remained for purely intelligence matters."[72] With this reasoning, the pure intelligence rule underlying the national security exception was born. The pure intelligence rule as first envisioned by Brownell was ratified by successive Presidential administrations insomuch that each President allowed warrantless bugging and wiretapping by the FBI and other similar agencies as long as the search was premised upon national security, a non-prosecutorial purpose.[73]

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[66] *See id.* at 1632-34 (discussing the "Amerasia" trials and the prosecution of Joseph Weingberg, a graduate student who had worked with J. Robert Oppenheimer on the Manhattan Project).

[67] *See id.* at 1364.

[68] *See id.* at 1366 ("McGrath concluded that trespassory bugging, even in national security matters, violated the Fourth Amendment.").

[69] *Id.* at 1367. Coincidentally, this is the same era that marked the beginnings of the American space program.

[70] *See id.* at 1367-68.

[71] Memorandum from Attorney Gen. Herbert Brownell for J. Edgar Hoover, Dir., FBI 1 (May 20, 1954) (copy on file with Atkinson, *supra* note 9.).

[72] Atkinson, *supra* note 9, at 1369.

[73] *See id.* at 1371-74.

However, the national security exception under the pure intelligence rule did not gain judicial acknowledgement until former Solicitor General Thurgood Marshall composed supplemental government briefs in *Black v. United States*[74] and *Schipani v. United States*.[75] Though these cases did not involve issues of national security, these cases did involve warrantless wiretapping conducted by the FBI.[76] Within these supplemental briefs, Marshall clearly stated that "governmental practice . . . prohibits such electronic surveillance in all instances except those involving the collection of intelligence with respect to matters affecting national security."[77]

This clearer assertion of the pure intelligence rule found some support in the all-so-important *Katz* case via a footnote composed by Justice White who had pushed for a national security exception in other cases.[78] This footnote allowed the *Katz* Court to "expressly reserve[] the question of 'whether safeguards other than prior authorization by a magistrate would satisfy the Fourth Amendment in a situation involving the national security,'" despite the fact that the Court found that warrantless wiretapping was indeed unreasonable.[79] With the Court's small blessing in *Katz*, the FBI began to resume warrantless wiretapping and eventually found official approval in the Fifth Circuit in *United States v. Clay*[80] and later on in the D.C. Circuit in *United States v. Hoffman*.[81]

In both these cases, certain phone conversations collected by the way of warrantless wiretapping were admitted into evidence

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[74] 385 U.S. 26 (1966) (involving warrantless wiretap of individual suspected of tax evasion).

[75] 385 U.S. 372 (1966) (involving warrantless wiretap of individual suspected of tax evasion).

[76] *See supra* notes 74-75 and accompanying text.

[77] Supplemental Memorandum for the United States at 4, Schipani v. United States, 385 U.S. 372 (1966).

[78] *See* Berger v. New York, 388 U.S. 41 (1967) (case involving device used to record individual suspected of bribing state officials). In his dissent, Justice White argued that the Court's decision left no room for a "national security exemption" to the Fourth Amendment's warrant requirement. *Id.* at 115 (White, J., dissenting).

[79] Katz v. United States, 389 U.S. 347, 358 n.23 (1967).

[80] 430 F.2d 165, 170-71 (5th Cir. 1970). This case is of special notoriety as it was the prosecution of Muhammad Ali for refusing to enlist for the draft during the Vietnam War.

[81] 334 F. Supp. 504, 508 (D.D.C. 1971).

based upon the fact that the searches were conducted for the purposes of national security.[82] Essentially, the judges in both cases relied upon the opinion of Justice White in *Katz* by holding that evidence collected *on the premise* of national security derived from a reasonable search.[83]

The long history of the development of the national security exception based on the pure intelligence rule came to a critical point in *United States v. United States District Court*, commonly known as the *Keith* case.[84] In this case, three members of the White Panther Party were arrested for the bombing of a CIA office, and during discovery before trial, the Government conducted warrantless wiretaps of the defendants.[85] The government admitted that much of its evidence was collected from these recorded conversations, but blatantly argued that such evidence should be admissible under the national security search exception to the Fourth Amendment, signaling a clear departure from the pure intelligence paradigm.[86]

Recognizing that evidence discovered under the national security exception had been deemed admissible in prior cases, the Supreme Court chose to solidify the pure intelligence rule by holding that a "domestic security interest" is not covered by the national security exception.[87] Therefore, the national security exception was limited to warrantless surveillance for the purpose of gathering *foreign* intelligence or essentially, "security cases . . . where foreign powers were involved."[88] In short, the *Keith* Court greatly limited the national security exception to a pure *foreign* intelligence rule. The new limitation on the national security exception as espoused

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[82] *Hoffman*, 334 F. Supp. at 505; *Clay,* 430 F.2d at 166.

[83] *See Hoffman*, 334 F. Supp. at 507; *Clay,* 430 F.2d at 171. The judges in these cases did opine for a national security exception per se, but still nonetheless held that the searches conducted did not fall in line with such an exception.

[84] 407 U.S. 297 (1972).

[85] *Id.* at 299. The White Panther Party was a group of white individuals who desired to aid the cause of the Black Panther Party. *See* Kaya Burgess, *Obama's Inauguration Hailed by White Panther Founder John Sinclair*, THE TIMES (U.K.) (Jan. 21, 2009), https://www.thetimes.co.uk/article/obamas-inauguration-hailed-by-white-panther-founder-john-sinclair-rvkg3pjk5l9.

[86] *See id.* at 301.

[87] *See id.* at 321-22.

[88] *Id.*

in *Keith* was upheld by subsequent lower court decisions such as *United States v. Buck*[89] and *United States v. Butenko*.[90]

But in reaction to the *Keith* case, Congress decided to pass the all-important Foreign Intelligence Surveillance Act of 1978 ("FISA").[91] In essence, this particular piece of legislation encompasses the national security exception within the parameters of the pure intelligence rule by allowing electronic surveillance[92] of one that is suspected of being a foreign power or one of its agents.[93] However, there are some very important caveats to the underlying foundations of FISA.

First and foremost, there are really two types of national security investigations under FISA. The unamended, first iteration of FISA allows electronic surveillance of a suspected foreign power or agent via an "intelligence warrant" supported by probable cause[94] which is provided by a special court known as the Foreign Intelligence Surveillance Court.[95] By conducting a search with a warrant, Congress is able to allow evidence collected from such national security investigations to be used in subsequent criminal trials.[96] This important premise of FISA has of course been subject to extensive litigation.[97]

The second type of surveillance allows for certain types of *warrantless* searches of non-U.S. individuals located overseas.[98] This particular surveillance was allowed by the FISA Amendments Act of 2008 and has become widely known as "FISA Section 702."[99] This

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[89] 548 F.2d 871 (9th Cir. 1977).

[90] 494 F.2d 593 (3d Cir. 1974).

[91] 50 U.S.C. § 1801 *et seq.* (2012).

[92] See *id.* at § 1801(f) for an exact definition of what constitutes *electronic* surveillance under FISA.

[93] *See id.* at § 1802.

[94] *Id.* at § 1804.

[95] *Id.*

[96] *Id.* at § 1806(c).

[97] *See* Atkinson, *supra* note 9, at 1398 (citing United States v. Duka, 671 F.3d 329, 337 (3d Cir. 2011); United States v. El-Mezain, 664 F.3d 467, 563 (5th Cir. 2011); United States v. Abu-Jihad, 630 F.3d 102, 117 (2d Cir. 2010) (listing Fourth Amendment challenges); United States v. Stewart, 590 F.3d 93, 99 (2d Cir. 2009); United States v. Campa, 529 F.3d 980, 993 (11th Cir. 2008); United States v. Hammoud, 381 F.3d 316, 331 (4th Cir. 2004); United States v. Miller, 984 F.2d 1028, 1032 (9th Cir. 1993); United States v. Sarkissian, 841 F.2d 959, 964 (9th Cir. 1988); United States v. Badia, 827 F.2d 1458, 1462 (11th Cir. 1987)).

[98] 50 U.S.C. § 1881a (2012).

[99] Pub. L. No. 110-261 § 101, 122 Stat. 2436, 2437 (adding Section 702 to FISA).

section may ensure that U.S. citizens are not targeted by certain national security investigations, but it does not ensure the standard of probable cause.[100] Rather, Section 702 only requires a reasonable belief that the suspected individual is a non-U.S. person located outside the United States and the surveillance has a foreign intelligence purpose.[101]

Regardless of the level of suspicion required of national security investigations under FISA, the legislation in itself stays true to the foundations of the pure intelligence rule. But as briefly mentioned, FISA has been amended several times since 1978, most notably by the PATRIOT Act of 2001.[102] As we will discover later on, changes to FISA pose significant implications for the continued evolution of the national security exception.[103]

ii. National Security and the Special Needs Doctrine

Since the *Keith* case and the passage of FISA, the national security exception has been contained within the "foreign powers" parameters of the pure intelligence rule.[104] That is, as repeated several times over, a search conducted under the national security exception must be clearly based upon the collection of foreign intelligence and not premised on ordinary, domestic criminal wrongdoing.[105] However, some scholars,[106] and some judicial opinions,[107] have attempted to place national security as subcategory of what is known as special needs.

The special needs doctrine was first introduced in *New Jersey v. TLO* in which a high school student was subjected to a warrantless search by school administrators.[108] The Supreme Court held

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[100] § 1881a.

[101] *See id.*

[102] Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act (US PATRIOT Act), Pub. L. No. 107-56, 115 Stat. 272 [hereinafter PATRIOT Act].

[103] *See infra* notes 192-96 and accompanying text.

[104] *See* Atkinson, *supra* note 9, at 1389.

[105] *See supra* Part I.C.1.

[106] *See, e.g.,* Ronald M. Gould & Simon Stern, *Catastrophic Threats and the Fourth Amendment*, 77 S. CAL. L. REV. 777 (2004) (arguing that national security fits within the special needs paradigm).

[107] *See infra* notes 119-26 and accompanying text.

[108] New Jersey v. *TLO*, 469 U.S. 325 (1985).

that the search was constitutional when it was "supported by reasonable suspicion" that it would yield "evidence of an infraction of school disciplinary rules or a violation of the law."[109] In holding that probable cause was not required, the Court reasoned that "the *special needs* of the school environment require assessment of searches against a standard less exacting than probable cause."[110] This particular rationale allowed the Court to assess the search based upon reasonableness per the Fourth Amendment.[111] In this instance, the Court found that determining reasonableness in the absence of a warrant required "balancing the [special] need of the search against the invasion which the search entails."[112] Justice Blackmun in his concurrence expanded the Court's reasoning beyond the school context by explaining that "only in those exceptional circumstances in which special needs, beyond the normal need for law enforcement, make the warrant and probable-cause requirement impracticable, is a court entitled to substitute its balancing of interest for that of the Framers."[113]

Justice Blackmun's concurrence has been the basis to justify a number of searches based upon special needs including, but not limited to, drug tests of student athletes[114] and government employees,[115] searches of probationers' homes,[116] and DUI checkpoints.[117] In sum, the special needs doctrine as solidified by several cases all involving different government interests allows a warrantless search if there is special need beyond the needs of law enforcement and the search is reasonable when balancing the government interest in furthering a special need against expectations of privacy.[118]

The national security exception has gained recognition as a special need in several lower court decisions. For prime example, in

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[109] *Id.* at 332 n.2.

[110] *Id.*

[111] *See id.* at 341.

[112] *Id.* at 337 (quoting Camara v. Municipal Court of S.F., 387 U.S. 523, 536-37 (1967) (establishing the foundations of the administrative search exception) (emphasis added)).

[113] *Id.* at 351 (Blackmun, J., concurring).

[114] *See* Vernonia Sch. Dist. 47J v. Acton, 515 U.S. 646 (1995)

[115] *See* Nat'l Treasury Emps. Union v. Von Raab, 489 U.S. 656 (1989); O'Connor v. Ortega, 480 U.S. 709 (1987).

[116] *See* United States v. Knights, 534 U.S. 112 (2001); Griffin v. Wisconsin, 483 U.S. 868 (1987).

[117] *See supra* note 13.

[118] *See supra* notes 110-13 and accompanying text.

MacWade v. Kelly, the plaintiffs in the case challenged New York City's practice of inspecting containers for explosives before individuals could board trains at particular subway stations.[119] Though the City initiated this practice in reaction to train bombings in Madrid, Moscow, and London,[120] the plaintiffs nonetheless asserted that such a practice was unduly intrusive and therefore unconstitutional.[121] However, the court plainly held that preventing terrorist attacks on board mass transit "constitutes a special need that is distinct from ordinary post hoc criminal investigation."[122] The court justified this reasoning and allowed the special needs doctrine to encompass the broader category of national security by citing other cases where similar searches have been upheld for the same reasons.[123]

Consequently, the court found that "on balance," the City's container program was permissible.[124] The court determined that the need to prevent danger on the City's transit system was "immediate and substantial," passengers had a full expectation of privacy in their containers, the search was minimally intrusive, and the program was reasonably effective.[125] With such reasoning, the court ultimately found that the City's program was indeed constitutional.[126]

iii. Comparing Pure Intelligence and Special Needs

All things considered, it is necessary for us to briefly analyze the connection and the disconnection between the national security exception under the pure intelligence rule and the justification of searches based upon classifying national security as a special need. Under both theories of the national security exception, the search in itself is premised upon the preservation of national security and

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[119] MacWade v. Kelly, 460 F.3d 260 (2d Cir. 2006).

[120] *See id.* at 264.

[121] *See id.* at 263.

[122] *Id.* at 271.

[123] *See id.* ("Accordingly, preventing a terrorist from bombing the subways constitutes a special need that is distinct from ordinary post hoc criminal investigation." (citing United States v. Hartwell, 436 F.3d 174, 179 (3d Cir. 2006) (holding that preventing terrorist activity on airplanes is a special need beyond criminal wrongdoing)).

[124] *See id.* at 271-75.

[125] *See id.*

[126] *See id.* at 275.

not upon ordinary criminal wrongdoing. Though it is quite possible that evidence may be admitted regardless of the search's original intention,[127] it is undisputed that searches conducted in the name of national security are not based upon the need for prosecution unlike other Fourth Amendment search exceptions.[128] In sum, the pure intelligence rule and the special needs doctrine share the same foundation insomuch the search is based upon public safety and security.[129]

But as alluded to above, the main difference between the competing theories of searches justified upon the need of maintaining national security is clearly based upon scope and application.[130] The long history of the pure intelligence rule demonstrates that the national security exception in this respect is considered reasonable as it is extremely narrow. It has been only applied to wiretaps and it is deemed reasonable *only* when it is used to collect *foreign* intelligence.[131]

The special needs theory of the national security exception may at first glance seem just as narrow in scope and application as the search itself is premised upon the need to maintain national security and not upon detecting ordinary criminal wrongdoing. Therefore, it would appear that the degree of invasion upon privacy is a moot point.[132] But a key limitation of the national security exception under the pure intelligence rule is that there is *no domestic security interest*.[133] However, by placing the national security exception under the guise of special needs, domestic security interests would presumably be considered as seen in cases like *MacWade*.[134] This in turn would allow the degree of invasion upon privacy, or

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[127] *See supra* notes 80-83 and accompanying text.

[128] *See supra* notes 57-58 and accompanying text.

[129] *See* Chandler v. Miller, 520 U.S. 305 (1997). This case determined that suspicionless drug tests of candidates running for public office in Georgia was unconstitutional as there was no special need to be maintained. In its final holding, the Supreme Court stated, "that where the risk to public safety is substantial and real, blanket suspicionless searches calibrated to the risk may rank as 'reasonable' . . . .". *Id.* (citing Nat'l Treasury Emps. Union v. Von Raab, 489 U.S. 656, 674-76).

[130] *See supra* Part I.C.1-2.

[131] *See supra* Part I.C.1.

[132] *See supra* notes 113, 125 and accompanying text.

[133] *See supra* notes 87-88 and accompanying text.

[134] *See supra* notes 119-26 and accompanying text.

reasonable expectations of privacy, to be considered and weighed against the government's interest in national security.[135]

The advancement of remote sensing in outer space and changing expectations of privacy have the potential to shift the national security exception away from the foundations of the pure intelligence rule and its traditional application, and more importantly, categorize national security as a special need. As will be demonstrated in the remainder of this Article, the advancement of remote sensing technologies and changing expectations of privacy have monumental implications for the future development of the national security exception.

III. CHANGING THE COURSE OF THE NATIONAL SECURITY EXCEPTION

To this point, we have recounted the current capabilities of remote sensing technology and basic Fourth Amendment jurisprudence, but more importantly, we have extensively discussed the development and current standing of national security investigations under both the pure intelligence rule and special needs paradigms. This Part will therefore demonstrate how the advancement of remote sensing when viewed alongside changing expectations of privacy and national security, endorsed by both society and the judiciary, have the potential to shift the national security exception away from the pure intelligence rule and to the special needs doctrine.

A. Allowing for a Domestic Security Interest

Neither the advancement of remote sensing technologies nor changing expectations of privacy in regards to national security is sufficient by themselves to push the national security exception away from the pure intelligence rule. Each particular phenomenon contributes to the national security exception's shift to the special needs doctrine. This is first demonstrated by the pure intelligence rule's most profound limitation - the requirement that the intelligence collected involve foreign powers or entities.[136] However, the changing order of world affairs and what constitutes a matter of national security has dramatically changed in the United States

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[135] *See* MacWade v. Kelly, 460 F.3d 260, 272-73 (2d Cir. 2006).

[136] *See supra* notes 87-88 and accompanying text.

since the days of September 11th. Unlike the period of the Cold War in which the FBI was apt on detecting Soviet agents or their collaborators, the twenty-first century has brought about new and unique challenges to the American security structure. [137]

A particular challenge that has direct implications for the "foreign" limitation is the increased potential for domestic terrorism on American soil. Again, the initial beginnings of the national security exception were mainly based upon the norms of the Cold War and more specifically, the fear of communist espionage.[138] With this context in mind, it is easy to see why the Supreme Court in *Keith* was unable to recognize a "domestic security interest" as the defendants committed a crime premised on their beliefs regarding American civil rights and not on a particular foreign ideology, much less an ideology associated with foreign powers.[139]

In that respect, numerous decisions from the Supreme Court demonstrate that "common sense" and general knowledge are taken into account when deciding matters critical to the Fourth Amendment.[140] In fact, this is a central tenet in determining reasonableness.[141] But such knowledge is not just reserved for determinations of privacy, but also for what constitutes a national security interest in the context of the Fourth Amendment.

To that end, it is with little question that homeland security has taken precedence in the minds of many Americans. A number of recent events have made American society mindful of potential threats to a large number of people that do not involve foreign powers or their agents. Aside from the tragedy of September 11th, the United States has suffered several large-scale domestic events such as mass shootings committed by American citizens that allegedly stemmed from motives associated with radical Islam.[142] Moreover,

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[137] *See, e.g.,* Alderman v. United States, 394 U.S. 165 (1969) (case regarding the prosecution of two suspected Soviet spies that were convicted after the admission of evidence collected by warrantless wiretaps conducted by the FBI).

[138] *See supra* notes 60-66 and accompanying text.

[139] *See supra* note 85 and accompanying text.

[140] *See* Peter Goldberger, *Consent, Expectations of Privacy, and the Meaning of Searches in the Fourth Amendment*, 75 J. CRIM. L. & CRIMINOLOGY 319, 333 (1984).

[141] CLANCY, *supra* note 34, at 466-68 (describing the complexity and importance of "reasonableness" contained within the Fourth Amendment).

[142] For example, in late 2015, two Muslim individuals fired upon an office holiday party killing fourteen and wounding twenty-two individuals. Investigators believed that such a crime was motivated by Islamic terrorism. *See Everything We Know About the*

the United States has also seen its allies in Europe like the United Kingdom and France suffer from similar incidents that many have blamed on the migrant crisis derived from the most recent wars engulfing the Middle East.[143] Regardless of whether such events were the result of a political motive or ordinary criminal intent, these occurrences have only fueled the debate surrounding domestic national security, and more importantly, have led to judicial reaction.

The *MacWade* example as cited above is a perfect example of how the judiciary has incorporated real world events into its decision making. As noted above, the subway search program implemented in New York City was directly correlated to the bombings of subways in Moscow, London, and Madrid.[144] Such events allowed the *MacWade* court to quickly reason that the New York subway search program was a measure implemented to protect national security, even though the search program did not necessarily involve foreign powers or agents.[145] Rather, it can be said that the court in *MacWade* based national security upon protecting public safety.[146] The need for public safety has indeed justified searches under the special needs doctrine,[147] and the court in *MacWade* was able to set a trend of sorts that allowed national security to become a *domestic* issue.

On that note, other courts have held that matters of national security fall squarely within the special needs framework even though these matters of national security do not necessarily involve

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San Bernardino Terror Attack Investigation So Far, LA TIMES (Dec. 14, 2015), http://www.latimes.com/local/california/la-me-san-bernardino-shooting-terror-investigation-htmlstory.html.

[143] In the spring of 2017, a Muslim British citizen mowed down dozens of civilians with a car on Westminster Bridge. The attack killed four pedestrians and injured fifty others. *See* Emily Allen & Barney Henderson, *Everything We Know So Far About the Events in London,* THE TELEGRAPH (Mar. 26, 2017), http://www.telegraph.co.uk/news/2017/03/22/westminster-terror-attack-everything-know-far/. In the summer of 2016, a Tunisian man drove through a large crowd gathered for Bastille Day celebrations in Nice, France. The attack left 86 people dead and several hundreds more injured. *See Nice Attack: What We Know About the Bastille Day Killings*, BBC (Aug. 19, 2016), http://www.bbc.com/news/world-europe-36801671.

[144] *See* MacWade v. Kelly, 460 F.3d 260, 264 (2d Cir. N.Y. 2006).

[145] *See id.* at 275.

[146] *See id.* at 272 (noting that the potential attack on board a subway train is a "risk to public safety [that] is substantial and real").

[147] *See, e.g.,* Chandler v. Miller, 520 U.S. 305, 322 (1997) (holding that blanket, suspicionless searches can be upheld as reasonable when "the risk to public safety is substantial and real").

foreign powers or agents. In fact, the *MacWade* court justified the New York City subway search program based upon several lower court decisions that justified airport screenings on the basis of special needs.[148] For example, the Third Circuit in *United States v. Hartwell*[149] clearly held that preventing terrorist attacks on board domestic aircraft is of "paramount importance."[150] The *Hartwell* court cited a vast number of cases in other Circuit courts that held that preventing terrorist attacks on board aircraft was a special need beyond the needs of law enforcement and that airport screenings, on balance, are reasonable in light of the attendant circumstances.[151]

Now at this point, we are not necessarily concerned about reasonableness of a national security investigation under the guise of special needs.[152] But nonetheless, cases like *MacWade* and *Hartwell*, along with the creation of various agencies (namely the Department of Homeland Security),[153] demonstrate that national security can now be seen within a domestic context in the eyes of the judiciary. This new perspective on national security in the lens of the Fourth Amendment is a clear departure from the *foreign* aspect of the pure intelligence rule. But more importantly, with such a departure comes a different analysis, hence a shift to special needs. But again, changing norms and expectations are not enough to push the national security exception away from the parameters of the pure intelligence rule. As will be demonstrated, remote sensing also contributes to such a monumental shift in Fourth Amendment jurisprudence.

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148 *See MacWade,* 460 F.3d at 270-71.

149 436 F.3d 174 (3d Cir. 2006).

150 *See id.* at 179.

151 *See id.* (citing United States v. Marquez, 410 F.3d 612, 618 (9th Cir. 2005) ("the potential damage and destruction from air terrorism is horrifically enormous"); United States v. Yang, 286 F.3d 940, 944 n.1 (7th Cir. 2002) ("the events of September 11, 2001, only emphasize the heightened need to conduct searches at this nation's international airports"); Singleton v. Commissioner, 606 F.2d 50, 52 (3d Cir. 1979) ("The government unquestionably has the most compelling reasons[—]the safety of hundreds of lives and millions of dollars [sic] worth of private property . . . for subjecting airline passengers to a search for weapons or explosives that could be used to hijack an airplane.")).

152 *See infra* Part III.A.

153 *See supra* note 1.

B. From Wiretapping to Remote Sensing

The national security exception was created in the very narrow context of wiretapping and has yet to be applied outside of this context.[154] As illustrated in earlier Fourth Amendment cases such as *Katz*, *Olmstead*, and *Goldman*, such investigative techniques are per se unreasonable and thus unconstitutional regardless of whether the practice trespasses upon a constitutionally protected place or intrudes upon reasonable expectations of privacy.[155] The Justice Department in the earliest days of FBI warrantless wiretapping held fast to this opinion even when the evidence collected from these unconstitutional searches would have been beneficial in the prosecution of those involved in foreign espionage.[156]

Since those days, many more techniques have been used in the collection of foreign intelligence and even in ordinary criminal investigations. In fact, wiretapping and bugging can be seen as almost ineffective when compared to data that can be collected through other advanced electronic means such as computer hacking, and of course, remote sensing.[157] Remote sensing has the ability to push the national security exception out of the pure intelligence parameters of the national security exception and to the special needs doctrine by the fact that the use of such technology is another investigative technique that must eventually be accounted for in the further development of the national security exception.

To that end, we must recall that the special needs doctrine developed over a number of years and has applied to a variety of situations.[158] But Justice Blackmun's concurrence in *TLO* ensured that for each situation, the government interest in maintaining a special need was balanced against expectations of privacy.[159] With this in mind, the use of remote sensing in national security operations forces us to analyze the national security exception under a different standard of reasonableness rather that the standard underlying the pure intelligence rule.

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[154] *See supra* note 90 and accompanying text.
[155] *See supra* note Part I.B.
[156] *See supra* note 66 and accompanying text.
[157] *See supra* notes 3, 23-27 and accompanying text.
[158] *See supra* notes 114-17 and accompanying text.
[159] *See supra* notes 113 and accompanying text.

Essentially, we know that the sheer invasiveness of wiretapping has deemed such search unreasonable by more than enough judicial opinions. In fact, the only reason why the Justice Department allowed the FBI to conduct warrantless wiretapping after the Brownell Memorandum was because the collection of such evidence would not be used for the purposes of prosecution.[160] Simply put, this limitation by itself allowed the national security investigations to be *reasonable*.[161]

But again, unlike wiretapping, remote sensing technology can retrieve valuable data from a far distance in a variety of different methods and thus could be considered less suspect than the traditional wiretap used for so many years.[162] Therefore, collection of evidence for the sake of national security by the way of remote sensing must be viewed under the balancing test that is the foundation of the special needs doctrine. As we will see below, the use of remote sensing not only has immense implications for the further development of the national security search exception, but also for Fourth Amendment jurisprudence as a whole.

IV. LEGAL IMPLICATIONS PRESENTED BY REMOTE SENSING AND THE EVOLUTION OF THE NATIONAL SECURITY EXCEPTION

As argued above, there are two particular phenomena that may erode the foundations of the traditional national security exception. First, changing attitudes towards national security in reaction to certain events have compromised the foreign limitation of the pure intelligence rule.[163] Second, the availability of remote sensing technology for security investigations brings the national security exception out of the narrow wiretap context thus calling for a different reasonableness analysis, specifically the balancing test as espoused by Justice Blackmun in his concurrence in *TLO*. Ultimately, we can see that the use of remote sensing in national security investigations allows the national security exception in itself to become a critical "subset" within the special needs doctrine. [164]

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[160] *See supra* note 72 and accompanying text.

[161] *See supra* notes 72-83 and accompanying text.

[162] *See supra* Part I.A.1.

[163] *See supra* Part II.A.

[164] Atkinson, *supra* note 9, at 1390 (citing Gould & Stern, *supra* note 106, at 777-78 (suggesting that suspicionless security investigations can be upheld by special needs)).

Therefore, this Part will discuss how remote sensing technologies may be employed in warrantless national security investigations under both the special needs doctrine and under the pure intelligence rule. Consequently, this Part will simultaneously evaluate various implications that the use of remote sensing in matters of national security would have on the further development of the national security exception.

A. The Balancing Act of Reasonableness

The searches conducted under the national security exception based upon the traditional foundations of the pure intelligence rule are considered reasonable solely on the fact that the search is premised on collecting foreign intelligence and not prosecution.[165] However, searches conducted under special needs are premised on both protecting public safety and allowing for the admission of evidence in subsequent prosecutions.[166] More importantly, because the special needs doctrine has been applied in a variety of circumstances, a balancing test of reasonableness must take place. The use of remote sensing to maintain national security is no exception.

While older technologies used in national security investigations implemented techniques that were per se unreasonable under the Fourth Amendment, remote sensing technology employs a variety of techniques that must be addressed on an individual basis. In other words, not only does remote sensing employ high-resolution aerial photography but also employs more detailed reports such as infrared scanning.[167] Though no court has addressed the use of remote sensing technology on the basis of national security, the Supreme Court has addressed the use of associated technologies in other scenarios.

The primary and most well-known cases in this respect are *California v. Ciraolo*[168] and *Florida v. Riley*.[169] In both cases, an aircraft was used to conduct an investigation of defendants who

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[165] *See supra* notes 72-83 and accompanying text.
[166] *See* United States v. Hartwell, 436 F.3d 174 (3d Cir. 2006).
[167] *See supra* notes 28-31 and accompanying text.
[168] 476 U.S. 207 (1986).
[169] 488 U.S. 445 (1989).

were suspected of being involved in the production of marijuana.[170] Though one could not see such production from the ground, the defendants in both cases did not have any sort of awning or cover that would shield their marijuana plants from being seen from the air.[171] After the Court analyzed a number of factors under the objective and subjective expectation of privacy analysis as initially created in *Katz*,[172] the Court ultimately held that investigations conducted from "navigable airspace" did not constitute a search and did not require a warrant under the Fourth Amendment.[173] The Court in both cases reasoned that there was no objective expectation of privacy from a public vantage point such as navigable airspace because such viewing is frequent and not at all intrusive.[174]

To that end, remote sensing in the pursuit of aerial photography would presumably be reasonable under both competing theories of the national security exception.[175] In respect to the pure intelligence rule, the standard of reasonableness contained therein only addresses the foreign intelligence aspect of the traditional form

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[170] *See Riley*, 488 U.S. at 448 (identified production through use of helicopter); *Ciraolo*, 476 U.S. at 209 (identified production through use of a plane).

[171] In *Ciraolo*, the defendant was growing marijuana in his backyard while in *Riley*, the defendant was growing marijuana in a greenhouse he had built on his rural Florida property. *See Riley*, 488 U.S. at 448; *Ciraolo*, 476 U.S. at 209.

[172] *See supra* notes 38-40 and accompanying text.

[173] *See Riley*, 488 U.S. at 450 ("Riley could not reasonably have expected the contents of his greenhouse to be immune from examination by an officer seated in a fixed-wing aircraft flying in *navigable airspace* at an altitude of 1,000 feet or, as the Florida Supreme Court seemed to recognize, at an altitude of 500 feet, the lower limit of the navigable airspace for such an aircraft. (emphasis added)); *Ciraolo*, 476 U.S. at 216-17 ("The Court rejects that contention, holding that respondent's expectation of privacy in the curtilage of his home, although reasonable as to intrusions on the ground, was unreasonable as to surveillance from the navigable airspace." (Powell, J., dissenting)).

[174] *See Riley*, 488 U.S. at 450 ("[P]rivate and commercial flight [by helicopter] in the public airways is routine in this country." (quoting *Ciraolo*, 476 U.S. at 215)); *Ciraolo*, 476 U.S. at 213 ("The observations by [the police officers] in this case took place within public navigable airspace, in a physically nonintrusive manner; from this point they were able to observe plants readily discernible to the naked eye as marijuana." (internal citations omitted)).

[175] In *Riley*, there was discussion as to what constituted navigable airspace. *See Riley*, 488 U.S. at 450 (citing Riley v. State, 511 So. 2d 282, 288 (Fla. 1987)). Of course, there is a question of whether outer space constitutes "navigable airspace." Considering that orbiting satellites is a common and frequent phenomenon much like aircraft flying overhead, it would be reasonable to infer that potential judicial opinions on this matter would yield that objects orbiting the Earth encompass a space very similar to "navigable airspace" as described by the Supreme Court in *Riley* and *Ciraolo*.

of the exception, and thus, it is unnecessary to further evaluate reasonableness under the typical *Katz* model.[176] On the other hand, the special needs doctrine not only requires the use of the *Katz* model to evaluate reasonableness, but balances this reasonableness against the government interest in maintaining this need. But again, because the Court has outright held that investigations from the air are fully reasonable under the *Katz* paradigm, it would be more than reasonable to infer that attempting to balance this evaluation of privacy expectations against the government interest in maintaining national security would be futile. In other words, the government interest in maintaining national security is almost fully aligned with expectations of privacy when it comes to aerial photography provided by remote sensing technologies in outer space.

However, this caveat is certainly not true for other capabilities of remote sensing. Another important case in the Supreme Court's evaluation of advancing technology within the context of the Fourth Amendment is *Kyllo v. United States*.[177] In this particular case, local law enforcement obtained evidence of marijuana production inside a home through the use of a thermal imaging device.[178] Like a remote sensing satellite, this particular device was able to gather information about heat emissions a distance away from the suspected residence.[179] Though the home was in a public vantage point like the residences in *Ciarolo* and *Riley*, the Court determined that the use of thermal imaging was unlike unaided views from the air.[180] The Court held that "[w]here . . . the Government uses a device that is not in general public use, to explore details of the home

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[176] *See supra* notes 38-40, 42-43 and accompanying text.

[177] 533 U.S. 27 (2001).

[178] *Id.* at 29.

[179] *Id.* at 30. "The scan of Kyllo's home took only a few minutes and was performed from the passenger seat of [a police] vehicle [parked] across the street from the front of [the defendant's] house and also from the street in back of the house. The scan showed that the roof over the garage and a side wall of [Kyllo's] home were relatively hot compared to the rest of the home . . . ." *Id.* Therefore, the police were able to conclude that the defendant was using high heat lamps to grow marijuana inside his home. *Id.*

[180] *See id.* at 34-39. In short, the Court reasoned that the use of the thermal imaging device was dissimilar from a plain view derived from a public vantage point. This was because the device essentially allowed the police to conduct "through-the-wall surveillance" by detecting heat emanating from the home, and of course, such heat cannot be seen with the naked eye. *See id.* at 35. The Court furthered reasoned that this is quite similar to the use of a microphone planted in the home. *See id.* Therefore, because such

that would previously have been unknowable without physical intrusion, the surveillance is a 'search' and is presumptively unreasonable without a warrant."[181]

Under the traditional notion of the national security exception, a search conducted by other capabilities of remote sensing such as radar or infrared is reasonable, regardless of the Court's holding in *Kyllo*, as long as the search is premised upon a national security interest that involves foreign powers or their agents. But if we placed national security within the context of special needs, then we must resort to the Blackmun balancing test.

Though the use of certain remote sensing technologies would be unreasonable without a warrant under *Kyllo*, an invocation of the balancing test of the special needs doctrine may hold otherwise. That is, the use of remote sensing technology may be considered reasonable as it is not as invasive or intrusive as bugging or wiretapping, and moreover, may be used for only a short duration. This particular position finds support in the Supreme Court's ruling in *Jones v. United States*[182] in which the Court held that a GPS device attached to a suspect's car constituted a search under the Fourth Amendment.[183] The Court may have ultimately held that the use of the device constituted an unlawful search, but the Court's reasoning revealed that a particular technology used for a short amount of time may be reasonable,[184] and more importantly, that the use of technology that does not constitute a "physical intrusion" may also be reasonable.[185] Although GPS technology is not exactly within the

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a technique is almost always unreasonable without a warrant, so would the use of a thermal imager that detects activity within the home.

[181] *Id.* at 40.

[182] 565 U.S. 400 (2012).

[183] *See id.* at 413.

[184] *See id.* at 430 (Alito, J., concurring) ("[R]elatively short-term monitoring of a person's movements on public streets accords with expectations of privacy that our society has recognized as reasonable. But the use of longer term GPS monitoring in investigations of most offenses impinges on expectations of privacy." (internal citations omitted))).

[185] The author of the *Jones* opinion, Justice Scalia, seems to have written the majority opinion in the context of the "constitutionally protected places" theory of Fourth Amendment jurisprudence as it was apparent that he was concerned with the physical attachment of the GPS device on the defendant's vehicle. *See id.* at 402, 404-05 ("It is important to be clear about what occurred in this case: The Government physically occupied private property for the purpose of obtaining information. We have no doubt that such a physical intrusion would have been considered a "search" within the meaning of the Fourth

realm of remote sensing, such a case demonstrates how the Court may have departed from the strict and narrow holding of *Kyllo* and to a more detailed analysis of reasonableness when it comes to evaluating the constitutionality of searches conducted by emerging technologies.[186]

As reiterated numerous times in the course of our discussion, we must still balance reasonableness against government interests when it comes to special needs. This balancing act is further complicated by the fact that the courts will account for subjective and objective expectations of privacy on a case-by-case basis. But if a court's analysis is deeply rooted in special needs precedent, it appears that the government interest in national security can almost always outweigh individual expectations of privacy.[187] This particular occurrence is only bolstered by changing societal norms towards privacy and national security in which courts may likely find that citizens have a lower expectation of privacy when it comes to national security.[188] As we have seen in cases like *MacWade* and *Hartwell*, the judiciary is quick to react to security concerns and

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Amendment when it was adopted."); *see also supra* note 35 and accompanying text (describing the "constitutionally protected places" theory of the Fourth Amendment). However, Justice Scalia remained true to the underlying *Katz* test and stated, "It may be that achieving the same result through electronic means, without an accompanying trespass, is an unconstitutional invasion of privacy, but the present case does not require us to answer that question." *Jones*, 565 U.S. at 412. Essentially, this particular statement allowed the Court to leave open the question of whether GPS data from wireless service providers or tracking services installed on phones or cars could be collected without a warrant.

[186] Though the Court may have carefully weighted reasonableness in *Kyllo*, the ultimate holding was indeed narrow when it came to emerging technologies. See *supra* note 181 and accompanying text. However, the "*Jones* decision reminded that the foundational underpinnings of the Fourth Amendment [i.e. (reasonableness)] cannot be ignored." Adam R. Pearlman & Erick S. Lee, *National Security, Narcissism, Voyeurism, and Kyllo: How Intelligence Programs and Social Norms Are Affecting the Fourth Amendment*, 2 TEX. A&M L. REV. 719, 742 (2015). Again, Justice Scalia did not attempt to apply a narrow rule on emerging technology but rather left the question of reasonableness for future discussion. *See supra* note 185.

[187] *See c.f.* Gould & Stern, *supra* note 106, at 830 ("But given the magnitude of the threatened harm, where there is any genuine hope of preventing disaster, even an invasive and suspicionless search would probably be viewed as reasonable.")

[188] *See* Robison, *supra* note 53, at 1399-1401 (arguing that airline passengers are deemed to have a lesser expectation of privacy considering that they are a highly regulated class of individuals as preventing terrorist attacks on board aircraft has been identified as a special need).

allow such concerns to further shape matters of the Fourth Amendment.

B. The Lingering Foreign Conundrum

Since the Supreme Court's decision in *Keith*, the national security exception has been rooted in the confines of the pure intelligence rule given the fact that the courts have not again addressed the national security exception in the domestic context. In fact, some have argued that the national security exception still fits within this paradigm despite the growing trend to place national security into the special needs doctrine.[189] As alluded to earlier, this argument is strengthened by FISA that permits electronic surveillance to protect national security.[190] FISA essentially codifies the pure intelligence rule as it allows electronic surveillance for the collection of "foreign intelligence information" between "foreign powers" and "agents of foreign powers" suspected of terrorism or espionage.[191]

However, the events of September 11th and changing American attitudes towards privacy have not only led to changing judicial perspectives regarding national security, but also legislative ones. Specifically, the PATRIOT Act of 2001 amends FISA insomuch that warrantless surveillance conducted under the Act must insure that that the "significant purpose" of the surveillance is to obtain foreign intelligence information.[192] Under the original FISA, obtaining foreign intelligence was required to be the primary purpose of the investigation.[193] According to some, the PATRIOT amendment was introduced in order to remove the "legal wall" between criminal and security investigations that could compromise the collection and use of evidence when such investigations overlapped.[194] This is the

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[189] *See* Atkinson, *supra* note 9, at 1392 ("These special needs cases, in and out of the security context, establish that the pure intelligence rule can fit comfortably within modern Fourth Amendment jurisprudence.").

[190] *See supra* notes 91-101 and accompanying text.

[191] *See* 50 U.S.C. §§ 1801-02 (2012).

[192] *See* PATRIOT Act, *supra* note 102, Sec. 218.

[193] *See id.*

[194] *See* Pearlman & Lee, *supra* note 186, at 754 ("[T]he [FISA] wall lead to "a diminished level of coverage of suspected al-Qa'ida operatives in the United States." (quoting U.S. Senate Select Comm. on Intelligence and U.S. House Permanent Select Comm. on Intelligence, Joint Inquiry into Intelligence Community Activities Before and After the Terrorist Attacks of September 11, 2001, S. Rep. No. 107-351, H.R. Rep. No. 107-792, at

same issue faced by FBI investigators in the earliest days of national security investigations.[195]

With this amendment, there is presumably a notion to keep the pure intelligence foundation of the national security exception somewhat intact, and indeed, this may delay the transition of the national security exception to the special needs doctrine. But, the PATRIOT Act amendment nonetheless demonstrates a departure away from this foundation. As is the repeating theme throughout this Article, the emergence of non-intrusive and powerful remote sensing technologies and societal reaction to recent events "change the game" of national security. FISA along with its PATRIOT amendments still only apply to invasive wiretapping and bugging even when remote sensing technologies are readily available for investigation.[196] And, if the national security exception continues to trend towards special needs, new legislation will have to account for new technologies in order to fully address reasonableness in light of the foundational Blackmun balancing test. This eventually could eliminate the foreign intelligence rule altogether and legislation as discussed above may fail to keep national security exception within the parameters of the pure intelligence rule.

V. CONCLUSION

The times we live in can be quite exciting, but unfortunately, can also be quite terrifying as well. On one hand, the United States has been the leader in the development of technologies in outer

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xvii (2002) (pagination from unclassified version of report))). It is also important to note that with the PATRIOT amendments to FISA, changing societal norms regarding privacy and security, and emerging technologies, the wall between criminal and security investigations may almost be fully eroded, thus strengthening the argument that the national security exception may continue to evolve as a subset of the special needs doctrine. *See id.* at 770 ("With much of the intelligence/criminal wall dismantled in law, policy, and public conscience, and with the consequential knowledge that law enforcement and intelligence functions can interact in meaningful ways in an era of ever-more-capable and prolific technological tools, the *Kyllo* test would imply it is reasonable to suspect that certain high-tech measures might be used in the law enforcement context, notwithstanding their development for intelligence purposes.").

[195] But unlike the development of the national security exception that took place behind closed doors and confidential memorandums, it could be argued that national security exception is now developing in the open courts and halls of the legislature. *See supra* Part I.C.

[196] *See* 50 U.S.C. §§ 1801-02 (2012).

space. These technologies have permeated everyday life to provide useful tools and information, and of course, have kept dangerous threats to our nation at bay. But on the other hand, these technologies can lead to potential unrestrained invasions upon the privacy of average Americans even when the use of such technology is justified by the need to maintain national security.

Fortunately, the foundations of the Fourth Amendment have the potential to strike a balance between the advancement of remote sensing technology and continuing threats to national security. Even with the potential shift of the national security exception from the confines of the pure intelligence rule to the broader landscapes of the special needs doctrine, a warrantless search will always be subject to the cornerstone of the Fourth Amendment – *reasonableness*.

With that said, it is important that society is always conscious of what type of government searches can be deemed as reasonable. However, it is more important that the government is not only conscious of these changing societal norms, but is also conscious of the continuing development of advanced technology. In the past, all branches of the Federal government have held narrow views when it comes to the reasonableness of searches justified by the national security exception. Whether it is applying the national security exception only within the context of wiretapping or holding there is no such thing as a domestic security interest, such determinations have not accounted for emerging technologies, much less technologies that currently orbit the Earth.

But with the progression of views regarding national security, that is the progression of the national security exception to the special needs doctrine, the government may be more aware of emerging technologies and adjust its views on constitutional reasonableness accordingly. In fact, this adjustment is necessary if we are to preserve our civil liberties provided by the Fourth Amendment. Therefore, it is in society's best interest to always be conscious of such developments in order to ensure an order that values both privacy and security.

ISRAEL–FLORIDA SPACE COOPERATION AGREEMENT: A HYBRID MODEL OF INTERNATIONAL COOPERATION

*Dr. Eytan Tepper**

ABSTRACT

In 2014, Florida and Israel launched the Innovation Partnership Program under an agreement for international cooperation. This agreement and the hybrid cooperation model it uses is the subject of this paper. International cooperation is a mantra in the space community, a basic norm and a practical necessity. However, there are numerous constraints *en route* to international cooperation in space activities. At the same time, carefully crafted cooperation models assist in overcoming barriers to international cooperation and, therefore, analysis of the various possible models enables actors to employ feasible and efficient models of cooperation. Recognizing the importance of such an investigation, the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) has established a working group tasked with the review of international mechanisms for cooperation in space activities. A common cooperation model is cooperation between national space agencies for the execution of a common project, at times under the auspices of an intergovernmental organization such as the European Space Agency (ESA). Another common model is cooperation between commercial entities. This paper presents a hybrid model for international cooperation, one in which governments cooperate to support commercial, business-to-business cooperation. The model is presented using the case of the agreement between Florida and Israel, which has already successfully concluded four rounds of funding and the launch of 15 joint commercial projects. In the case study, Florida and Israel both support joint projects of Florida and Israeli

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corporations, resulting in a steadily growing number of corporations from each jurisdiction seeking to cooperate with corporations from the other. This paper presents the rationale, goals, means, and modes of this cooperation model, as well as the results of its implementation so far. The paper concludes that the success of the model calls for its adoption alongside the regular models of cooperation.

I. INTRODUCTION

International cooperation in space activities is a basic principle in space law and arguably a legal duty. The principle of international cooperation was introduced in the first instrument on space law - a 1958 United Nations General Assembly (UNGA) resolution[1] - and in practically every subsequent instrument, including the five UN space treaties,[2] the annual UNGA resolutions on space issues - most of which are titled "International Co-operation in the Peaceful Uses of Outer Space"[3] - and the 1996 UNGA Declaration on International Cooperation[4]. Article I of the 1967 Outer Space Treaty[5] provides that States shall facilitate and encourage international co-operation in scientific investigation in outer space, and as Wolfrum noted, it elevates the norm of international cooperation in space activities to a legal duty.[6]

International cooperation is also a practical need, due to the technological challenges and financial risks involved in space activities. Developing a space industrial base requires having, or having access to, technological capacity, development tools, infrastructure, advanced industrial base and significant financing. For most countries, this can be achieved only by pooling resources across national borders.

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[1] U.N. GAOR, 13th Sess., 792 plen. mtg. at 1348 (XIII), U.N. Doc. A/13/PV. 792 (Dec. 13, 1958).

[2] *Space Law Treaties and Principles,* U.N. OFF. FOR OUTER SPACE AFF., http://www.unoosa.org/oosa/en/SpaceLaw/treaties.html (last visited Dec. 17, 2018).

[3] *Space Law: Resolutions*, U.N. OFF. FOR OUTER SPACE AFFAIRS (Feb. 16, 2015), http://www.unoosa.org/oosa/en/SpaceLaw/gares/index.html (last visited Dec. 17, 2018).

[4] G.A. Res. 51/122 (Dec. 13, 1996).

[5] Treaty Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205.

[6] *See* Rüdiger Wolfrum, *International Law of Cooperation*, *in* MAX PLANCK ENCYC. OF PUB. INT'L L. (Oxford Pub. Int'l L. ed. 2010) *available at*, http://opil.ouplaw.com/home/epil.

However, cooperation in a decentralized international society is not easily achieved. Moreover, international cooperation in space activities has its own unique difficulties, mainly involving the dual-use nature of most of the technologies and products. This makes export controls a serious barrier to cooperation. Carefully tailored cooperation agreements assist in overcoming numerous barriers to international cooperation.[7] Considering the importance of international cooperation and the barriers to its achievement, it logically follows that research is necessary to determine how to best achieve cooperation under the current constraints. Within this research, the investigation of cooperation strategies is essential to the design of feasible and efficient models of cooperation. The investigation of various approaches to cooperation is the sole task of a special working group established in 2013 by the Legal Subcommittee of the United Nations Committee on Peaceful Uses of Outer Space (COPUOS).[8]

This paper contributes to the investigation of cooperation strategies and search for feasible and efficient models of cooperation by presenting a hybrid model of international cooperation as used in the Florida–Israel cooperation agreement. The first section introduces the hybrid model, the second and third sections review the Florida–Israel cooperation agreement, and the fourth describes the results of its implementation to date, including the completion of four rounds of funding and initiation of fifteen commercial projects, each a joint venture of corporations from Florida and Israel. The fifth section places the hybrid model in the wider context of promoting international cooperation and, based on Institutional Analysis, suggests that large-scale international cooperation can be achieved through numerous instances of small-scale cooperation.

II. THE HYBRID MODEL FOR INTERNATIONAL COOPERATION

A common model of international cooperation in space activities is cooperation between governments, often through their space agencies, and at times under the auspices of an intergovernmental organization such as the European Space Agency (ESA). Another

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[7] Yun Zhao, *The Role of Bilateral and Multilateral Agreements in International Space Cooperation*, 36 SPACE POLICY 12 (2016).

[8] Comm. on the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Fifty-Second Session, 23 U.N. Doc. A /AC.105/1045 (2013).

common model, especially in the satellite-based telecommunication sector, is an almost purely commercial cooperation between commercial entities. A hybrid model is one in which two or more governments support international business-to-business (B2B) cooperation on a joint project. Such joint projects may be initiated by the governments, which may include matching relevant corporations, or by the corporations themselves. Unlike in the case of national space activities, the goal of such joint projects is not necessarily national interest but more often profit—or even the realization of a personal vision, as is the case with certain billionaire entrepreneurs.[9] In contrast to a purely commercial cooperation, under the hybrid model the States or nations within which the cooperating corporations are operating support the cooperation, notably by providing financial support. This hybrid model is exemplified by the case of the agreement between Florida and Israel.

III. THE FLORIDA–ISRAEL INNOVATION PARTNERSHIP PROGRAM

In October 2013, national authorities from the state of Florida and the State of Israel signed an agreement[10] establishing the Florida–Israel Innovation Partnership Program. The program was formally launched in January 2014 at the occasion of the ninth Ilan Ramon Annual International Space Conference in Herzliya, Israel.[11]

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[9] For example, Elon Musk's SpaceX, Jeff Bezos' Blue Origin, Sir Richard Branson's Virgin Galactic, and Robert T. Bigelow's Bigelow Aerospace.

[10] Cooperation Agreement for Promotion of Industrial Research and Development, Space Florida and MATIMOP–Israeli Industry Center for R&D. (Oct. 22, 2013) (unpublished agreement) (on file with the Journal of Space Law) [hereinafter Space Florida-MATIMOP Agreement].

[11] *9th Ilan Ramon Annual International Space Conference*, Isr. Min. of Foreign Affairs (Oct. 1, 2014), https://mfa.gov.il/MFA/InnovativeIsrael/Conferences/Pages/9th-Annual-International-Ilan-Ramon-Space-Conference-Jan-2014.aspx; Frank Dibello, *Space Florida -A Model for Space Entrepreneurship and Collaboration of Industry and State*, Ilan Ramon Annual Int'l Space Conference (Jan. 29-30, 2014).

A. The Contracting National Authorities

i. Space Florida

Space Florida is the spaceport authority and aerospace economic development agency for the state of Florida.[12] Space Florida was established by a 2006 act of the Florida legislature[13] (the "Space Florida Act") with a view "to foster the growth and development of a sustainable and world-leading aerospace industry in [the] state."[14] Legally defined as "an independent special district, a body politic and corporate, and a subdivision of the state"[15] , Space Florida operates independently from the government of Florida with an independent board of directors.[16] Besides providing independence, the special status bestows Space Florida with a wide range of special powers and tools, including tax benefits, to promote its stipulated goals.

The state of Florida is home to a significant portion of US space installations and activities. These include the Kennedy Space Center, which was used for the Apollo manned moon landing missions and all space shuttle launches; the Cape Canaveral Air Force Station, an installation of the United States Air Force Space Command's 45th Space Wing; and the Center for the Advancement of Science in Space (CASIS) -the sole manager of the International Space Station U.S. National Laboratory.[17] NASA's retirement of the space shuttle program in 2011 after 30 years of service affected the jobs of 9,135 people.[18] Space Florida was established after the cessation of the program, in recognition of the need to increase the role of the private sector in the space industry, in order to maintain, if not increase, the capacity of the space sector in Florida and provide new jobs to replace the lost ones. For this purpose, Space Florida is promoting the commercial space industry in the state of Florida by, among other things, consulting, granting access to infra-

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[12] *See* SPACE FLORIDA, http://www.spaceflorida.gov (last visited Dec. 17, 2018).

[13] Space Florida Act, Fla. Stat. § XXV.331.302 (2006).

[14] *See id.* at § XXV.331.305.

[15] *See id.*

[16] Florida-Israel Innovation Program, *Information Day and Project Generation Workshop* (Feb. 2, 2014) (unpublished workshop) (on file with the Journal of Space Law).

[17] *See* ISS – U.S. NAT'L LAB., http://www.iss-casis.org (last visited Dec. 17, 2018).

[18] Dibello, *supra* note 11.

structure and resources, arranging financial incentives, and providing startup and relocation support for private companies in the space sector.[19]

ii. The Israel Innovation Authority

The Israel Innovation Authority (IIA)[20], formerly known as the Office of the Chief Scientist of the Israeli Ministry of Economy and Industry,[21] promotes industrial research and development (R&D) under the Encouragement of Industrial Research and Development Act, 1984.[22] The IIA "is Israel's central agency to manage the country's governmental support of the resource of innovation... created to maintain Israel's position at the forefront of global innovation and to elevate the entire economy through technological innovation."[23] The IIA strives to enhance the development of science-based industry in Israel by utilizing and expanding the country's existing technological and academic infrastructure.[24] Israel has an established space program, having completed its first launch in 1988, and has recently put an emphasis on the commercial sector with regard to space. Under the new Israeli Civil Space Program of 2012, the IIA has started to support R&D in the space sector as well. In late 2013 the IIA introduced a framework program to support space-related R&D in Israel[25] A framework program is a program established by a government, a governmental agency, or a consortium thereof to encourage and support industrial R&D by providing funding to R&D projects with the purpose of boosting economic

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[19] *See* SPACE FLORIDA, *supra* note 12.

[20] *See* ISR. INNOVATION AUTH., https://innovationisrael.org.il/en/ (last visited Dec. 17, 2018).

[21] *Israel Innovation Authority Announces Record Response to Call for Projects*, SPACE FLORIDA (Mar. 5, 2019), https://www.spaceflorida.gov/news/space-florida-israel-innovation-authority-announce-record-response-to-call-for-projects/.

[22] *See* Encouragement of Industrial Research and Development Law, 5744-1984 (2005) (as amended) (Isr.), *available at* http://economy.gov.il/Legislation/Laws/Legislation_Links/T001.pdf.

[23] *Space Florida and Israel Innovation Authority Announce Fourth Round Winners of Innovation Partner Funding*, SPACE FLORIDA (July 13, 2017), http://spaceref.com/news/viewpr.html?pid=51031.

[24] Eytan Tepper, *New Israeli Civil Space Policy to Boost R&D and Commercial Space Industrial Base*, 2(1) NEW SPACE 1, 1-7 (2014).

[25] *See id*.

growth.[26] Framework programs implemented in Israel have two types: (i) a program that supports a domestic corporation to perform R&D domestically and (ii) a program that supports R&D performed in cooperation with foreign entities. The Florida-Israel program is the first framework program the IIA has introduced that emphasizes and promotes international cooperation in space-related R&D. The international department of the IIA, formerly known as the Israeli Industry Center for R&D (MATIMOP),[27] implements the Florida–Israel Innovation Partnership Program.

The Israeli experience over the last thirty years with such framework programs providing support for industrial R&D has been highly positive, as demonstrated by a 2008 study commissioned by the Israeli Ministry of Finance and the IIA.[28] The study showed that these framework programs have had positive economic effects for the participating corporations, the industry, and the Israeli economy as a whole; it found that the total return on government support for the Israeli economy as a whole ranged from 475% to 751%. This figure represents private investment that followed government investment and R&D spillover - the spread of knowledge in the industry.[29] There was a clear excess return to the economy as a whole that went far beyond the return for the researching firms.

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[26] One famous such framework program is the EU's "Horizon 2020 Program." For more information on this program and the history of framework programs in the EU and their effects, see Ben Deighton, *The Scale of Horizon 2020 is a Vote of Confidence for Research*, HORIZON MAGAZINE (Mar. 2015) (on file with the Journal of Space Law).

[27] MATIMOP, the Israeli Industry Center for R&D, is the executive agency of the Office of the Chief Scientist. MATIMOP is responsible for promoting industrial R&D cooperation between Israeli and foreign corporations and implements international agreements between Israel and other States for industrial and technological cooperation. *See* ISR. INNOVATION AUTH., https://innovationisrael.org.il/en/program/kird-karnataka-india-israel-industrial-rd-program (last visited Dec. 17, 2018).

[28] Shaul Lach, Shlomi Prizat & Daniel Wertak, *The Effect of Government Support for Industrial R&D on the Israeli Economy*, *translated by Eytan Tepper* ISRAELI MIN. OF FIN. & THE OFF. OF CHIEF SCIENTIST IN THE MIN. OF INDUSTRY, TRADE & LABOR (June 2008).

[29] *See* Graziola Giancarlo, Cristini Annalisa, & Di Ciaccio Simona, *The Importance of the Technological Spillovers for the Returns to Space Investments, with an Empirical Application to the Italian High-Tech and Space Sectors*, 3 NEW SPACE Vol. 3, No. 3: 179-190 (Sept. 2015).

B. The Florida–Israel Cooperation Agreement

The Cooperation Agreement for Promotion of Industrial Research and Development was signed in Florida by Space Florida and MATIMOP on behalf of the governments of Florida and Israel, respectively.[30] The vision of the agreement is cooperation based on the principles of equality and reciprocity to encourage taking advantage of the opportunities generated by technical and scientific advances in industrial R&D to develop new products, applications, or processes that can be commercialized in the global market.

Each partner government has committed to provide US$1 million a year for financial support of the partnership program.[31]The agreement states that it is nonexclusive and that each party has the right to enter into similar agreements with other governments.

C. Scope of Cooperation

i. In General

Under the agreement, Space Florida and the IIA undertake to work together and to take the following actions:[32]

- Identify areas of mutual interest;
- Identify existing national and international programs for supporting and facilitating access to financing opportunities for joint industrial R&D projects;
- Identify specific projects, partnerships, or collaborations that could lead to industrial R&D cooperation;

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[30] Space Florida-MATIMOP Agreement, *supra* note 10.

[31] The Florida legislature has allocated its contribution. Israel has not allocated a special budget for the program, but committed to allocate the same amount from the general budget of the IIA. *See* Florida-Israel Innovation Program*, supra* note 16; Space Florida-Israel Innovation Partnership Aerospace Track–Request for Proposals, RFP-SF-38-0-2014/BM, released Dec. 6, 2013 (on file with the Journal of Space Law) [hereinafter 1st Call for Projects]; Call for Projects for the Florida-Israel Innovation Partnership, Aerospace Track & R&D Aerospace Grant, released Oct. 29, 2014 (on file with the Journal of Space Law) [hereinafter 2nd Call for Projects]; Call for Projects 2016 for the Florida-Israel Innovation Partnership, Aerospace Track & R&D Aerospace Grant Application, released Oct. 29, 2014 (on file with the Journal of Space Law) [hereinafter 3rd Call for Projects].

[32] *See* Florida-Israel Innovation Program, *supra* note 16.

- Stimulate contacts and facilitate the exchange of technical information and expertise;
- Identify and match corporations in Florida and Israel to cooperate in space-related industrial R&D;
- Organize workshops, seminars, and meetings for corporations from both sides to promote the knowledge and use of the framework program;
- Form a work plan and establish procedures for cooperation;
- Hold joint meetings and review the progress of the cooperation under the agreement.

The two important tools provided by the agreement to accomplish these goals are the matchmaking services and the financial support through periodic calls for projects, which provide the main support and incentive for private companies in each state to cooperate with companies from the other state.

ii. The Matchmaking Services

Both Space Florida and the IIA offer matchmaking service by which they assist corporations from Florida and Israel in finding potential corporate partners in the other state for cooperation on a joint project, including submission of a joint application for support under the program. Both Space Florida and the IIA hold or have access to a database of technology corporations in their respective jurisdictions. The IIA maintains a database of Israeli technology corporations, and it regularly provides matching services for both Israeli and foreign corporations seeking international partners. Space Florida has access to commercial databases that can assist in identifying potential partner corporations from Florida.[33]

iii. The Annual Call for Projects

Space Florida and the IIA jointly release an annual call for projects inviting corporations from Florida and Israel to initiate and to apply for financial support of joint projects. The goal of a call for

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[33] *See id.*

projects is to stimulate the generation and development of new or significantly improved products or processes for commercialization in the global marketplace,[34] particularly within specific technological subfields of the space industry. The available funds are an incentive for corporations from Florida and Israel to form partnerships to pursue such projects.

So far five calls for projects have been put out and resulted in financial awards. The next subsections present the common features of all the calls for projects released to date. Section 4 reviews the outcome of four calls for projects already concluded and evaluates the success of the program to date.The financial support mechanism, the heart of the Florida-Israel Innovation Partnership Program, will be discussed in the following two sections.

IV. THE FRAMEWORK FOR FINANCIAL SUPPORT

A. The Annual Call for Projects

The call for projects invite companies to form project-specific partnerships and submit joint applications for support. The incentive is clear and substantial: for approved projects, each authority will provide financial support to the partner corporation in its jurisdiction. Each of the five calls for projects issued so far have combined available funds of $2,000,000.[35]

B. Eligibility to Apply

i. Eligibility of Applicants

All four calls for projects have set general terms of eligibility:[36]

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[34] *See* Florida-Israel Innovation Program*, supra note* 16. *See also* Call for Projects for the Space Florida-Israel Innovation Partnership Aerospace Track & R&D Aerospace Grant Application Process, released Aug. 30, 2017 (on file with the Journal of Space Law) [hereinafter 5th Call for Projects]; Call for Projects for the Space Florida-Israel Innovation Partnership Aerospace Track & R&D Aerospace Grant Application, released Aug. 2, 2016 (on file with the Journal of Space Law) [hereinafter 4th Call For Projects]; 3rd Call for Projects, *supra* note 31; 2nd Call for Projects, *supra* note 31; 1st Call for Projects, *supra* note 31.

[35] *See id.*

[36] *See id*.

- **Residency in Florida/Israel**: an application must be submitted jointly by a corporation from Florida and a corporation from Israel for the execution of a joint project. For a corporation to be considered a Florida company, it must be a for-profit corporation or limited liability company with three out of four of the following activities located in Florida: headquarters, R&D, sales and marketing, and manufacturing; for a corporation to be considered an eligible Israeli company it must be a company registered and operating in Israel.

- **For-profit projects**: applications may be submitted only by partnerships consisting of at least one for-profit corporation from Florida and one for-profit Israeli corporation. This limitation renders the whole program a framework for commercial B2B cooperation. Space agencies, academic institutions, and other not-for-profit organizations are not eligible to apply. The promotion of commercial activities is the exclusive focus. Nevertheless, academia–industry cooperation is welcomed; an eligible pair of for-profit companies may involve research institutions and universities as subcontractors, in accordance with each jurisdiction's funding regulations. This enables the joint projects to benefit from academic resources such as knowledge, especially in basic research, and infrastructure.

- **Collaboration of independent parties**: joint projects in which one of the partner corporations is a wholly owned subsidiary or joint venture of the other corporation are not eligible. Projects in which one of the applying partner corporations has a nominal equity position in or a contractual business relationship with the other corporation (for example, distributor in its jurisdiction of the products of the corporation from the other jurisdiction) will be considered so long as the relationship is fully disclosed in the application.

ii. Eligibility of Projects

In all five calls for projects, the technological fields in which participants were particularly encouraged to propose projects were:[37] satellite communications; small satellites and small launch vehicles; sensors for space research/applications including bio-sensors; biosensors for space research; nanomaterials and coatings for

[37] *See id.*

space applications; electric power resources and solutions for space applications; microgravity research related to human life sciences; unmanned aerial vehicles and systems; nanoelectronics, flex electronics, and low-power electronics; and micro- and nanorobotics technologies. Other aerospace-related research projects can, however, qualify for support.

C. Selection of Projects

i. Criteria for Selection

After submission, projects are evaluated according to the following criteria:[38]

- **Technical merit**: the significance of the problem or opportunity, the degree of innovation or novelty of the technology, and the technical feasibility of the proposed application;

- **Commercial merit**: the size of the potential market for the product, the extent to which the need for the product or process can be validated, and the potential disruptiveness of the technology to be developed;

- **Ability to carry out the proposed research successfully**: the soundness of the approach and the work plan, the adequacy of the management plan, the qualifications of key members of the research team, and the strength of the partnership and compatibility between the corporations from Florida and Israel;

- **Ability of project participants to commercialize resulting technology successfully**: the current position of each partner in the market, the adequacy of the commercialization plan, and the ability to secure the needed financing.

In addition to the above criteria commonly used by Space Florida and the IIA, Space Florida also considers the "potential economic benefit" for the partners and for the Florida economy, including: the benefit to the corporations and organizations participating in the project, the expected number of jobs to be created or retained, the locations where the project's work will be conducted, and the

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[38] *See id.*

expected overall economic impact of the project. Each of the four common criteria and the one additional criterion will be evaluated by Space Florida with weights of 20% for each criterion.[39]

In addition to the above common criteria, the IIA will also consider the added value of the international cooperation, including: access to expertise, the use of infrastructures and development tools not easily available in Israel, the use of outcomes of R&D made by the Florida partner, the business and commercial prospects of the technological cooperation, and sharing of the R&D risk. No weights are allocated to these criteria.[40]

The IIA operates numerous framework programs for support of industrial R&D and has a long established, tested and mature set of selection criteria and procedure, which it regularly employs in its evaluation of projects applying for support. These criteria are used in conjunction with the above criteria, which share the same basic principles. These across-the-board criteria are: innovation, commercialization, team, financial stability and potential market.[41]

ii. Evaluation and Selection

In order for a project to be awarded financial support, it needs to be approved by both authorities. Each application undergoes an initial evaluation separately and independently by Space Florida and the IIA. Subsequently, both authorities mutually decide whether an application is accepted for an award. Notwithstanding the independent procedure in each state, Space Florida and the IIA work in close cooperation and constant interaction. Their decisions are coordinated in such a way that approval of a project by one government and rejection by the other, though possible, is unlikely.[42]

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[39] *See id*.

[40] *See id*.

[41] *See* Florida-Israel Innovation Program*, supra* note 31; Interview with Israel Shamay, Executive Director, Strategic Initiatives, Head of the Americas Operations at MATIMOP, Israeli Industry Center for R&D (Aug. 24, 2015). The across-the-board criteria are available at *The Processing Stages of an Application Criteria for Evaluation of Applications* (Isr.), ISR. INNOVATION AUTH., (Mar. 6, 2019), https://innovationisrael.org.il/programprocess/evaluationcriteria.

[42] Interview with Israel Shamay, *supra* note 41; Interview with Liron Eldar, Manager - North American Desk at MATIMOP, Israeli Industry Center for R&D (Dec. 29, 2014).

D. Scope of Support

Each selected project is awarded funds from both Space Florida and the IIA. Space Florida provides funding directly to the Florida corporation, and the IIA provides funding directly to the Israeli corporation, each working according to the laws and regulations applicable in its jurisdiction.

The framework program has an initial span of five years with a budget of $1,000,000 a year from each government, meaning $2,000,000available funds annually.[43] The program was granted approval for a five-year recurring appropriation from the Florida legislature during the 2013 legislative session. Barring unforeseen circumstances, Space Florida will be appropriated US $1,000,000annually in fiscal years 2014–2018 to provide funding to eligible Florida corporations. The IIA has committed to make available a similar amount for funding Israeli corporations out of its regular budget.[44]

i. Funding for Florida Corporations

The maximum grant to be provided by Space Florida for a single project over the lifetime of the project will not exceed $500,000 and must constitute no more than half of the approved R&D expenditure for the project. The corporation's matching contribution to the budget may consist of any combination of equipment, services, or money.

ii. Funding for Israeli Corporations

The grant provided by the IIA will be at least 20% and no more than 50% of the approved R&D expenditure for the project. The support is given only for R&D costs and not for costs associated with production and marketing. The exact percentage of support (between 20% and 50%) is decided on a case-by-case basis. The same criteria used for the evaluation of a project are used for deciding the extent of the funding.[45] The better the project fits the general goals of the IIA, the greater the percentage.

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[43] Interview with Israel Shamay, *supra* note 41.

[44] Florida-Israel Innovation Program, *supra* note 16; Interview with Liron Eldar, *supra* note 42.

[45] Interview with Liron Eldar, *supra* note 42.

iii. Duration of Support

Support is limited to projects with durations of up to two years. Whenever a project is planned to require more than one year, a progress review is held at the end of the first year. The review includes milestones and deliverables showing that significant progress has been made during the first year.

iv. Final Report

A final report is due at the end of the project, and it should provide an account of what was accomplished with the grant funds.[46]

E. Intellectual Property Allocation

The issue of intellectual property (IP) rights is of interest to Space Florida and the IIA, each wishing to increase the local IP reservoir. For this reason, applications for support must include a draft of a cooperation agreement (an outline of which is provided in the appendices to the call for projects) that addresses R&D, IP rights, and commercialization strategy.[47] The allocation of IP rights, as specified in the cooperation agreement, is also evaluated by each authority.

Space Florida did not announce a specific policy regarding IP on technologies developed during supported projects, and cooperation agreements will be evaluated on a case-by-case basis.[48]

The IIA has a structured policy on the issue of IP rights and usage. In a domestic framework program, transferring knowledge or production outside of Israel requires approval of the IIA and payment of extended royalties. A program involving international cooperation has different stipulations: transfer of knowledge is possible if the agreement between the Israeli corporation and the Florida corporation is balanced and fair. An agreement would be considered balanced and fair if it is based on the following principles:

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[46] *See* 4th Call for Projects, *supra* note 34; 3rd Call for Projects, *supra* note 31; 2nd Call for Projects, *supra* note 31; 1st Call for Projects, *supra* note 31.

[47] *Id.*

[48] Interview with Liron Eldar, *supra* note 42.

- Knowledge developed by one of the parties will be exclusively owned by the developer, but the other party will have an unlimited license to use the knowledge;

- Knowledge developed jointly by both parties will be jointly owned by both, and both parties will have an unlimited license to use it;

- Division of markets, if decided, will be based on geographic considerations.

Cooperation agreements will be evaluated on a case-by-case basis, and it is possible that agreements that diverge from these principles will be approved if they are nonetheless considered balanced and fair, having adequate compensation for each diversion.

F. Export Controls

Space products are mostly dual-use,[49] and therefore export to third countries of products or technologies generated through the program is subject to export control regulations. Export of such products or technologies from the US must conform with the International Traffic in Arms Regulations (ITAR).[50] Export of space products from Israel requires approval of the Defense Export Controls Agency (DECA).[51] The procedure for obtaining such an approval involves a committee in which the Israeli space industry is represented, along with representatives from the Ministry of Defense. The process of obtaining a license under ITAR takes, on average, less than two months[52] and the process for obtaining DECA

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[49] A good definition of dual-use items is given by the European Commission: "Dual-use items are goods, software and technology that can be used for both civilian and military applications. The EU controls the export, transit and brokering of dual-use items so the EU can contribute to international peace and security and prevent the proliferation of Weapons of Mass Destruction (WMD)." *Dual-use Trade Controls*, EUROPEAN COMM., http://ec.europa.eu/trade/import-and-export-rules/export-from-eu/dual-use-controls/ (last visited Dec. 17, 2018).

[50] *See The International Traffic in Arms Regulations*, U.S. DEP'T OF STATE – DIRECTORATE OF DEF. TRADE CONTROLS, https://www.pmddtc.state.gov/?id=ddtc_kb_article_page&sys_id=%2024d528fddbfc930044f9ff621f961987 (last visited Dec. 17, 2018).

[51] *About DECA*, ISRAELI MIN. OF DEFENCE, (July 26, 2017), http://www.exportctrl.mod.gov.il/English/Pages/default.aspx.

[52] *See* U.S. DEP'T OF STATE, *supra* note 50.

approval normally takes three months, but may be expedited in certain cases.[53]

G. Confidentiality

Submitted applications, including all information therein, will become part of the project file within Space Florida and the IIA and, consequently, become public records. Both Space Florida and the IIA are subject to broad national freedom of information laws that provide for the disclosure of public records; consequently, all files might be disclosed upon request by certain parties. These laws do provide statutory exemptions for confidential information, which may or may not apply. Accordingly, the calls for projects explicitly stipulate that "trade secrets and proprietary confidential business information are not solicited, nor desired, as information to be submitted by the Applicants."[54] If applicants wish to submit information and ask for confidentiality, they need to follow a specific stipulated procedure.

V. IMPLEMENTATION

The experience from the implementation of the framework program so far shows it achieves its goal of fostering international B2B cooperation in the space sector between Florida and Israel. The program has yielded cooperation and projects that would not otherwise have happened.

The first call for projects released in 2013[55] stated that "Israeli and Floridian companies are asked to present cooperative proposals, which will be jointly vetted for feasibility, and research funding will be awarded to the most promising partnerships" and that the total available funds were $2,000,000. Five teams had applied,[56] two projects were selected for first-round awards and $460,000 in funding was awarded. One project would attempt to

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[53] *See* Florida-Israel Innovation Program, *supra* note 31.

[54] *See* 4th Call for Projects, *supra* note 34; 3rd Call for Projects, *supra* note 31; 2nd Call for Projects, *supra* note 31; 1st Call for Projects, *supra* note 31.

[55] The First Call for Projects had a different title: "Space Florida-Israel Innovation Partnership Aerospace Track–Request for Proposals." The call was released on December 6, 2013, with a deadline for submission of applications set for February 28, 2014, followed by an evaluation period of three months.

[56] Interview with Liron Eldar, *supra* note 42.

significantly improve an existing technology, while the other one would develop a new technology.[57] While only a quarter of the total funds available were used, it was nevertheless a satisfactory start for the program, considering it was a new program with insufficient awareness of the target audience and a short period for application.[58] Indeed, the following call for projects would be a better test of the long-term success of the program.

A second call for projects was released in 2015.[59] A total of seven teams had applied, six of them were found to have good proposals, but only four were selected, to allow sufficient funds for the selected projects.[60] Lockheed Martin Space Systems is the Florida partner in one of the winning projects.[61] This time round, all available funds were allocated. The outcome of the second call demonstrated that after only one round, the program gained sufficient awareness in both Florida and Israel. Furthermore, the program seems to be attractive enough to draw more projects than available funds and to bring about new partnerships and projects that otherwise would probably not have been initiated.

A third call for projects was released in 2015[62] and followed the lines of the second call. The number of submissions had risen again,

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[57] On September 17, 2014, Space Florida and the IIA announced the projects that would be funded. *See Space Florida and Israel's Chief Scientist Announce Industry Awardees of Innovation Project Funding*, *Enterprise Florida*, SPACE FLORIDA (Oct. 8, 2014), https://www.enterpriseflorida.com/news/space-florida-and-israels-chief-scientist-announce-industry-awardees-of-innovation-project-funding/.

[58] The call was released just three months before the closing date. It takes time to raise awareness for the mere existence of the program. Moreover, it also takes time for companies to prepare for an application from identifying a suitable project, through finding a relevant partner in the other country, discussing the technological and technical issues, agreeing on the business model, negotiating the legal issues, and preparing the application.

[59] 2nd Call for Projects, *supra* note 31. The Second Call for Projects was released on October 29, 2014, with the application submission period starting that day and running through March 16, 2015. The evaluation period ranged from October 30, 2014, through June 15, 2015.

[60] Interview with Israel Shamay, *supra* note 42.

[61] On July 20, 2015, Space Florida and the IIA announced the projects that would be funded. *See Space Florida and Israel's Chief Scientist Announce Industry Awardees for 2nd Round of Innovation Partner Funding*, SPACE FLORIDA (July 20, 2015), https://www.spaceflorida.gov/news/space-florida-and-israels-chief-scientist-announce-industry-awardees-for-2nd-round-of-innovation-partner-funding/.

[62] *See* 3rd Call for Projects, *supra* note 31. The evaluation period ranged from February 2, 2016, through May 1, 2016.

to twelve (comparing to five in the first call and seven at the second call). The increase demonstrates growing awareness of the program and its appeal to companies in both Florida and Israel. Out of the twelve submissions, four teams were selected to be awarded financial support for their joint project.[63] Again, all available funds were allocated, and Lockheed Martin Space Systems was the Florida partner in one of the teams.

A fourth call for projects was released in 2016,[64] and followed the lines of the second and third calls. The number of submissions has risen yet again, to twenty-two (comparing to five in the first call, seven at the second call and twelve in the third). The sharp increase demonstrates a wide awareness of the program, a significant appeal to companies in both states and the success of the program and its implementation to date. Out of the twenty-two submissions, five teams were selected to be awarded financial support for their joint project and all available funds were allocated. [65] In addition to the five chosen projects, the IIA has approved funding, unilaterally but under the fourth round, for an Israeli corporation which continues to work in partnership with a Florida corporation on a joint project.[66]

A fifth call for projects was released in 2017[67] and followed the lines of the previous calls.

The outcomes of the calls for projects so far demonstrates the success of the program as reflected in several factors: (i) popularity - the increasing awareness of the program and an increase in its popularity, which comes into effect in the growing number of applications; (ii) diversified research fields - the representation among applicants of a significant variety of fields of research, in accordance

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[63] On June 8, 2016, Space Florida and the IIA announced the projects that would be funded. *See Space Florida and Israel's Chief Scientist Announce Third-Round Winners of Innovation Partner Funding*, SPACE FLORIDA (June 1, 2016) https://www.spaceflorida.gov/news/space-florida-and-israels-chief-scientist-announce-third-round-winners-of-innovation-partner-funding/.

[64] *See* 4th Call for Projects, *supra* note 34.

[65] On June 13, 2017, Space Florida and the IIA announced the projects that would be funded. *See Space Florida and Israel Innovation Authority Announce Fourth Round Winners of Innovation Partner Funding*, SPACE FLORIDA (July 5, 2017) https://www.spaceflorida.gov/news/space-florida-and-israel-innovation-authority-announce-fourth-round-winners-of-innovation-partner-funding/.

[66] *Id.*

[67] *See* 5th Call for Projects, *supra* note 34.

with the aims of the program; (iii) diversified actors - the program attracts both well-established corporations like Lockheed Martin Space Systems and smaller and younger companies, including start-ups; and (iv) small nations benefit - the program is advantageous especially to Israeli corporations, being provided access to resources and facilities they would otherwise find it much more difficult to get access, like the International Space Station (ISS).[68]

The list of corporations that applied for funding shows corporations that have won previous rounds applying again in subsequent rounds, demonstrating satisfaction from the program by its participants.

VI. TOWARD A NETWORK OF COOPERATION MODULES

The cooperation agreement between Florida and Israel is important beyond its immediate effects. Once a government has a well-functioning cooperation agreement, it is in a position to collaborate with even more governments using a similar model, eventually fostering cooperation between a large number of governments. The proliferation of such small-scale cooperation modules will, as shown by the findings of Institutional Analysis, result in the promotion of large-scale international cooperation in space activities and promote the basic norm of international cooperation in space activities.

Institutional Analysis is a research field within the social sciences studying the creation and operation of institutions. Institutions include, by definition, cooperation modules.[69] A major contributor to modern institutional analysis was Elinor Ostrom, the 2009 Nobel laureate in economic sciences, who developed the neo-institutional approach. Ostrom studied diverse institutional arrangements for governing common-pool resources (CPRs) and public

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[68] The joint projects of Micro-gRx and SpacePharma, approved in the fourth round, aims to develop better disease models of muscle-wasting associated with aging by using human muscle cells placed in a microgravity environment on board the ISS. The Israeli partner would otherwise find it much more difficult to get access to the ISS. *See* SPACE FLORIDA, *supra* note 66.

[69] Institutions are structures and mechanisms of social order and cooperation that govern human behavior and interaction. Institutions may take the form of sets of rules and established organizations, including rules deriving from agreements and international institutions.

goods; as the Nobel committee noted, her observations are important not only to the study of natural resource management, but also to the study of human cooperation more generally.[70]

Building on a wide empirical database, supported by theoretical models and analysis, Ostrom demonstrated that collective action is feasible and that decentralized local institutions perform better than their counterparts.[71] Moreover, and relevant to this discussion, Ostrom found that large-scale cooperation can be amassed gradually from below.[72] This suggests that promoting international cooperation does not require either a strong, central, global institution or rules imposed from above. Instead, gradually expanding the number of cooperation modules and participants will have the aggregate effect of creating a network of cooperation modules and cooperative relations. Furthermore, the overlapping and crossing of cooperation modules is not a threat but an advantage, creating an ever-expanding network of cooperation and clusters of cooperation.[73]

VII. CONCLUSION

The agreement between Florida and Israel serves numerous goals. To begin with, it connects corporations from Florida and Israel that would otherwise not cooperate and further enables the launch of joint projects, initiated by the private sector with funding from both governments. As the experience from similar framework program has shown, the spillover effects are expected to benefit the space sector in Florida and Israel and both economies overall. Furthermore, the agreement established a model that can be used by Florida, Israel, and other governments to enter into other similar partnerships. Lastly, it contributes to international cooperation in

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[70] *See* The Econ. Scis. Prize Comm. of the Royal Swedish Acad. of Scis., *Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance* 1, 2 (Jan. 15, 2014), http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html [hereinafter Royal Swedish Acad.].

[71] That is, better than both the market and the state, in cases of CPRs and public goods. *See* Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, 100 AM. ECON. REV. 641(2010).

[72] *See id.* at 16-18; *see also* Eytan Tepper, *Applying Ostrom's Nobel Winning Study to International Cooperation in Space Activities*, 57 INT'L INST. OF SPACE L. 675 (2014); Royal Swedish Acad., *supra* note 70.

[73] Tepper, *supra* note 72.

space activities in general, by expanding the network of cooperation modules and introducing a model for even more such modules.

Both Florida and Israel have in recent years shifted more weight to commercial space activities. Florida, once home of the most advanced, complicated, and expensive US space projects (i.e., the Apollo missions and the space shuttles), has seen a significant downsizing of government activities, resulting in massive job loss. The state government has responded by promoting commercial initiatives. The new Israeli civil space policy, likewise, is focused on the promotion of commercial activities and international cooperation.

In the current age of New Space, with commercial activities and the private sector slowly taking the lead, promoting international cooperation in space activities means not just cooperation between States and space agencies but also commercial, business-to-business cooperation. The model reviewed in this paper relieves some of the obstacles to B2B cooperation and fosters such cooperation.

The Florida – Israel Innovation Partnership Program is based on well-tested and successful model of framework programs, with a focus on international cooperation. The program seems to be solid and includes all the necessary ingredients for success, most notably (i) identifying areas of mutual interest to both states; (ii) identifying specific projects and companies that will benefit from industrial R&D cooperation; (iii) matchmaking corporations from both countries suitable for cooperation; (iv) stimulating contacts and facilitating exchange of technical information and expertise; (v) providing business consultation; (vi) providing access to infrastructure and development tools; and (vii) providing financial support and sharing the financial risk of R&D.

The experience of the implementation of the program so far shows a steady and sharp increase in applications, indicating growing awareness and a significant appeal to companies in a variety of research fields in both states. The framework program attracts both well-established corporations like Lockheed Martin Space Systems and smaller and younger companies, even startups. The first four calls for projects already concluded have brought together companies from the two states that might not have cooperated otherwise.

Fifteen collaborative projects have been awarded financial support and are already underway.

Such cooperation agreements as that between Florida and Israel have important downstream effects, as the Israeli experience over the last thirty years with framework programs has demonstrated. A recent Israeli study has shown the significant positive economic effects of such framework programs for the applicants, the industry, and the economy, with a total return on government support for the economy as a whole ranging from 475% to 751%.

Moreover, once a State has a well-functioning cooperation agreement, it is in a position to collaborate with even more States using a similar model, and other governments wishing to establish similar programs can do so with few adjustments, eventually fostering cooperation between a large number of States (including agreements among more than two governments). Expanding the model to include more governments would increase the likelihood of synergy between projects, companies, and personnel and increase the dissemination of know-how, expertise, and experience.

Clearly, the more agreements of this sort are established, the wider the resulting network of cooperation becomes and the bigger the expected impact on the commercial space industries of the participating States. This network will facilitate and promote space-related R&D, commercial space activities, commercial utilization of outer space, and as Ostrom demonstrated, large-scale international cooperation in space activities.

STUDENT ARTICLE

A MODEST PROPOSAL: USING REMOTE SENSING TO MONITOR AND PROMOTE WASTE ANNIHILATING MOLTEN SALT REACTORS AND NUCLEAR WASTE RECYCLING

Cameron Pittman[*]

ABSTRACT

The power needs of humanity are increasing, particularly as the global human population continues its unprecedented high levels of growth. In order to meet these needs, nuclear power must be utilized in order to protect Earth's natural environment from carbon emissions and provide people with the most reliable means of energy production. Waste Annihilating Molten Salt Reactors are one way of safely generating clean energy, and the use of remote sensing technology can hasten adoption and development of these reactors around the world. Waste Annihilating Molten Salt reactors can safely be shut down in the event of an accident, meaning that dangerous meltdowns from industry standard light water reactors can be avoided. These reactors do not require highly enriched uranium for their use, meaning that they do not contribute to nuclear weapons proliferation. These reactors can even be fueled with some forms of nuclear waste which would otherwise accumulate in inadequate storage facilities and remain dangerously radioactive for hundreds of thousands of years. The tremendous benefits that Waste Annihilating Molten Salt Reactors offer humanity cannot be overstated. By encouraging an international regime to help construct these reactors across the globe, and by using remote sensing

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technology to help ensure compliance, map out ideal locations for these reactors and track dangerous weather patterns, remote sensing and Waste Annihilating Molten Salt Reactors can be used to preserve Earth's environment for future generations in a clean, responsible manner while also adequately providing for humanity's growing energy needs.

I. INTRODUCTION

Remote sensing is the act of scanning the Earth via satellite or aircraft flying at high altitude in order to obtain information. This provides humanity with a plethora of vital intelligence regarding the Earth and has changed our everyday lives in immeasurable ways. There are, of course, military applications for remote sensing, which include the United States GPS satellite network free for the use of everyone,[1] the targeting of missiles for increased precision, and many other applications. Remote sensing satellites are also used for global communications, to detect and transmit information about weather and storms, tracking the movement of migrants, generating highly accurate topographical maps, mapping the ocean floor, tracking the growth of population centers, observing forest fires or erupting volcanos,[2] studying climate change, and even aiding in locating lost ancient cities.[3] In short, remote sensing technology offers tremendous benefits to humanity.

Remote sensing also provides countless more indirect ways to improve our lives on Earth. In particular, this paper encourages and provides a proposed legal framework for the use of remote sensing to address the soon-to-be critical global issue of nuclear waste accumulation. Nuclear waste is a growing threat across the world

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[1] Juquai McDuffie, *Why the Military Released GPS to the Public*, POPULAR MECHS. (June 19, 2017), https://www.popularmechanics.com/technology/gadgets/a26980/why-the-military-released-gps-to-the-public/.

[2] *What is Remote Sensing and What is it Used For?* U.S. GEOLOGICAL SURVEY, https://www.usgs.gov/faqs/what-remote-sensing-and-what-it-used?qt-news_science_products=7#qt-news_science_products (last visited Oct. 20, 2018).

[3] *See* David Stott et al., *Mapping an Ancient City with a Century of Remotely Sensed Data*, 115 Nat'l Acad. of Scis. of the U.S. 24 (2017), *available at* http://www.pnas.org/content/115/24/E5450; Abigail Tucker, *Space Archaeologist Sarah Parcak Uses Satellites to Uncover Ancient Egyptian Ruins*, SMITHSONIAN MAGAZINE, Dec. 2016, *available at* https://www.smithsonianmag.com/innovation/space-archaeologist-sarah-parcak-winner-smithsonians-history-ingenuity-award-180961120/.

and there remains insufficient means for proper permanent disposal.[4] Nuclear waste will only continue to accumulate if we follow the current paradigm of nuclear waste storage. Moreover, the amount of waste in the world is only going to increase as the world's energy needs continue to grow and developing nations continue to nuclearize in order to achieve power independence.

Technology exists that can mitigate the dangers of accumulated nuclear waste. Waste Annihilating Molten Salt Reactors ("WAMSR") are a form of nuclear reactor that can utilize nuclear 'waste' in order to generate more power.[5] Currently, only about 3-5% of the available energy in uranium rods can be extracted in traditional fission nuclear plants.[6] WAMSRs are capable of extracting up to 98% of the remaining energy in depleted uranium fuel rods.[7] By utilizing these spent rods to generate power, we efficiently use our nuclear resources to their maximum extent and dramatically reduce both the quantity and radioactive half-life of the resulting nuclear waste. Spent fuel that would be radioactive for hundreds of thousands of years would become safe within centuries instead.[8]

WAMSRs and nuclear power plants as a whole also have the benefit of being truly efficient regardless of weather conditions, unlike wind and solar energy, and have the benefit of producing virtually no greenhouse gases.[9] A 550 megawatt WAMSR reactor can be built for about two billion USD with a three year construction time,[10] but these reactors pay for themselves in the long run in

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[4] Michael Wallace et al., *Finding a Solution to America's Nuclear Waste Program*, CTR. FOR STRATEGIC & INT'L STUDIES (Aug. 2, 2013), https://www.csis.org/analysis/finding-solution-america%E2%80%99s-nuclear-waste-problem.

[5] *Molten Salt Reactors*, INT'L ATOMIC ENERGY AGENCY, https://www.iaea.org/topics/molten-salt-reactors (last visited Feb. 11, 2019).

[6] Louise Lerner, *Nuclear Fuel Recycling Could Offer Plentiful Energy*, ARGONNE NAT'L LAB. (June 22, 2012), https://www.anl.gov/articles/nuclear-fuel-recycling-could-offer-plentiful-energy.

[7] Chris Lo, *Molten Salt Reactor: The Face of New Nuclear?* POWER TECH. (June 16, 2013), https://www.power-technology.com/features/featuremolten-salt-reactor-face-new-nuclear/.

[8] Lerner, *supra* note 6.

[9] David Biello, *How Nuclear Power Can Stop Global Warming*, SCI. AM. (Dec. 12, 2013), https://www.scientificamerican.com/article/how-nuclear-power-can-stop-global-warming/.

[10] Transatomic Power Corp., *Technical White Paper*, 24 (Nov. 2016), http://www.transatomicpower.com/wp-content/uploads/2015/04/TAP-White-Paper-v2.1.pdf.

terms of energy produced, the safety of these reactors, their ability to recycle dangerous nuclear waste, and to use uranium-238, which is a much more prolific isotope of uranium, instead of the much rarer uranium-235[11] used in traditional reactors. These reactors also aid nuclear weapon non-proliferation because the radioactive material used is not weapons grade and requires a very low enrichment percentage compared to other traditional fission reactor types.[12]

WAMSRs benefit from being able to be quickly and safely shut down in the event of an emergency,[13] something that traditional nuclear fission reactors are incapable of doing, as demonstrated by the Fukushima nuclear accident which was incapable of shutting down after the tsunami and earthquake disasters damaged the plant.[14] A WASMR does not need to be near a large body of water and is not geographically limited in where it can be placed, and it is much safer than traditional reactor designs; because there is no water used as a coolant there is no risk of steam or hydrogen explosions.[15] These reactors are also smaller and easier to miniaturize, making them suitable for use on container ships instead of diesel fuel, the largest of which each produces more pollution than fifty million cars.[16] The US Navy has utilized nuclear reactors on their ships for decades without major incident,[17] a clear model for how commercial ships could safely operate – a method that is ultimately more reliable, environmentally friendly, and safer than tanking around millions of gallons of fossil fuels.

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[11] *What is Uranium?* URANIUM PRODUCERS OF AM., http://www.theupa.org/what_is_uranium/.

[12] Transatomic Power Corp., *supra* note 10, at 26.

[13] *Id.* at 22-23.

[14] *Fukushima Accident*, WORLD NUCLEAR ASSOC. (Oct. 2017), http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-accident.aspx.

[15] *See* Badaway M. Elsheikh, *Safety Assessment on Molten Salt Reactors in Comparison with Light Water Reactors*, 6 J. OF RADIATION RESEARCH & APPLIED SCIS. 63 (2013).

[16] John Vidal, *Health Risks of Shipping Pollution Have Been 'Underestimated'*, THE GUARDIAN (Apr. 9, 2009), https://www.theguardian.com/environment/2009/apr/09/shipping-pollution.

[17] *Operating Naval Nuclear Propulsion Plants and Shipping (Rail) Naval Spent Fuel Safely for Over 60 Years*, DEP'T OF ENERGY, https://www.energy.gov/sites/prod/files/migrated/nnsa/2018/01/f46/united_states_naval_nuclear_propulsion_program_operating_naval_nuclear_propulsion_plants_and_shipping_rail_naval_spent_fuel_safely_for_over_sixty_years.pdf.

This article proposes an international agreement governed by the International Atomic Energy Agency ("IAEA") which will encourage states to build WAMSRs and recycle their nuclear waste. Contracting States should also assist interested developing nations in building these types of reactors so that they too can benefit from nuclear power in a much safer way than if those developing States had to start from scratch and develop nuclear power generating technologies by themselves. This article stresses the importance of remote sensing for the furtherance of this agreement in order to ensure compliance with the treaty. Members to this agreement would consent to register the locations of the nuclear waste repositories and nuclear plants for ease of remote sensing. Nations would provide their processed and analyzed data to nations planning new sites in order to assist them in selecting safe locations that do not risk potentially poisoning ground water in the event of a disaster. Nations would also remain bound by the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency of 1986 in the highly unlikely event of a nuclear accident, with stronger requirements on member States to act and aid each other. Remote sensing is paramount to ensure compliance with this agreement, it will also help to establish international cooperation and trust between countries and better educate the public on the benefits of nuclear power produced from WAMSRs. This agreement will be an advancement both in protecting Earth's natural environment, and an advancement of the lofty goals of the Remote Sensing Principles, some of which this proposed agreement would seek to strengthen.

II. REMOTE SENSING AND EXISTING LEGAL REGIMES SURROUNDING IT

Remote sensing remains uncontrolled by any binding international legal regime, though the Remote Sensing Principles offer non-binding principles to guide nations in the use of their remote sensing capabilities.

Remote sensing is conducted via a variety of tools beyond simple cameras. All satellites are capable of capturing at least one band of light. Commercial satellites typically sell four bands: red, green, blue, or near infrared (invisible to the human eye). However, the

US government's Landsat satellite offers eleven bands.[18] In terms of optical imagery, there is greyscale data, which offers high spatial resolution because it contains less data, and then there are multi-spectral images which offer colors that the human eye can detect in the red, green, and blue wavelengths. These images have less sharp resolution because they contain more data per pixel.[19] Google Maps (and others) use a technique known as pan-sharpening with the use of software to process panchromatic and near infrared images, which creates a compromise of panchromatic sharpness and the usefulness of color images.[20] Many bands capture light invisible to the human eye, which capture information that would otherwise be missed. For instance, near infrared reflects very well off vegetation, making it useful for detecting camouflaged vehicles or netting, as well as construction, burn marks in vegetation from missile launches, or even the tracks from heavy vehicles. These images are then translated into red, green, and blue images that humans can view.[21]

Additionally, remote sensing also involves more than mere collection of raw data, but also the processing and analysis of remote sensing data. These steps are just as important as collecting the data, otherwise the raw data would be largely useless to most people. First, a remote sensing satellite uses an energy source to illuminate the target. As this energy travels to the target, the energy passes through the atmosphere, which may happen twice as the energy travels back from the target to the sensor. The energy will interact with the target, and this interaction can vary depending on the properties of the target, the type of sensing being conducted, and radiation. The energy is then scattered, reflected, or otherwise emitted from the target, and this interaction is then recorded by the satellite's sensor. Thereafter, the energy readings are transmitted (typically electronically) to a receiving and processing station. There, the data are processed into images. The image is processed

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[18] Melissa Hanham & Jeffrey Lewis, *Remote Sensing Analysis for Arms Control and Disarmament Verification* 2 (FED'N OF AM. SCIENTISTS), https://fas.org/wp-content/uploads/media/Remote-Sensing-Analysis-for-Arms-Control-and-Disarmament-Verification.pdf.

[19] *Id.*

[20] *Id.* at 2-3.

[21] *Id.* at 2-5.

and then interpreted visually and/or electronically to extract information about the remote sensing target. Finally, the information gained from the imagery is used to better understand the target, reveal some new information, or otherwise assist in solving a problem.[22]

Remote sensing, also referred to as a national technical means of verification, has been written into several treaties, mostly arms treaties. For instance, the 1991 Strategic Arms Limitation Treaty (START 1) between the US and Soviet Union deals in part with using remote sensing to ensure compliance. In Article V(26), both parties have an obligation to not locate railcars at sites of rail garrisons eliminated under the provisions of Section IX of the Convention or Elimination Protocol unless those railcars have differences observable by national technical means of verification from rail-mobile launchers of ICBMs or launch-assisted railcars.[23] Article VII(1) of this treaty also notes that the conversion and elimination of strategic offensive arms, fixed structures for mobile launchers of ICBMs, and facilities shall be verified by national technical means of verification.[24] Article IX(1) reads that both parties shall use national technical means of verification to ensure compliance with the treaty, in a manner consistent with generally recognized principles of international law.[25] Clearly the United States and the Soviets had confidence in their remote sensing satellites to ensure compliance with these treaties, or else such treaties would have either never been ratified, or required an agreement with more invasive means of compliance verification.

New START, a treaty between the US and Russian Federation which came into force in 2011 also relies on remote sensing to ensure compliance. In Article VI(3), compliance with the treaty to ensure conversion, elimination, or other means of removal of strategic

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[22] *Fundamentals of Remote Sensing*, NAT. RES. CAN., https://www.nrcan.gc.ca/node/9363 (last visited Feb. 11, 2019).

[23] Treaty Between the United States of America and the Union of Socialist Soviet Republics on Further Reduction and Limitation of Strategic Offensive Arms (START I), US-USSR, art. V(26), July 31, 1991, *available at* https://www.state.gov/documents/organization/27360.pdf.

[24] *Id* at art. VII(1).

[25] *Id* at art. IX(1).

offensive arms and facilities will be monitored with national technical means of verification as well as inspections.[26] Importantly, Article X(1) includes a provision in which the parties are prohibited from interfering with the national technical means of verification of the other party in accordance with this Article, as well as prohibiting parties from using concealment measures to impede verification by national technical means.[27] Remote sensing satellites and their capabilities have only increased over time, making remote sensing a logical and effective means of ensuring treaty compliance. The potentially high stakes of arms limitation treaties require that all parties involved have effective and reliable means to ensure that the terms of the arms reduction treaties are being complied with. Without having highly reliable means to ensure compliance, parties would be unlikely to agree to arms limitation treaties for fear that the other party would not comply in an effort to gain a strategic advantage over other parties. Remote sensing satellites are highly useful for ensuring compliance with arms limitation treaties, and they should be equally effective (if not more so) in ensuring compliance with a treaty involving WAMSRs and nuclear waste depositaries given their less mobile nature.

III. THE THREAT OF NUCLEAR WASTE AND OTHER ENVIRONMENTAL PROBLEMS THAT THE WORLD FACES TODAY DUE TO A GROWING NEED FOR POWER GENERATION

A. Current Threat and the Growing Need for Power

Nuclear power is a very important means of power production, accounting for 18% of the world's power.[28] This number is expected to skyrocket as new generations of nuclear reactor technology are developed which are safer, more efficient, and which developing nations will surely seek for the many advantages that nuclear power has over fossil fuel, coal, wind, or solar energy production. While some European States such as Germany have elected to move away

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[26] *Id* at art. VI(3).

[27] *Id* at art. X(1).

[28] *OECD Gross Electricity Production by Source, 1974-2016*, INT'L ENERGY AGENCY (Aug. 8, 2017), https://www.iea.org/newsroom/energysnapshots/oecd-electricity-production-by-source-1974-2016.html.

from nuclear energy[29] due to misconceptions about the hazards of nuclear energy production, many other States, including Turkey[30] and the United Arab Emirates,[31] are currently investing in nuclear power plants and this trend is only likely to grow. However, with this investment in traditional nuclear fission plants comes the added problem of nuclear waste, which is difficult to safely store[32] and which remains radioactive for hundreds of thousands of years instead of several hundred with WAMSR designs.[33]

Nuclear waste is produced by traditional fission nuclear reactors, and is not destroyed. It is typically stored 'temporarily' at nuclear power plants due to the difficulty in safely storing the waste and the lack of sufficient permanent long term storage sites.[34] The United States in particular has no long term storage site for nuclear waste.[35] More than thirty countries around the world utilize nuclear reactors to produce electricity, and this number is only going to grow[36] as the energy needs of humanity grow, and as nations further develop. Currently some nuclear waste storage sites in the US contain more than five times the permitted amount of nuclear waste that they are licensed to store;[37] long term nuclear waste storage is a huge problem even in developed States that have long used nuclear energy. As of 2017, the IAEA projects nuclear energy production to rise 42% from current levels by 2030, and double by the year 2050.[38]

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[29] *Nuclear Power in Germany*, WORLD NUCLEAR ASSOC. (Jan. 2019), http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/germany.aspx.

[30] *Nuclear Power in Turkey*, WORLD NUCLEAR ASSOC. (Dec. 2018), http://www.world-nuclear.org/information-library/country-profiles/countries-t-z/turkey.aspx.

[31] *Nuclear Power in United Arab Emirates*, WORLD NUCLEAR ASSOC. (July 2018), http://www.world-nuclear.org/information-library/country-profiles/countries-t-z/united-arab-emirates.aspx.

[32] Charles de Saillan, *Disposal of Spent Nuclear Fuel in the United State and Europe: A Persistent Environmental Problem*, 34 HARV. ENVTL. L. REV. 461, 472-78 (2010).

[33] Transatomic Power Corp,, *Technical White Paper* 17(Mar. 2014), http://large.stanford.edu/courses/2015/ph241/khalaf1/docs/TAP_White_Paper.pdf.

[34] Saillan, *supra* note 32, at 464.

[35] *Id.* at 464.

[36] *Id.* at 462.

[37] *Id.* at 477.

[38] *See* Int'l Atomic Energy Agency, *Energy, Electricity and Nuclear Power Estimates for the Period Up to 2050,* 18, 22 (2017), https://www-pub.iaea.org/MTCD/Publications/PDF/17-28911_RDS-1%202017_web.pdf, at 18 and 22

It is true that nuclear waste can be reprocessed, but this solution is not the answer to the problem of the nuclear waste. Nuclear waste reprocessing has a wide array of problems, including the highly acidic and radioactive waste that is produced from reprocessing;[39] it is also extremely expensive and is still not especially technologically feasible.[40] Reprocessing plutonium also raises dangers of nuclear waste proliferation because the reprocessing of plutonium cuts back on the extremely dangerous gamma rays that the plutonium produces, making it safer and easier to handle.[41] Nuclear reprocessing is not a desirable method of getting rid of nuclear waste; the process itself produces nuclear and other highly problematic types of waste. Even if nuclear reprocessing or long term storage of nuclear waste are not answers to the growing problem and environmental hazards of nuclear waste, we do have the means to recycle nuclear waste – by building Waste Annihilating Molten Salt Reactors.

B. Using Waste Annihilating Molten Salt Reactors to Recycle Nuclear Waste and Generate Green Energy

Waste Annihilating Molten Salt Reactors are the answer to the ever growing problem of our high level nuclear waste, and they are an ideal solution to the environmental dangers of greenhouse gas production because WAMSRs have the benefit of being emission free.[42] About 42% of all greenhouse gas production comes from the production of electricity and heat,[43] with China producing about 26% of all greenhouse gases, followed by the United States at 16% and then India at 6.2%.[44] India's production, however, is expected to skyrocket in the next several decades as it is the world's second

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[39] Saillan, *supra* note 32, at 465.

[40] *Id.* at 477.

[41] *Id.* at 483.

[42] *Greenhouse Gas Emissions Avoided Through Use of Nuclear Energy*, WORLD NUCLEAR ASSOC., http://www.world-nuclear.org/nuclear-basics/greenhouse-gas-emissions-avoided.aspx (last visited Feb. 11, 2019).

[43] Takashi Kamei, *Perspective of R&D of Small Molten Salt Reactor (MSR) – Proposal of UNOMI* 299 (ResearchGate, Dec. 2014), https://www.researchgate.net/profile/Takashi_Kamei2/publication/291115859_Perspective_of_RD_of_small_molten_salt_reactor_MSR_-_proposal_of_UNOMI/links/569e15e108ae16fdf07b8d13.pdf.

[44] *Id.* at 299.

largest country as well as a developing country and economy.[45] The development of countries such as India present a unique challenge as well as a unique opportunity. If the necessary financing, international assistance, and incentives are provided, greenhouse gas production in countries that might otherwise heavily rely on coal and fossil fuel burning to produce power can be mitigated or even eliminated by building WAMSRs instead. India has the goal of producing 25% of all of its energy needs by utilizing nuclear energy by the year 2050,[46] and India has rich reserves of Thorium[47], an important nuclear fuel type, and one which WAMSRs could utilize.[48] Therefore, getting a rapidly developing country such as India on board with an international agreement for producing WAMSRs is important for protecting Earth's natural environment and pursuing the safest and arguably most versatile form of nuclear power production.

Power needs for humanity are anticipated to rise by 28% by the year 2040, and the United States Energy Information Administration ("EIA") projects that China and India alone will account for 60% of that increase.[49] While renewable energies such as solar and wind have made large strides in recent years, they are not the sole means why which we can generate enough energy to sustain humanity while remaining environmentally conscious. Some areas on Earth are less hospitable to solar and wind power, which are for obvious reasons somewhat weather dependent. WAMSRs do not have this problem, and reliably generate clean, safe energy all year. When the molten salt reactor concept was originally conceived in the 1960's, the reactor required high enrichment uranium that was suitable for nuclear weapons due to its high enrichment.[50] This turned people off from the concept of molten salt reactors, which is unfortunate considering their many advantages. However, due to

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[45] *Id.*

[46] *Nuclear Power in India*, WORLD NUCLEAR ASSOC. (Jan. 2019), http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/india.aspx.

[47] *Id.*

[48] Takashi Kamei, *Review of R&D of Thorium Molten-Salt Reactor*, 81 (ResearchGate, June 2013), https://www.researchgate.net/profile/Takashi_Kamei2/publication/282085819_Review_of_RD_of_thorium_molten-salt_reactor/links/5602a4d708aeaf867fb6ccc0.pdf.

[49] *EIA Projects 28% Increase in World Energy Use by 2040*, U.S. ENERGY INFO. ADMIN. (Sept. 14, 2017), https://www.eia.gov/todayinenergy/detail.php?id=32912.

[50] Transatomic Power Corp., *supra* note 33, at 2.

technological advancements in WAMSR technology, WAMSRs can now operate off very minimally enriched uranium which can be as low as 1.8% in some WAMSR designs.[51] This voids the nuclear proliferation concerns and makes these reactors much more attractive.

Because WAMSRs are capable of utilizing previous spent fuel rods to create power, they recycle that nuclear waste that would otherwise sit around doing nothing other than glowing dangerously for hundreds of thousands of years. By adopting WAMSR designs, humanity benefits not only from recycling nuclear waste and generating environmentally friendly energy, we benefit from a reactor design that can be adapted to utilize thorium[52] for energy production as well as uranium. WAMSRs are also inherently safer than traditional reactor designs, and do not suffer from the same safety problems that the Fukushima reactor had due to the ability to always shut down a WAMSR quickly, which allows for reactions to end within 1.5 – 3 hours.[53] After an earthquake and tsunami struck Japan in 2011, the Fukushima nuclear power plant was badly damaged that the reaction was unable to shut down,[54] resulting in meltdown. Seawater had to be pumped into the reactors as an emergency means to keep the fuel rods cool.[55] It took the better part of a year for the Fukushima reactor to achieve a cool shut down[56] and radiation was released into the environment.[57] Traditional reactors require electricity to complete emergency shutdowns, and their reactions are far hotter than the liquid coolants used.[58] WAMSRs have multiple safety systems that can all be implemented without any operator commands or electricity, unlike light water reactors which operate at high pressure, WAMSRs operate at the infinitely

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[51] *Id.*

[52] *See* Kamei, *supra* note 48.

[53] Transatomic Power Corp., *supra* note 10, at 9.

[54] *Fukushima Accident*, WORLD NUCLEAR ASSOC. (Oct. 2017), http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-accident.aspx.

[55] *Id.*

[56] *Id.*

[57] *Fukushima Radiation Exposure*, WORLD NUCLEAR ASSOC. (Feb. 2016), http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/appendices/fukushima-radiation-exposure.aspx#ECSArticleLink1.

[58] Transatomic Power Corp., *supra* note 10, at 10-11.

safer level of near atmospheric pressure.[59] In the worst case scenario, the molten salt encases and disperses the liquid nuclear fuel used in a WAMSR and this slurry is gravity fed into a contained concrete holding tank.[60] Because the molten salt is a solid at ambient temperatures, the mixture will cool to a solid within the holding tanks within 1.5 – 3 hours without any outside power or coolant added.[61] WAMSRs are much safer than traditional reactor designs.

IV. A PROPOSED INTERNATIONAL REGIME TO ENCOURAGE THE INVESTMENT IN AND USE OF WAMSRS - MONITORING COMPLIANCE WITH REMOTE SENSING TECHNOLOGIES

Waste Annihilating Molten Salt Reactors are essential for the safe and responsible future of nuclear fission technology and for the elimination of harmful nuclear waste. With this in mind, a proposal for an international agreement surrounding the adoption of WAMSRs around the world should be made. It is clear at this time that despite the interest the United States and other countries have in preventing some countries from obtaining nuclear power, such as North Korea and Iran, these efforts have failed. Not only do they have nuclear power, but North Korea has fielded nuclear weapons and intercontinental ballistic missiles;[62] Iran is not expected to be far behind, with the aid of Russia and China in developing their nuclear program.[63] Nuclear power is an attractive means of energy production, and countries are going to continue pursuing it for its many advantages; the United Arab Emirates have just completed construction on their first nuclear fission reactor, for instance.[64]

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[59] *Id.* at 21.

[60] *Id.* at 22.

[61] *Id.* at 9.

[62] Alan Yuhas, *North Korea Nuclear Threat: Should California Start Panicking?* THE GUARDIAN (Apr. 20, 2017), https://www.theguardian.com/world/2017/apr/20/north-korea-nuclear-missile-could-it-hit-california-trump.

[63] Patrick Goodenough, *China, Russia to Help Iran Build New Nuclear Facilities*, CBS NEWS (Jan. 20, 2018), https://www.cnsnews.com/news/article/patrick-goodenough/china-russia-help-iran-build-new-nuclear-facilities.

[64] AFP, *UAE Says its First Nuclear Power Reactor Complete*, Daily Mail (Mar. 26, 2018), http://www.dailymail.co.uk/wires/afp/article-5545251/UAE-says-nuclear-reactor-complete.html.

France maintains a large and healthy domestic nuclear power industry accounting for about 75% of all French power production,[65] while Germany has opted to eliminate their programs with a scheduled phase out around 2022,[66] contrary to the trend of other States that are actively seeking nuclear power.

Other countries will undoubtedly continue to nuclearize, and therefore it is imperative that developed nations with nuclear sophistication assist those nations in the safe and peaceful development of nuclear power plants. WAMSRs are the answer to this problem, and will allow for developed and developing countries to not only safely develop these superior reactors and begin eliminating nuclear waste stockpiles, but also to utilize low enrichment uranium between 1.8% enrichment[67] and 5% enrichment[68] to generate electricity, unlike previous WAMSR reactor designs which required up to 93% enrichment.[69] While the first sections of this article dealt with the desirability of WAMSRs, this section will deal with how such an international agreement can be monitored and enforced with remote sensing technologies.

Remote sensing will be an essential part of this proposal. Not only will remote sensing allow States party to this agreement to monitor the development and safe operation of nuclear sites, remote sensing will be invaluable in mapping out and determining ideal locations for WAMSRs, related nuclear facilities, planning for further infrastructure and development, and ensuring compliance with this agreement. This agreement will establish the International Atomic Energy Agency ("IAEA") as the controlling agency. The IAEA will be empowered with mandatory, non-binding arbitration powers to settle disputes between member States, with optional ICJ jurisdiction in the event that arbitration efforts fail. Member States will be empowered to conduct remote sensing activities on the commercial nuclear plants and nuclear waste reposito-

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[65] *Nuclear Power in France*, WORLD NUCLEAR ASSOC. (Nov. 2018), http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx.

[66] *Nuclear Power in Germany*, WORLD NUCLEAR ASSOC. (Jan. 2019), http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/germany.aspx.

[67] Transatomic Power Corp., *supra* note 33, at 1.

[68] Transatomic Power Corp., *supra* note 10, at 14.

[69] *Id.* at 3.

ries of other member States with a mandatory one-week notification period except in the event of emergencies. This agreement would require States to be open about the location of their commercial facilities, nuclear waste repositories, and other related civilian locations so as to aid the monitoring of member States. The main purposes of this agreement are to prevent nuclear disasters, promote safe and responsible nuclear power generation, and to educate the public about the safety and desirability of WAMSRs for a sustainable future.

A. The Remote Sensing Principles

Perhaps the most controversial aspect of this agreement will be the requirement that member States permit the remote sensing of their nuclear power plants and territory, something that some States, such as France, restrict with the use of shutter control under the French Decree on Remote Sensing and Articles 5-6 of the French Space Operations Act.[70] This agreement seeks to avert some of the controversy by requiring that monitoring States give a mandatory one-week advance notice of their intent to conduct non-penetrative remote sensing of specific nuclear sites of another member State. This diverges from the Remote Sensing Principles because a monitoring State will have an affirmative duty to declare their remote sensing activities to the sensed State without that sensed State making a request. This one-week requirement will be eliminated in the event of an emergency in the sensed State so that sensing State may provide the sensed State with emergency assistance in the form of remote sensing data.

The Principles Relating to Remote Sensing of the Earth from Outer Space ("The Principles") are instructive, but for the purposes of this proposed agreement there are specific areas in which the Principles will need to be strengthened rather than merely incorporated. For instance, Principle II of the RS Principles requires that

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[70] ATSUYO ITO, LEGAL ASPECTS OF REMOTE SENSING 92-93 (2011); LOI no 2008-518 du 3 juin 2008 relative aux opérations spatiales, *available at* https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000018931380&fastPos#LEGISCTA000018939316.

remote sensing be done for the benefit of all humankind.[71] This proposal would expand this goal with specificity and require more developed States to assist developing States in their domestic remote sensing; specifically by aiding the developing States in locating deposits of uranium and thorium, as well as providing the developing States with access to information that will aid those States in planning the best locations for nuclear facilities. This can include information about ground water so that risks of ground water contamination can be avoided, information about fault lines, and so on. Principle IV requires remote sensing activities to be conducted with respect for the sovereignty of all nations over their own wealth and resources, so that remote sensing will not be done in a detrimental manner to those rights.[72] This proposal would expand upon Principle IV to allow States to freely withhold information that they discover when that information is not related to development and monitoring for the purposes of this proposal. This change would not affect the rights of sensed nations to request access to sensed data, merely that sensing nations would not be automatically required to provide irrelevant and potentially profitable information not strictly related to the development of nuclear sites.

Principle V requires States to make opportunities available for States to participate in remote sensing based on equitable and mutually acceptable terms.[73] This proposal would expand on Principle V to specifically allow sensed States to participate in remote sensing over certain regions for the purposes of planning and developing ideal sites and necessary infrastructure for their own WAMSRs; this undertaking would be completed on a waivable reasonable cost basis. Principle VII requires nations involved in remote sensing activities to make available technical assistance to interested nations on mutually agreed upon terms.[74] This proposal would expand on this commitment and have the sensed and sensing States collaborate on the analyzing of processed data related to the development of WAMSRs. Principle VIII states that the UN and relevant agen-

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[71] G.A. Res. 41/65, at Principle 2 (Jan. 22, 1987), *available at* http://www.unoosa.org/oosa/en/ourwork/spacelaw/principles/remote-sensing-principles.html [hereinafter "The Principles"].

[72] *Id.* at Principle 4.

[73] *Id.* at Principle 5.

[74] *Id.* at Principle 7.

cies shall promote international cooperation, including technological assistance and coordination in the area of remote sensing.[75] The proposal would specify that the International Atomic Energy Agency ("IAEA") will be the body responsible for coordination of remote sensing in relation to the planning, development, and monitoring of WAMSR facilities.

Principle IX requires a sensing State to inform the UN Secretary General of their remote sensing program and to provide sensed States affected by the program with any other relevant information at its request.[76] The proposal would specifically require the sensing State to provide remote sensing information to requesting sensed member States on a reasonable cost basis at that nation's request. Principle X relates to environmental protection and requires remote sensing States with identified information capable of averting disasters harmful to Earth's natural environment to forward that information to States concerned.[77] The proposal would add a further requirement to not only forward all identified and relevant information within twenty-four hours of identification, but would also require member States to offer what further assistance they can, if any, to help avert or mitigate a nuclear disaster.

Principle XI requires States with processed data and analyzed information regarding natural disasters in their possession to forward that information to those States affected or likely to be affected as soon as possible.[78] This same requirement would be transferred to the proposal; natural disasters can impact nuclear power plants as cause damage, for example, as earthquakes and tsunamis damaged the Fukushima reactors in 2011.[79] While WAMSRs are safer than traditional fission reactors and won't have the same problems with shutting their reactions down that occurred in Fukushima because of their inherent, walkaway safe design,[80] this agreement pertains to assistance with all nuclear programs with a focus on advancing the adaptation, construction, and use of

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[75] *Id.* at Principle 8.

[76] *Id.* at Principle 9.

[77] *Id.* at Principle 10.

[78] *Id.* at Principle 11.

[79] *Fukushima Accident*, WORLD NUCLEAR ASSOC. (Oct. 2018), http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-accident.aspx.

[80] Transatomic Power Corp., *supra* note 10, at 22-23.

WAMSR technology. Traditional reactors are unlikely to disappear in the near future, so this agreement must take them into account.

Principle XII states that sensed States shall have access to the primary, processed, and analyzed data concerning their territory on a non-discriminatory and reasonable cost basis; with special consideration for the needs and interests of developing countries.[81] This proposal would require sensed States to make requests to sensing States for assistance in planning their nuclear sites, and then require those sensing States to provide all relevant remote sensing data at their earliest opportunity on a reasonable cost basis. Sensed States would have an obligation to identify which regions they are specifically interested in developing for the purposes of this request so as to ease the provision of relevant data. Principle XIII requires sensing States to, upon request, enter into consultations with a State that they are sensing in order to intensify international cooperation by providing the sensed State with opportunities to participate and enhance the mutual benefits of cooperation in remote sensing.[82] This proposal would rely on consultations fairly heavily so that sensed States can enter into agreements and partnerships with sensing States so as to aid in the development of WAMSRs in the sensed, developing States. This procedure would allow for international cooperation and trust building, and ideally streamline the natural of remote sensing requests between States for the purposes of nuclear development and monitoring.

Principle XIV requires States to bear international responsibility for their remote sensing activities regardless of whether the activities are done by a governmental or non-governmental actor.[83] This proposal would adopt a modification that would not result in sensing States incurring liability for mere negligence in providing inaccurate remote sensing data to sensed States. Incurring international liability for inaccurate data would require a showing of gross negligence or malice in order to incur any level of liability. Furthermore, the level of inaccuracy would factor into the analysis. Low levels of inaccuracy resulting in little to no actual harm would be treated far more leniently than high levels of inaccuracy or inaccuracies that result in substantial harm. So long as sensing States

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[81] The Principles, *supra* note 71, at Principle 12.

[82] *Id.* at Principle 13.

[83] *Id.* at Principle 14.

provide the data in good faith, they should generally not be punished for providing inaccurate data.

Principle XV states that any disputes arising from the application of the Remote Sensing Principles shall be resolved through the established procedures for the peaceful settlement of disputes.[84] The proposal would establish a first step of mandatory, non-binding arbitration handled by the IAEA via a panel of arbitrators from contracting States provided that States party to a dispute are incapable of diplomatically settling the dispute between themselves via peaceful methods agreeable to both parties. In the event that the arbitration is unsuccessful, then the States would reserve the right to submit the issue for final adjudication by the ICJ. In the event that the IAEA is a party to a dispute, the issue could be sent before the UN Secretary General who would then be empowered to select neutral arbitrators.

B. Current International and Domestic Laws that Should Be Modified and Incorporated into a New Protocol Promoting the Use of WAMSRs

i. Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency

There are a number of international conventions, regional agreements, and domestic laws that warrant discussion in relation to this agreement. To begin with, there is the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency. This convention has been widely adopted and has 112 party countries, although four States (Bulgaria, Hungary, Mongolia, and Poland) have since denounced it and withdrawn.[85] This convention is an IAEA treaty, and along with the Convention on Early Notification of a Nuclear Accident, both came about immediately after the Chernobyl nuclear accident. This analysis will examine key aspects of this Convention, making notation of specific areas in which it would be improved upon or otherwise modified by this proposal;

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[84] *Id.* at Principle 15.

[85] *Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency – Participant List*, U.N. https://treaties.un.org/Pages/showDetails.aspx?objid=08000002800cf807 (last visited Feb. 11, 2019).

otherwise the unchanged requirements of the Convention would either be incorporated into a separate, new agreement as outlined here, or the new proposal could be a protocol to the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency.

Article 1 of this convention requires States to cooperate between themselves and with the IAEA to facilitate prompt assistance in the event of nuclear accidents so as to minimize the consequences and to protect life, property, and the environment from ill effects of radiation.[86] Article 1(2) encourages nations to enter into bilateral, multilateral agreements, or a combination of both to prevent or minimize injury or damage from nuclear accidents,[87] which is exactly what this article is proposing – a new agreement regarding nuclear power to not only prevent or minimize damage or injury as a result of nuclear accidents, but to provide a cooperative framework for technology transfer and remote sensing that will more effectively ensure the safety of a nuclear-powered world with the safest nuclear power sources currently available.

Article 2 of the convention allows States in need of assistance in the event of a nuclear emergency to request assistance directly from other States or indirectly through the IAEA, and may also request the assistance of the IAEA or other intergovernmental associations.[88] State parties may request assistance regardless of whether or not the accident originated in their territory or jurisdiction,[89] which is a fairly important element in the event that accidents cross territorial boundaries. States that request assistance must specify the scope and type of assistance that they require, although when the requesting State is unable to specify what they need, they can determine and decide what is necessary in consultations with assisting parties.[90]

Article 2(4) requires States to inform the IAEA of experts, equipment, and materials which could be made available for the provision of assistance in the event of a nuclear accident as well as

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[86] Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency art. 1, Nov. 18, 1986, 1457 U.N.T.S. 133, *available at* https://www.iaea.org/sites/default/files/infcirc336.pdf.

[87] *Id.*

[88] *Id.* at art. 2.

[89] *Id.*

[90] *Id.*

the terms, including financial, under which the assistance could be provided.[91] Article 2(4) is important because it allows nations to quickly access what international assistance is available to them through the IAEA without needing to individually contact nations to determine what help they have to offer while in the middle of a crisis. Available technology could be very important to a nation in the middle of a disaster; particularly remote sensing technology which would be very advantageous to have on hand during a crisis. However, this proposal would go further than Article 2(4) by requiring States party to the agreement to provide emergency assistance on a reasonable cost basis rather than for any significant profit, and all relevant remote sensing information must be provided for free and as promptly as possible, as discussed in Article 11 of the Remote Sensing Principles.[92] Furthermore, the new proposed agreement would require nations to update the IAEA annually with the technology that they have available to assist in the event of nuclear accidents so as to ensure that such critical information always remains up to date.

Article 5 requires that the IAEA collect and disseminate information regarding available resources that States are willing to offer in the event of nuclear accidents, available research and methodologies relating to responses to nuclear accidents, and assisting requesting States with preparing emergency plans, training programs, legislative recommendations, and developing radiation monitoring programs, procedures, and standards.[93] This proposal will require that the IAEA produce an annual report containing all of this information where such information changes or updates. This will facilitate the IAEA's mission and provide the most relevant and up to date information to aid in the event of nuclear accidents as well as to aid in radiation monitoring around the globe. This report should contain any relevant information surrounding a remote sensing program (among other things) so as to assist developing States in developing their own domestic remote sensing programs that allow them to engage in global radiation monitoring in furtherance of this proposal.

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[91] *Id*.

[92] The Principles, *supra* note 71, at Principle 11.

[93] Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, *supra* note 86, at art. 5.

Article 6 of the Convention requires assisting and requesting states to protect confidential information that becomes available to either of them in connection with the assistance offered in the event of a nuclear accident, requiring that such information be solely used for the purpose of rendering assistance.[94] This proposal would go a little further than the Convention in conjunction with certain requirements of the Remote Sensing Principles. Insofar as an assisting State becomes aware of information such as the location of resource deposits in the requesting/sensed State while conducting remote sensing to provide emergency aid, that information will not truly be confidential once the sensed State is aware of it. Therefore, this proposal would specifically require that a State who is made aware of this information to provide compensation to the sensing/assisting State for information that might not otherwise have been freely offered. This compensation requirement would be delayed for the extent of the duration of the nuclear accident and for the subsequent relief and recovery period.

Article 6(2) requires the assisting party to make every effort to coordinate with the requesting State before releasing information to the public regarding assistance being provided.[95] This proposal would recommend that liability for any inaccurate information accidentally released after coordination between the assisting and requesting party not be dealt with on a strict liability basis. If a State provides remote sensing data to a State requesting aid, and that State makes a simple mistake, it should not incur liability where it was merely negligent but acting in good faith. This situation is arguably contemplated in Article 8 of the Convention, which will be discussed later in this article.

Article 7 allows States to provide free or discounted assistance in the event of a nuclear accident, providing a list of factors to consider such as whether the State is a developing one or not.[96] This article's proposal would incorporate this with a strong recommendation that States at minimum discount the cost of their provided assistance even for wealthier countries, and provide it free of charge where possible if any developing States suffer from a nuclear accident.

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[94] *Id.* at art. 6.

[95] *Id.* at art. 6.

[96] *Id.* at arts. 6-7.

Article 8 of the Convention discusses privileges and immunities. Article 8(2) requires the requesting State to afford immunity from arrest, detention and legal process, including civil and criminal administrative justice to accepted emergency personnel provided by the assisting State with regards to acts or omissions in the performance of their duties.[97] This arguably includes personnel from the assisting State engaged in emergency relief related remote sensing activities. However, Article 8(9) allows nations to specifically opt to not be bound by Articles 8(2) and 8(3) when signing this Convention.[98] This proposal would strike Article 8(9) as an option – States would not be permitted to opt out of the requirements of Article 8(2) or 8(3) for the purposes of this proposal. If a States provides emergency relief, its workers must not be subject to the civil or criminal penalties of the State that they are assisting in the event that laws of the requesting State are breached while those workers are engaged in their relief related duties.

Article 8(7) helps alleviate this requirement by requiring workers enjoying legal immunities under Article 8 to respect the laws and regulations of the requesting State, so they would rightly not receive immunity for breaching laws unrelated to the performance of their duties absent any specific contract between the requesting and assisting State for that additional grant of immunity. Emergency workers engaged in remote sensing activities either within or without the requesting State would receive the same immunity as other workers from the assisting State provided that they were not in violation of Article 8(7). Remote sensing relief workers who maliciously provided inaccurate data to the requesting nation would be criminally or civilly liable under Article 8(7).

Liability is specifically addressed in Article 10(2), which states that requesting States shall hold the assisting State and its personnel harmless with respect to damage to property or the environment, or death or injury to persons while engaged in their duties unless the assisting State or its personnel were engaged in willful misconduct which led to death, injury, or damage.[99] Just as discussed with regards to Article 8(9), Article 10(5) allows a State to

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[97] *Id.* at art. 7.

[98] *Id.* at art. 8.

[99] *Id.*

opt out of Article 10(2).[100] Pursuant to this proposal, no State would be permitted to opt out of Article 10(2); there are sufficient protections provided for requesting States to shield them against willful misconduct, there is too strong a public policy interest in encouraging international assistance in the event of nuclear accidents to allow States to make rendering such assistance more dangerous or difficult than it is currently. This proposal seeks to promote international cooperation and trust, Articles 8(9) and 10(5) take away from that mission.

Article 13 of the Convention discusses dispute resolution procedures. Article 13(1) encourages States to work issues out between themselves by whatever peaceful means they find acceptable.[101] Article 13(2) allows for States to submit their disputes to arbitration or resolution by the ICJ if the dispute is not settled within 1 year of the parties initiating dispute resolution between themselves. If an arbitration is not settled within six months of initiation, a party may request that the ICJ adjudicate the issue, or the UN Secretary General may appoint one or more arbitrators, with the UN Secretary General having priority.[102] This proposal would mirror Article 13 fairly closely for the purposes of dispute resolution, though it would ultimately replace the UN Secretary General's position in Article 13(2) with the Director General of the IAEA in disputes where the IAEA is not itself a party.

Article 17 of the Convention allows States to denounce it, with such action taking effect one year after denunciation.[103] Only four States of the 114 States party to this convention have denounced it.[104] This proposal would also allow a State that has denounced the convention to withdraw from the emergency aid aspects of the proposal.

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[100] *Id.*
[101] *Id.* at art. 9.
[102] *Id.*
[103] *Id.* at art. 11.
[104] *See supra* note 71.

ii. Convention on Early Notification of a Nuclear Accident

The Convention on Early Notification of a Nuclear Accident[105] is largely an identical supplement to the Convention on Assistance in the Event of a Nuclear Accident or Radiological Emergency. It does not offer much more than what has already been discussed in this proposal, but it deserves mention in this proposal for completeness.

iii. Convention on Nuclear Safety

The Convention on Nuclear Safety is another IAEA treaty that bears consideration for the purposes of this proposal. The preamble of this Convention explains that it is intended to enhance and reaffirm high levels of safety in nuclear power around the globe, promote a culture of nuclear safety, reaffirm that States are responsible for the safe operation of nuclear facilities within their borders and cooperating in further technical work to improve safety throughout the nuclear fuel cycle, such as in nuclear waste storage.[106] In large part, this treaty will be incorporated into this proposal, with some modifications or amendments which will be discussed here.

Article 4 of this Convention requires States to create a framework within their domestic law for taking the necessary legislative, regulatory, and administrative measures for implementing its obligations.[107] This element is important, because States will need their own domestic laws surrounding the safe operation of nuclear power plants and nuclear waste storage facilities. This proposal would charge the IAEA with developing a model set of laws and regulations that States could consider adopting with regards to the safe development, construction, operation, and decommissioning of nuclear reactors. This requirement along with other specific requirements incorporated in this proposal would help developing States get a head start on pursuing their nuclear programs and establishing laws at the time that they develop nuclear power.

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[105] Convention on Early Notification of a Nuclear Accident, Sept. 26, 1986, 1439 U.N.T.S. 275, *available at* https://www.iaea.org/sites/default/files/infcirc335.pdf.

[106] *Id.* at art. 1.

[107] *Id.* at art. 4.

Article 5 requires States to submit for review a report on the measures that they have taken to implement its obligations to this Convention.[108] This proposal would expand on this concept and require developing States to provide annual reports to the IAEA with regards to the development of their WAMSR and other civil nuclear programs. More developed States would also have this same commitment, but emphasis would be particularly on developing States or other States without long-standing experience with operating nuclear facilities.

Article 6 requires States to take appropriate steps to ensure the safety of their existing nuclear installations and to ensure that all reasonably practicable improvements are made to upgrade the safety of their reactors.[109] This proposal would mirror this approach, with States committing to routine upgrades that are practicable to ensure that all nuclear facilities are maintained in the safest condition possible. WAMSRs are extremely safe, but it is important to remember that traditional fission reactors still exist and will continue to exist for some time; we cannot afford to lose our emphasis on maintaining and improving on the safety of reactor designs.

Article 7 deals with legislative and regulatory frameworks and indicates that each contracting party shall have the necessary legislative and regulatory framework to safely operate nuclear facilities, this is to include mandatory licensing to operate a nuclear facility, systems of inspection and assessment, and a means of enforcement which shall include the means to modify, suspend, or revoke a license.[110] Article 10 requires all organizations directly related to nuclear installations maintain safety as their number one priority.[111]

Article 11 requires States to ensure that they have the necessary financial resources to support the safe operation of their nuclear operations.[112] Article 11(2) also requires States to ensure that they have the properly educated and trained staff on hand for all safety related aspects of nuclear operation for the entire life of the

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[108] *Id.* at art. 8.
[109] *Id.* at art. 6.
[110] *Id.* at art. 7.
[111] *Id.* at art. 10.
[112] *Id.* at art. 11.

nuclear installation.[113] This proposal will seek to encourage international cooperation. Therefore, when professionals necessary for the safe construction, maintenance, and operation of nuclear facilities cannot be found within a State, States must be free to recruit the necessary professionals from around the globe and send their nationals abroad to receive necessary education and training to operate these facilities when the necessary educational opportunities are not available domestically. This proposal would encourage international cooperation not only via technology transfer to promote the use of WAMSRs, but also promote the sharing of education and information necessary to safely operate nuclear facilities.

Article 13 deals with quality assurance, requiring contracting States to develop quality assurance programs for all nuclear activities for the duration of that facility's operational life.[114] This proposal would expand on that requirement and additionally require the IAEA to develop model quality assurance programs for States to follow pursuant to this agreement so that a safe minimum base line assurance program could be established. States would be encouraged to exceed the minimum requirements of such an assurance program. Article 14 deals with assessment and verification of safety, requiring comprehensive and systematic safety assessments to be carried out during construction and prior to commissioning a nuclear installation as well as throughout its life.[115] Article 14(2) indicates that verification may be done via analysis, surveillance, testing, and inspection procedures that shall be completed to ensure that the physical state and operation of nuclear installations continue in accordance with its design, applicable safety requirements, and its operational limits.[116] This proposal would specify that remote sensing is one of many ways to conduct the necessary surveillance of a nuclear installation to help verify the safe operation of such facilities, particularly for the purposes of continuous monitoring of nuclear facilities by other States.

Article 17 deals with the siting and location of nuclear facilities, requiring States to consider all siting related factors that are likely to affect the safety of a nuclear facility during its operation,

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[113] *Id.*
[114] *Id.* at art. 13.
[115] *Id.* at art. 14.
[116] *Id.*

likely effect on individuals, society, and the environment, re-evaluating all relevant factors periodically to ensure continued safety of the facility, and consult other States in the vicinity of the nuclear installation insofar as they might be affected by the installation.[117] This obligation extends to allowing neighboring States to request the necessary information for them to make their own assessments about the safety impact on their own territory by nuclear installations.[118] This concept meshes well with those in this proposal; not only will States have the ability to freely conduct non-penetrative remote sensing of other contracting parties' nuclear facilities to ensure safety, States will be free to request information from the State in control of their nuclear facilities for relevant information so as to allow them to independently ascertain the safe operation and siting of nuclear facilities.

Article 18 deals with safe construction and design of nuclear power plants, requiring the design and operation to provide several reliable methods of protection against the release of radioactive materials to prevent accidents; furthermore the nuclear installation must allow for reliable, stable, and easily manageable operation.[119] Fortunately for the purposes of this proposal, WAMSRs fit the bill very nicely due to their inherently safe design and operation. There are a variety of safety mechanisms in place to ensure the safe operation of WAMSRs, and the end mechanism to shut the reaction down in the event of an emergency involves the uranium and molten salt mixing together and being gravity fed into dump tanks, shutting down the reaction without requiring any external electricity for pumping, nor requiring any actual human commands to do so.[120] WAMSRs fit perfectly with the requirements of Article 18.

iv. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was the first treaty to deal with the management of nuclear waste on an

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[117] *Id.* at art. 17.
[118] *See id.*
[119] *Id.* at art. 18.
[120] Transatomic Power Corp., *supra* note 10, at 22-23.

international scale. It is an IAEA treaty written in 1997 with seventy-one States party to the treaty. Article 4 of this Convention requires that States take appropriate steps to protect individuals, society, and the environment from the radiological hazards from spent fuel.[121] This requirement is important because of the dangers of nuclear waste, particularly the high level waste such as the spent fuel rods. WAMSRs can recycle the fuel rods and make use of the remaining energy, seriously depleting the dangerous radioactivity of that waste so that it will only be dangerous for a few centuries rather than hundreds of thousands of years.[122] Because radioactive waste is difficult and dangerous to store, it is important to incorporate stringent safe storage and transportation standards for nuclear waste so as to prevent leakages that could harm people or the environment.

Article 6 deals with siting requirements for waste storage facilities, requiring contracting parties to consider site-related factors that might impact the facility during its life time, the likely safety impact on individuals, society, and the environment, making safety information available to the general public, and consulting other contracting parties in the vicinity of the storage facility, providing them at their request with data relating to the facility so they can determine the likely safety impact the facility may have on their territory.[123] Article 7 continues along this vein of thought by discussing the design and construction of such facilities, requiring that these facilities provide suitable measures to protect against radiological harm to individuals, society, and the environment by discharges or other uncontrolled releases of nuclear waste.[124]

This proposal would require States to consider a list of specific environmental factors when selecting siting of nuclear plants and waste storage, such as ground water tables in the region. For instance, the proposed nuclear waste storage site in the US known as Yucca Mountain has been cited as unsuitable because of the existence of fault lines and the risk of nuclear waste seeping into the soil

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[121] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Managementart. 4, May 5, 1997, 2153 U.N.T.S. 303, *available at* https://www.iaea.org/sites/default/files/infcirc546.pdf.

[122] *See* Lerner, *supra* note 6.

[123] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, *supra* note 121, at art. 6.

[124] *Id.* at art. 7.

and ground water.[125] The US has produced about 64,000 metric tons of spent fuel rods since the inception of its nuclear energy program, enough to cover a football field seven meters deep.[126] Nearly all of the nuclear facilities in the US have exceeded the permissible amount of waste that they store on site due to a lack of sufficient long term storage facilities for nuclear waste,[127] and this is a major problem. WAMSRs will help to alleviate this problem, but the issue of long term storage is still something important to consider, particularly because it will take time to develop sufficient numbers of WAMSRs to cut down on enough existing nuclear waste to help resolve this problem. Therefore, establishing more long term waste storage facilities will be important for the purposes of this proposal.

Article 8 requires safety and environmental assessments to be completed so as to ensure that the facility will be a safe place to store nuclear waste for the lifetime of the facility.[128] This proposal will specify measures such as remote sensing to be conducted to help plan for safe nuclear facility locations to protect people and the environment from contamination. WAMSRs may be safe, but we cannot afford to be irresponsible and not put equal amounts of consideration into the storage of nuclear waste as to the construction of WAMSRs and other nuclear facilities. Chapter 3 of the agreement (Articles 11 – 17) essentially echoes the same responsibilities as outlined in this section on the Convention and will also be incorporated into this proposal.

v. Bamako Convention on the Ban of the Import into Africa and Control of Transboundary Movement of Hazardous Waste Within Africa

The Bamako Convention on the Ban of the Import into Africa and Control of Transboundary Movement of Hazardous Waste Within Africa ("Bamako Convention") is a complementary treaty to

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[125] David Biello, *Spent Nuclear Fuel: A Trash Heap Deadly for 250,000 Years or a Renewable Energy Source?* SCI. AM. (Jan. 28, 2009), https://www.scientificamerican.com/article/nuclear-waste-lethal-trash-or-renewable-energy-source/.

[126] *Id*.

[127] *Id*.

[128] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, *supra* note 121, at art. 8.

the 1989 Basel Convention, which prevented any shipment and disposal of hazardous waste from industrial to developing countries.[129] The Bamako Convention[130] came into force in 1998 and has been important in protecting the environment of the African continent. For the purposes of this proposal, the Bamako Convention will only be discussed and examined here as necessary for the purposes of this WAMSR proposal.

The Bamako Convention has helped prevent Africa from becoming a nuclear dumping ground for the West. While this is absolutely a laudable and important goal, for the purposes of this proposal, certain alterations will be necessary. WAMSRs can operate using nuclear waste and thus by using the remaining energy within the waste, the dangerous radioactivity lifespan plummets from thousands of years to several hundred years).[131] Per this proposal, States are going to want to transport nuclear waste around the world, and this includes into Africa, if for no better reason than to help power the WAMSRs of developing States. It would certainly be easier for States first developing their own domestic nuclear programs and WAMSRs to utilize nuclear waste shipped to them than it would be to mine and enrich uranium or obtain other sources of fuel such as thorium; at least for the immediate and early future of their WAMSRs. Allowing the transfer of nuclear waste to other States around the world is an effective way to ensure existing stocks of nuclear waste will be quickly recycled and prevent further dangerous accumulation of that nuclear waste; the existing 270,000 tons of nuclear waste is sufficient to power the entire world for about seventy-two years.[132] As such, this is too valuable a resource to waste.

Article 4 of the Bamako Convention requires contracting States to make it a criminal act to import all hazardous waste into

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[129] *Bamako Convention: Preventing Africa from Becoming a Dumping Ground for Toxic Wastes*, U.N. ENV'T PROGRAMME (Jan. 30, 2018), https://www.unenvironment.org/news-and-stories/press-release/bamako-convention-preventing-africa-becoming-dumping-ground-toxic.

[130] Bamako Convention on the Ban of the Import into Africa and Control of Transboundary Movement of Hazardous Waste Within Africa, *available at* https://www.informea.org/en/treaties/bamako-convention/text.

[131] Lerner, *supra* note 6.

[132] Julie Barr, *Nuclear Energy with Staying Power*, MIT ALUMNI (June 18, 2015), https://alum.mit.edu/slice/nuclear-energy-staying-power.

Africa for any reason from any non-contracting parties.[133] This proposal would require a specific exemption for parties exporting nuclear waste to an African state for the sole purpose of utilizing that nuclear waste as nuclear fuel for a WAMSR. It is clearly an important interest for African nations to keep dangerous waste out of Africa so as to not damage their environment or risk becoming a dumping ground. This proposal would seek to create a specific exemption to allow importation of nuclear waste into an African State that has constructed a WAMSR. This does not harm the interests of any African State and importantly does not otherwise interfere with the remaining important goals of the Bamako Convention.

Article 4(3)(j) requires states to not permit hazardous waste to be exported to a State which does not have the facilities for treating or disposing of them in an environmentally safe manner.[134] This is an important requirement under the Bamako Convention and one that would be incorporated into this proposal – it is vitally important for both environmental and nonproliferation reasons to ensure that no State without the appropriate storage facilities ends up possessing nuclear waste. This is why the proposal requires any waste imported into Africa or anywhere else to only be transferred once the end State has the means to properly and safely store and also use the nuclear waste in a WAMSR. These robust legal requirements protect everyone's interests and ensure that developing States cannot be coerced or abused into becoming the nuclear waste dumping grounds for the rest of the world.

Article 11 requires States party to the Convention to enter into other agreements with regards to the transboundary movement and management of hazardous waste provided that such agreements do not derogate the hazardous waste management policies of the Bamako Convention.[135] Arguably, the requirements under this proposal do not detract from the hazardous waste management requirements under the Bamako Convention. Therefore, States party to this convention should be in a position to become parties to this proposal if they wish to do so.

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[133] Bamako Convention on the Ban of the Import into Africa and Control of Transboundary Movement of Hazardous Waste Within Africa, *supra* note 130, art. 4.

[134] *Id.*

[135] *Id.* at art. 11.

vi. Convention on the Liability of Operators of Nuclear Ships

The Brussels Convention on the Liability of Operators of Nuclear Ships[136] has not been particularly relevant as a treaty because beyond military vessels and nuclear powered ice breakers, no one has made or operated nuclear powered seagoing vessels. But the US Navy has an excellent operational record for its nuclear vessels, and nuclear powered ice breakers have operated safely for decades without a single instance of a reactor accident resulting in the release of radioactivity that harmed either humans or the environment.[137] WAMSRs were disfavored in early adoption over light water reactors because the light water reactors were less bulky than the early MSR designs. But there is no reason why MSRs could not be developed to power seagoing vessels as well.

Adopting WAMSRs on commercial shipping vessels would greatly aid the goal of protecting the environment by eliminating the gross waste from the largest container ships; the fifteen largest of which release more pollution in the form of nitrogen and sulfur oxides than all of the world's cars combined.[138] Because the emergency function of WAMSRs is to shut the reaction down by mixing the liquid fuel with molten salt and encase it all into concrete,[139] this type of nuclear reactor is arguably safer than any other type of reactor to use at sea. This topic extends slightly beyond the scope of this particular proposal, but this Convention would be highly relevant for any future discussion on adopting nuclear powered vessels and utilizing WAMSRs as a safe and environmentally friendly source of power in maritime transport and trade.

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[136] Convention on the Liability of Operators of Nuclear Ships (1962), *available at* https://iea.uoregon.edu/treaty-text/1962-liabilityoperatorsnuclearshipsentxt.

[137] *See supra* note 17.

[138] *Green Finance for Dirty Ships*, THE ECONOMIST (May 11, 2017), https://www.economist.com/news/finance-and-economics/21718519-new-ways-foot-hefty-bill-making-old-ships-less-polluting-green-finance.

[139] See supra note 71.

vii. Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Materials

The Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Materials[140] is relevant to discussions around shipping nuclear waste and nuclear materials, which goes slightly beyond the topic of this proposal. Future discussion of WAMSRs in maritime shipping should certainly examine this agreement for its relevancy in any future related agreements.

viii. Vienna Convention on Civil Liability for Nuclear Damage (1963)

The Vienna Convention on Civil Liability for Nuclear Damage is an IAEA treaty amended in 2003 by the Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage.[141] Liability goes beyond the scope of this article but it is a topic worth future exploration.

ix. UN Convention on the Law of the Sea

The UN Convention on the Law of the Sea ("UNCLOS") touches on the subject of nuclear powered vessels and the transport of nuclear waste. In Article 22, coastal states may require foreign States innocently traveling through their territorial waters to use specific sea lanes, particularly for tankers, nuclear-powered ships, and ships carrying nuclear or other noxious substances.[142] This is an important principle, particularly when transporting nuclear waste because it is not as safe as a WAMSR. Article 23 requires nuclear-powered ships or ships carrying nuclear waste or other nox-

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[140] Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Materials, Dec. 17, 1971), 974 U.N.T.S. 256, *available at* https://treaties.un.org/doc/Publication/UNTS/Volume%20974/volume-974-I-14120-English.pdf.

[141] Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage, Oct. 4, 2003, 2241 U.N.T.S. 279, *available at* https://www.iaea.org/sites/default/files/infcirc566.pdf.

[142] United Nations Convention on the Law of the Sea art. 22, Dec. 10, 1982, 1833 U.N.T.S. 397 *available at* http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf.

ious substances to carry documents and observe special precautionary measures established for such ships.[143] This proposal would require the IAEA to create model rules for the safe transport of nuclear waste across the seas to the extent that uniform and internationally accepted norms do not currently exist.

x. Outer Space Treaty

Remote sensing from space utilizing national technical means of verification is a space activity governed by the Outer Space Treaty (OST). Article 1 of the OST states that the use of outer space shall be carried out for the benefit and in the interests of all mankind, regardless of a State's level of economic or scientific development.[144] Article 3 of the OST further states that States shall use and explore outer space in accordance with international law in the interest of maintaining international peace and security as well as promoting international cooperation and understanding.[145] While this is certainly aspirational language, these ideas of international cooperation and conducting space activities for the benefit of all mankind are directly relevant to this proposal.

If States are willing to use their satellites to engage in remote sensing that helps less developed States engage in remote sensing and build WAMSRs then those States will also be in compliance with the aspirational language of the OST and with the requirements under this proposal to engage in remote sensing and technology transfer between States to ensure international cooperation in building and developing WAMSRs. Remote sensing technology will help with the planning and developing of WAMSR sites and can be used to help monitor Earth's natural environment for pollution. Nuclear power and WAMSRs release almost no carbon or greenhouses gases and will benefit Earth's natural environment substantially,[146] something that remote sensing satellites will be able to monitor and measure.

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[143] *Id.* at art. 23.

[144] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. VI, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205, *available at* http://www.unoosa.org/pdf/gares/ARES_21_2222E.pdf, at 13.

[145] *Id.* at art. III.

[146] *See* Biello, *supra* note 9.

V. CONCLUSION

Remote sensing is vital to the formation of a new protocol to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency designed to promote the use of WAMSRs, recycle nuclear waste, and promote the safe operation of nuclear reactors. Remote sensing plays an instrumental role in ensuring compliance with this proposed agreement, allowing the pursuit a future consistent with the objectives of sustainable energy and protecting Earth's natural environment. Molten Salt Reactor technology is vital and should be heavily invested in on a global basis. By sharing our technology with developing States, we will foster international trust and cooperation and we will enter a competitive global market in which other States such as China and Russia already compete. Pursuing WAMSR designs throughout the world will help to recycle dangerous radioactive waste into clean energy, avoid the dangerous proliferation of weapons grade uranium and other elements necessary to create nuclear weapons, reduce the carbon imprint of humanity by utilizing the carbon free emissions of nuclear power, and foster a future in which States assist each other in pursuing newer and safer energy generating technologies.

Remote sensing technology is essential to this agreement because it allows for the continuous monitoring of nuclear programs around the globe to ensure safe planning, construction, and operation of nuclear facilities. Satellite technology has steadily improved over the decades of its use and will only continue to do so. The OST states that the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind. By utilizing our satellites to assist in creating and maintaining a global agreement to pursue WAMSR technology internationally, our satellites are well within the scope of the noble goals of the OST. We use remote sensing for the benefit of all humanity when we monitor weather conditions, share the GPS network, and conduct environmental monitoring; it is time that we use our remote sensing capabilities further still to protect the Earth's environment by monitoring our nuclear installations so that a truly green future in energy production can be realized and maintained.

FRANCIS LYALL AND PAUL B. LARSEN, SPACE LAW: A TREATISE, SECOND EDITION

Review by Dr. Andrea J. Harrington

OVERVIEW

Like the First Edition, the Second Edition of *Space Law: A Treatise* written by Francis Lyall and Paul B. Larsen is a well-cited and comprehensive guide to space law. The level of citation, with footnotes frequently exceeding half of the page, is one of the greatest benefits of this volume. The author's assertions are well-supported and explained, allowing the reader to track down additional information or dig deeper into controversial questions. While the volume is written in accessible language, its technical subject matter and careful citation renders it most easily accessible to those versed in legal text; legal scholars, practitioners, and law students. It is also certainly useful to others who are willing to dig into the subject matter at a more than cursory level.

The wide range of subjects covered by this treatise is a very valuable aspect of the work. This breadth allows the reader to understand where issues exist and place them in the context of space law and provides the sources for those wishing to delve into a particular aspect more deeply. One example of subject matter not otherwise oft discussed in space law texts is SETI (the Search for Extra-Terrestrial Intelligence), found in the penultimate chapter of the book.

ORGANIZATION

The introductory chapter sets the stage, as many other works do, opening with a statement about Sputnik in 1957 and the beginning of the space age. This chapter, however, quickly moves into substantive discussion, covering not only the history of space activities but importantly the organizations and actors that have shaped and been shaped by those space activities. In the second chapter,

the book moves into a discussion of the "Sources of space law" including the sources as articulated in Article 38 paragraph 1 of the Statute of the International Court of Justice and into more controversial territory such as the nature of 'soft law' which is an important an often-discussed subject in international space law.

Chapter 3 delves into the 1967 Outer Space Treaty and Chapter 4 covers the treaties and practice of control, registration, return, and liability of "space objects. Chapter 5, though entitled "Astronauts," does address the differing terminology (astronaut, personnel of a spacecraft) and the challenges in determining who qualifies for the protections offered to these categories of people, as well as a discussion of the obligations owed to astronauts/personnel of a spacecraft. Chapter 6, "Of boundaries and orbits," discusses the absence of a legal boundary between air space and outer space, the alternatives from a spatialist and functional approach, as well as a description of satellite orbits. Chapter 7, "The Moon, asteroids and other celestial bodies" covers the issues with the Moon Agreement and "common heritage of mankind" as well as the more broadly applicable space law and relevant developing activities. Chapter 8 reviews the role of the International Telecommunication Union in regulating space activities. This is one of the more important, but less discussed aspects of international space law, and thus the discussion of the institution, its history, functioning, and legal instruments is essential and well-covered in a relatively concise chapter.

In the center of the book is Chapter 9, dealing with "Unusual problems: space tourism, planetary defense, small satellites and large constellations." The topics discussed here do not have a lot in common, other than that they are emerging important issues with which current and future space lawyers will need to continue to grapple. Chapter 10 addresses environmental issues in outer space law, which range from contamination of Earth, contamination of other celestial bodies, space debris, space traffic management, use of nuclear power sources, and even geoengineering. Chapter 11, Satellite communications: Telecommunications and direct broadcasting, discusses the development of satellite telecommunications and the organizations, service providers, and legal issues most relevant to this topic. Chapter 12 covers Global Navigation Satellite Systems (GNSS) and GNSS law. Chapter 13 discusses the broad

topic of remote sensing, including observation, weather, and disaster management issues and the frameworks in place governing such activities. Chapter 14 moves on to "Space activities, finance and international trade law" topics essential to set up the following chapter, "Commercial activities and the implementation of space law" which delves more deeply into domestic space law regimes that the other chapters. Treatment of insurance, other than as required by domestic regimes, is not present in this book.

Chapter 16 deals with the subject of military use of outer space, including the history of the issue, the technologies used, and the particular positions of the United States, Russia, China, and Europe. As mentioned above, Chapter 17 uniquely addresses the search for extra-terrestrial life in the context of space law, setting up the basis for SETI activities as well as their legal considerations. Finally, Chapter 18 is a well-developed and realistic discussion of the future of space law, recognizing the limitations of the policy and legal environment in which we operate. As a sort of concluding chapter, "The future" chapter addresses the topics of each of the preceding chapters in turn and the likely future developments with which space lawyers will need to grapple.

CONCLUSION

The second edition of Space Law: A Treatise is a valuable addition to any library or personal collection on the subject of space law, space activities, or international law. Updates to the book in the 2018 edition make it a worthwhile revision, as there have been significant developments in space law since the first edition in 2007. Among these developments is the new 2015 act signed into law in the United States addressing space resource utilization, discussed from page 183. Future editions of this book could benefit from a more comprehensive table of contents also providing section headings. The book does have an index, which is useful, but not as comprehensive in its listing of topics within the work as some others.

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