

REMOVAL OF NON-FUNCTIONAL SPACE OBJECTS WITHOUT PRIOR CONSENT

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Abstract

The increase of space debris has motivated several space agencies to consider the removal of non-functional space objects. In recent years, several technical proposals have appeared for the capture of space debris and its transfer to disposal orbits. As launching States or States of registry have jurisdiction on the space object (or parts thereof), the removal of non-functional space objects without prior consent poses a legal problem. This article addresses the new Wreck Removal Convention, which may serve as a model for the space debris removal and mandatory insurance.

1. INTRODUCTION.

Since 1957, humans have introduced man-made objects to outer space. Most of these objects are not longer functional, move in orbits around our planet and are increasingly populating the Earth's neighborhood. These objects have been labeled as space debris.

Some of these space objects descend enough to be captured by the Earth's atmosphere. Other objects that reach high altitudes are condemned to stay there for several years or centuries. It is difficult to estimate the number of such objects, but Perek has considered that approximately 5,000 tons¹ of materials have been launched to outer space, most of which are non-functional.

In outer space all space debris objects, small and large, are in permanent movement at speeds that makes them a hazard for operating satellites, manned spacecrafts and astronauts' health and life.

With the increasing presence of space debris, the number of collision will grow, which also will have an impact on commercial space activities.

There have been several proposals to mitigate space debris. One of these proposals addresses measures to remove space debris from valuable orbits: low orbits and the Geostationary Orbit². Space debris in low orbits must be transferred into the upper layers of the atmosphere in order to reduce their orbital life³. Space debris in the Geostationary Orbit, should be removed to graveyard orbits, which have been designated at an altitude of approximately 300 km over the Geostationary Orbit⁴.

At present, active removal can only be undertaken by using the existing guidance capabilities of the space objects and the remaining fuel onboard.

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In the future, removal will be performed also using automated systems.

Although the development of space removal systems is in its infancy, this technique will very surely evolve to remove space debris.

2. SPACE DEBRIS REMOVAL SYSTEMS.

2.1. Manned Removal.

So far several manned space missions have taken place to recover stranded satellites for refurbishment or to recover experiments. The risks that astronauts face while retrieving valuable space assets by hand or remote controlled devices are still too high to consider manned missions as the primary method for the removal of space debris. On top of that, such manned missions only take place in low orbits (around 300 km. altitude), within the Earth's magnetosphere where astronauts are protected against dangerous radiation of the Sun.

2.2. Earth Automated Removal.

A second method in the future would be Earth remote controlled removal systems. One of such systems has already been successfully tested for refurbishing purposes. The 'Orbital Express' servicing system was developed by the US Defense Research Projects Agency (Darpa) and consists of a 'chaser' satellite and a heavier target satellite. In 2007, the Orbital Express system completed "...satellite rendezvous, capture, refueling and components exchange" in low orbit (500 km. altitude)⁵.

Although the Orbital Express and other orbit servicing systems are designed to work with compatible docking systems, where only specially constructed spacecrafts can be captured, this could be the beginning of a salvage

industry in space that may later be used for space debris removal⁶.

3. MARITIME WRECK REMOVAL.

The introduction of space debris removal systems in outer space may take some years. Nevertheless, such operations require legal models covering procedures and cost sharing mechanisms. The new maritime wreck removal rules may serve as a model.

3.1. Historic Development.

Since ancient times, many objects have sunk into the sea. As time passed by, coastal States started to take measures to clear traffic lines in territorial waters in order to provide safe passage for national and foreign vessels. Valuable objects which could be saved were lifted, giving birth to 'maritime salvage' as an industry.

Companies started to offer contracts for salvage operations using the principle 'no cure, no pay': the salvor used to be rewarded only if the salvage operation was successful. The recovery cost of valuable sunken ships and cargoes were covered by owners, who later decided to take insurance or other financial backing to fund the salvage.

When the owner considered the sunken ship and cargo to be a wreck, the coastal States covered the removal costs, if the wreck hindered a traffic line. After some time, States started to take measures to share such costs with wreck owners and insurance companies started to offer insurance for such operations. Wreck removal started to be performed also by the salvage industry, which at the present is mature, has many salvage methods and technologies and its expertise is under permanent development⁷.

Today, in case that a State orders the removal of a wreck from its territorial waters, salvage companies bid to get the salvage contract. The negotiations for the wreck removal include representatives of ship owners, of insurance underwriters, coastal States authorities and interested salvage companies. Such negotiations may be complex and take several months until an agreement is reached and hands on the wreck are set.

3.2. Wreck Removal in Territorial Waters.

Many coastal States have adopted national legislation, by which all vessels entering the coastal State's ports need insurance that covers the removal of wrecks and of onboard hazardous materials in case of accident.

3.3. Wreck Removal in the Economic Exclusive Zone.

In May 2007, the text of the 'Nairobi International Convention on the Removal of Wrecks' was adopted⁸ (hereinafter 'Nairobi Wreck Convention'). This Convention addresses the procedures to remove wreck that hinders maritime traffic and the wreck with hazardous materials that pose a risk to damage the marine environment⁹. This Convention enlarges the application area of wreck removal to include the Exclusive Economic Zone (EEZ)¹⁰.

3.4. Wreck Removal in International Waters.

For international waters there is no international legal instrument to regulate wreck removal. Ships at the high seas are likely to sink very deeply, without hindering maritime traffic. But in the shallow waters of international straits

with busy traffic lines, wreck removal is necessary. In such cases the same mechanisms used in territorial waters are applied to include salvage and insurance companies¹¹.

4. ELEMENTS OF THE WRECK REMOVAL REGIME.

The Nairobi Wreck Convention addresses aspects which could also become relevant for space debris removal.

4.1. Definition of Wreck.

The Nairobi Wreck Convention defines wreck as "...a sunken or stranded ship" including any parts of such ship and any object that is or has been on board. The definition includes also ships still afloat that are "...reasonable [to] be expected to sink or strand"¹².

4.2. Area of Application.

Wreck removal is not undertaken everywhere, but for clearing important nautical lanes and when the marine environment may get damaged due to hazardous substances¹³.

4.3. Reporting wrecks.

Art. 5 of the Nairobi Wreck Convention directs the States Party to require masters and operators of ships flying their flag to report to the 'Affected State'¹⁴ without delay when that ship has been involved in a maritime casualty resulting in a wreck. Such report shall provide the location of the wreck, the type size and construction of the wreck, nature of damage and condition of the wreck, nature and quantity of the cargo and any hazardous and noxious substances, the amount and types of oil onboard, etc.

4.4. Hazard Categories.

Hazard has been defined by the Nairobi Wreck Convention as the danger or impediment to navigation or the danger that may reasonable be expected to result in major harmful consequences to the marine environment, or damage to the coastline or related interests of one or more States (art. 1(5)). Among the criteria that shall be followed for the determination of hazard of wreck (art. 6), there are the size and construction of the wreck, depth of water in the area, tidal range and currents in the area, proximity of established traffic lanes, traffic density and frequency, type of traffic, nature and quantity of wreck's cargo, in particular the damage likely to result to the marine environment, vulnerability of port facilities, prevailing meteorological and hydrographical conditions, submarine topography of the area, height of the wreck above and below the surface of the water, acoustic and magnetic profiles of the wreck, etc.

After the determination of a wreck as a hazard, the Affected State shall ensure to take steps to mark the wreck and promulgate the marking in appropriate nautical publications (art. 8).

4.5. Wreck Removal Procedures without Consent.

Once a wreck has been determined as a hazard, the Affected State shall set a reasonable deadline for the removal and inform the State of ship's registry and owner. Thereafter, States Parties shall take measures to ensure that their registered owners undertake the wreck removal. Such removal can be performed by itself or by a salvor under contract (art. 9 (2)(4)).

In case the registered owner does not remove the wreck within the deadline, the Affected State may remove the

wreck at the registered owner's expenses (art. 9 (b)).

States Parties give their consent to the Affected State to remove the wreck without the wreck owner's prior consent, provided he was notified.

The Nairobi Convention recognizes that registered owners have rights in their wreck which shall be observed by the State wishing to remove it. But it is clear that removal operations can be accomplished without the owners' prior consent, if the registered owner fails to comply with the procedural steps that were accepted by its State through the Convention.

4.6. Insurance.

Once the Affected State sets a deadline to the wreck's owner, the later shall present evidence of insurance or other financial security (art. 9 (3)).

States Parties shall take measures to ensure that their registered owners comply with the requirement of mandatory insurance.

This mandatory insurance plays a crucial role in a self-enforcing mechanism: if the registered owner does not remove his wreck, third parties may do so without prior consent of the owner and with the incentive of the payment by the insurance.

5. ELEMENTS OF A FUTURE SPACE DEBRIS REMOVAL REGIME.

The long standing practice of wreck removal and the new Wreck Convention may serve as a model for the removal of space debris. The international sea faring community saw a need to keep the Exclusive Economic Zone and international waterways free of obstacles and to preserve the maritime environment from the impact of shipping disasters. Following international

practice, the international community found consensus to make those rules legally binding in the Exclusive Economic Zone. The situation in space is similar and the space community should not miss the opportunity to elaborate on the consensus reached for the maritime parallel.

5.1. Definition of Space Debris.

Space debris is not yet defined in an international treaty, but for the International Academy of Astronautics 'space debris' are "...all man-made objects including fragments and parts, whether their owners can be identified or not, in Earth orbit...that are non-functional, with no reasonable expectation of their being able to assume or reassume their intended functions or another functions for which they are or can be authorized"¹⁵.

5.2. Area of Application.

Space objects are in permanent movement around the Earth and are a danger to manned missions and operating satellites. But not all areas of outer space are equally relevant.

Low Earth orbits, where manned space missions take place and where other civilian and military satellites are operating (e. g. remote sensing satellites with high resolution capabilities, scientific satellites, etc.) could be the first area to be considered for space debris removal. The Geostationary Orbit, where most communications satellites are operating (civilian and military), as well as meteorological satellites, could be the second area. A third area may be in the range of medium Earth orbits (20, 000 km. altitude), where navigation satellites are at work. Finally, space debris removal may be expanded to reach higher orbits and escape orbits for

space probes and manned missions to celestial bodies.

5.3. Reporting Space Debris.

When satellites are no longer usable, some satellite owners or operators declare their dead satellites as 'decommissioned'. When a satellite is no longer worth to keep operating or its entire fuel is used up and it is not maneuverable, by declaring a satellite decommissioned, the satellite owner informs the national and international authorities that the satellite will be deactivated and transmissions will no longer take place and contracts with transponders users and operating hired centers are terminated.

An important aspect of this decommissioning procedure is to warn other satellite operators that a space object will not longer be controlled and may endanger operational satellites in the proximity. Implicitly the decommissioning notice declares a satellite as space debris.

A number of States inform the international community also about the detaching of stages during launching and positioning phases. Other States do not inform at all about the space debris they produce.

Decommissioning notifications should become mandatory for all satellite owners and operators and be included in an international agreement, e.g. as amendment of the Convention on Registration of Objects Launched into Outer Space¹⁶. Following the analogy of the Nairobi Wreck Convention, the decommission declaration may provide the location of the space debris, its size and construction, nature of damage and condition and any danger to space traffic and hazardous elements onboard.

5.4. Hazard Categories.

Among the criteria for the determination of hazard of space debris are its size and shape, the orbits where they are present, the traffic of such orbits, the vulnerability of manned space missions (e.g. orbits of ISS and visiting spacecrafts), space weather conditions that may produce orbit changes, etc.

There are two categories of space debris hazards:

- a) Kinetic energy of debris that may endanger operating spacecrafts and astronauts. Besides the normal space debris pieces, entire dead spacecrafts that were not passivated and are at danger of exploding in outer space can particularly be considered as a hazard¹⁷.
- b) Hazardous materials of certain spacecrafts, as the ones using nuclear power sources do not pose a danger to the environment of outer space, but to the Earth's environment, if they enter the atmosphere and survive air friction¹⁸.

5.5. Space Debris Removal Procedures.

The procedures developed for wreck removal could also be applied to future space debris removal. As a first step, a State or an authorized international technical institution would inform the international space community that a space object is a hazard.

As a second step, a deadline may be set for the removal of dangerous space debris. In the future, an international technical institution may be considered as qualified to issue such a deadline.

States of registry or launching States should supervise that owners whose space objects became debris, comply with removal procedures. Such removal could be performed by themselves or by a salvor under contract.

In case the registered owner does not remove the space debris within the

deadline, another user of outer space may perform the operation at the registered owner's expenses and without consent of the owner or operator.

States performing the removal operation may rely on surveillance data¹⁹ as proof that such space object is no longer functional and is moving in a non-controllable way, endangering satellites and manned space missions. It is reasonable to consider that the result of any act exerted on space debris can not be considered as damage to that object; consequently there is no place for damage claims and compensation.

5.6. Insurance.

Similarly to maritime salvage and wreck removal, the owner should take insurance to cover the costs. It is very likely that the State responsible of the space object would grant licenses and authorizations for space activities only if the spacecraft owner acquires insurance cover for the removal of space debris. Taking the example of the Nairobi Wreck Convention, space debris removal could thus be established with a similar self-enforcing mechanism. This insurance would create a financial incentive for third parties to remove space debris, if it is not removed by the owner operator or State of nationality.

Already many States require compulsory insurance for national space activities. It is possible that an insurance to cover space debris removal could be included in the existing space insurance packages.

6. CONCLUSIONS.

Since the beginning of the space era, space debris has been introduced into outer space, which endangers manned space missions and operational satellites. In recent years, concerns about the

growing space debris population have prompted concepts for its removal from valuable orbits.

The transfer of objects without own capabilities to be properly disposed represents a problem. To tackle this problem, the development of Earth remote controlled space systems is on its way. But legal and financial issues arise.

The maritime wreck removal practice could serve as a model for future space debris removal.

For the EEZ, the Nairobi Wreck Convention establishes binding rules of international practices, which were already recognized and implemented in many national legislations of coastal States. An important aspect is the mandatory insurance to cover removal costs and removal without prior consent of ship's owner if he fails to comply with certain requirements.

Such a self-enforcing mechanism of wreck removal could also be applicable to space debris removal and create a financial incentive for third parties to remove space debris.

Subcommittee of COPUOS. Space Debris-Spotlight, ESA, Mar. 31 (2005), at 3.

¹ Perek L.: Rational Space Management, ZLW Nr. 53, p. 574 (2004).

² So far the Inter-Agency Space Debris Coordination Committee (IADC) has designated two protected regions around our planet. One protected region is from the lowest orbit up to 2000 km. altitude. The second one is around the Geostationary Orbit. The IADC has proposed that these regions should be cleared of space debris through active removal. Position Paper on Space Debris Mitigation, International Academy of Astronautics (IAA), (2006) at 8.

The IADC is a non-governmental organization. Its members are the space agencies of China, France, Germany, India, Italy, Japan, Ukraine, United Kingdom, USA, the Russian Federation, the European Space Agency and the Scientific and Technical

³ Space objects in low orbits are exposed to remnants of the Earth's atmosphere that exert a drag effect on them and reduce their 'orbital life'. 'Orbital life' is the time span between the arrival of a space object in outer space and entry into the Earth's atmosphere. A space object entering the Earth's atmosphere, may completely or partially be burned up due to air friction. Depending on the altitude, the physical parameters of the space object and natural factors affecting the object's movement, the 'de-orbiting' or descending time between a low orbit and its entering in the Earth's atmosphere may take from some minutes to several years.

In order to prevent the creation of more space debris, the IADC recommends to transfer space objects that approach their end-of-life to low orbits (de-orbiting maneuver). The IADC considered 25 years as a 'reasonable and appropriate lifetime limit' to de-orbit a space object. International Academy of Astronautics (IAA), Position Paper on Space Debris Mitigation, (2006) at 8.

⁴ Graveyard orbits are between 245 and 435 km. above the geostationary ring. Robotic Geostationary Orbit Restorer, Final Report-Executive Summary, EADS Space Transportation, June 10 (2003), at 1.

⁵ The mission started in March 2007 and lasted 3 months. In July 2007 both spacecrafts were declared decommissioned and are in a de-orbiting modus. AW & ST, May 28, 2007 at 22 and AW & ST July 9, 2007 at 18 and Dornheim M., Express Service, AW & ST, June 5, 2006 at 48.

Most planned systems are intended for refurbishing large space objects or for retrieving experiments. Although small space debris, like bolts, droplets, paint flakes and aluminum bits, are as dangerous as large space debris, present plans for experimental removal systems are mostly for large space objects.

⁶ Salvage is defined in the Black's Dictionary as "...a compensation allowed to persons by whose assistance a ship or its cargo has been saved, in whole or in part, from impending danger, or recovered from actual loss in cases

of shipwreck, derelict or recapture...” BLACKS LAW DICTIONARY 932 (6th. Ed. 1991). Key word: salvage.

‘Salvage’ means the rescue of objects that have a particular value (commercial, historic, accident investigation, experimental or scientific nature, emotional value, etc.). Wrecked items can also be ‘salvaged’ with commercial purposes (by selling as scrap). The term ‘removal’ considers the change of place of an object, its scrap value being of second importance only.

In outer space, ‘salvage’ is the operation to rescue space object that are valuable. Such operations may be undertaken for re-fuelling or refurbishing purposes, for gathering scientific or military data, for studying the causes of a space object malfunction, etc.

⁷ E. g. pulling tugs, divers, robotic submarines, floating cranes, systems to remove oil or to cut hull in pieces, use of cargo helicopters, etc.

⁸ Nairobi International Convention on the Removal of Wrecks, 2007. Adoption of the Final Act in Nairobi, on the 18th of May, 2007. International Maritime Organization, IMO LEG/CONF.16/19, 23 May 2007. The text will be open for its signature in November 2007 (art. 17).

⁹ ‘Hazard’ is defined as “...impediment to navigation; or...may be...expected to result in major harmful consequence to the marine environment or damage to coastline or related interests of one or more States”, art. 1(5). Ibid.

¹⁰ EEZ is the area adjacent to the territorial waters of a coastal State but no larger than 200 miles from the baseline agreed by the United Nations Convention on the Law of the Sea (UNCLOS) (1982). States Party to UNCLOS and many States that have not ratified it yet, have accepted 12 miles as territorial water, measured from its baseline in accordance to UNCLOS.

According to UNCLOS art. 58, “...all States, whether coastal or land-locked, enjoy...freedom of navigation” in the EEZ.

The first area of application proposed in the early drafts of the Nairobi Wreck Convention referred to ‘international waters’. Griggs P. (Immediate Past President, Comite Maritime

International), Draft Wreck Removal Convention at 3. www.comitemaritime.org/capetown/pdf/13.pdf at 1.

¹¹ In 2002 a ship sank in the English Channel as a result of a collision. The ‘Tricolor’, flying the Norwegian flag, touched the sea bottom at 30 meters depth. As the location of the ship was in a busy maritime traffic line in an international strait, it was properly marked. Nevertheless, some hours later, a third ship was damaged after colliding with the Tricolor and two others made near misses. A team dove and inspected Tricolor’s damages. As a result of such inspections the Tricolor was declared as a total loss nine days after the sinking and became a major navigational hazard for many months. The event took place in the English Channel, an international strait, but also inside the French Economic Exclusive Zone. The French authorities issued a wreck removal order ten days after the collision. The removal operation included the cutting of the vessels in pieces, which were later transported to a Belgian port. This removal operation became the biggest ever and the wreck was finally removed 2 years after it sank. The location of the event was 55 nautical miles from Dover, UK and 25 miles from Zeebrugge, Belgium (51°21.9’ N 02°65’ E). www.tricolorsalvage.com

¹² ‘Wreck’ means: “a) a sunken or stranded ship; b) or any part of a sunken or stranded ship, including any object that is or has been on board such ship; or c) any object that is lost at sea from a ship and that is stranded, sunken or adrift at sea; or d) a ship that is about, or may reasonable be expected, to sink or to strand where effective measures to assist the ship or any property in danger are not already being taken”. Nairobi Wreck Convention, art. 1(4), supra note 8.

¹³ Nairobi Wreck Convention, art. 1(5) and 2 (1), supra note 8.

¹⁴ “‘Affected State’ means the State in whose Convention area the wreck is located”. “‘Convention area’ means the exclusive economic zone of a State Party...”. Nairobi Wreck Convention, art. 1(10) and 1(1), supra note 8.

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- ¹⁵ Position Paper on Orbital Debris, International Academy of Astronautics, (1995) updated in 2001 and Technical Report on Space Debris (Rex Report), UN A/AC.105/720, 1999. Mentioned in Cosmic Study on Space Traffic Management (IAA), (2006) at 21.
- ¹⁶ Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, T.I.A.S. 8480, 1023 U.N.T.S. 15 (effective Sept. 15, 1976).
- ¹⁷ The IADC has recommended passivating spacecrafts through the elimination of internal energy: "...residual propellants shall be dumped, pressurants shall be depleted, batteries safed, etc." IAA Position Paper on Space Debris Mitigation, supra note 2 at 4.
- ¹⁸ In 1978 the nuclear elements of the Soviet Cosmos 954 survived the atmospheric entrance in north Canada.
- ¹⁹ Although there are several countries performing monitoring activities, only the United States (USSPACECOM) and Russia (Space Surveillance System) have space surveillance capabilities to permanently monitor the whole space debris population. Both countries inscribe all detected man-made objects in a catalog of their own, where the nationality of many space debris objects can be identified. Besides dead satellites and launching stages, also large fragments resulting from space objects collisions, explosions and tests are entered into these catalogs. USSPACECOM not only detect objects in outer space but "...characterizes them, correlates them with a launch or release event, determines their orbits and tasks its sensors for subsequent follow-up observations". Klinkrad H.: Monitoring Space: Efforts Made by European Countries, IAF, 2003, p.2. www.fas.org/spp/military/program/track/klinkrad.pdf. Among the items entered in these catalogs are the non-functional Ariane booster, that after 10 years orbiting collided with an operational French military satellite Cerise (July 1996). This catalog also lists a part of a US rocket, which after 31 years collided with a Chinese space object, which had separated

from its launching vehicle after an explosion. The collision, between the US and Chinese objects created at least three large pieces that separated from the US rocket body. Press Announcement (August 15, 1996), www.ee.surrey.ac.uk, Leonard D.: US-China Space Debris Collide in Orbit. April 16, (2005), www.space.com Unclassified information on space debris is transmitted on a routine basis to satellite operators and agencies managing manned space missions (e.g. for the International Space Station).