INTERNATIONAL
MARITIME
ORGANIZATION

Future Guidelines for Floating Nuclear Power Plants

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01. What are Floating Nuclear Power Plants?

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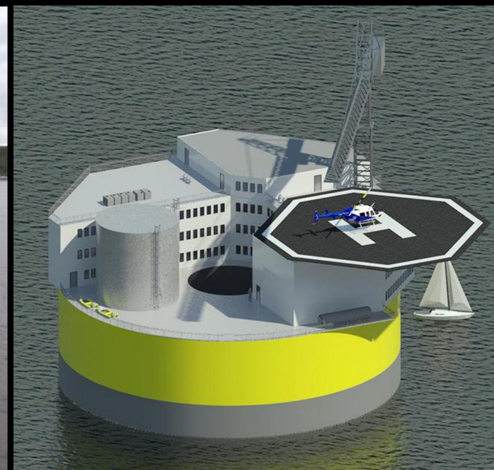
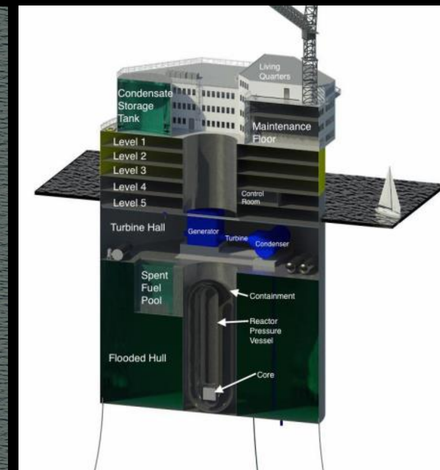
Definition





- Self-contained nuclear power plants that are deployed at sea [1]
- Equipped with a full-sized, autonomous nuclear power plant and its necessary auxiliaries
- Usually deployed within internal waters or docked in harbors

Usage



- Used to deliver energy to remote locations eg. islands .
- Movable nature allows flexible deployment according to energy demand.
- Main purposes are to deliver energy and desalination to citizens in remote areas, and power offshore projects such as drilling sites.
- Popular due to its low investment costs; fNPPs are economically advantageous compared to conventional nuclear reactors.

Status Quo

First fNPP made in the 1960s. However, decommissioned after brief usage

First fully implemented fNPP. Currently positioned the Russian Arctic Sea. Scheduled to be put into action this year

Currently proceeding fNPP project. Announced to deploy 20 fNPPs in the South China Sea

fNPPs are receiving more and more attention all over the world

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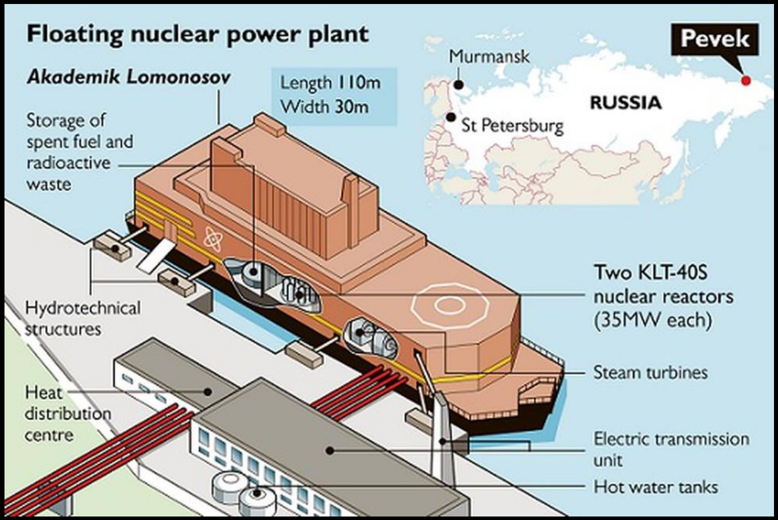
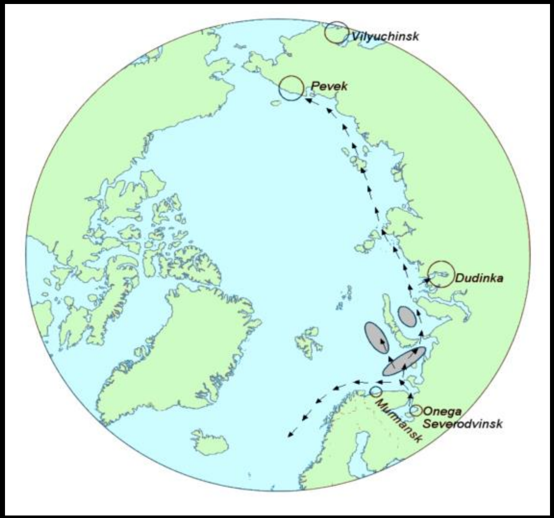
Russia – Akademik Lomonosov





- **110m in length, 30m in width, 21,000t in weight**, the **first** and currently only one if its kind[2]
- Sent to the siberian region of Chutkoka, intended to **provide power for 200,000+ people**, and **power the extraction of natural resources** in the region
- Contains 2 KLT-40S reactor systems, each with a capacity of 35 megawatts.
- Has an overall **"life cycle" of 40 years**, which may be extended to 50 years, according to Rosatom
- Condemned by **Greenpeace** as **"Chernobyl on ice"**
  - ✓ Massive protests towards the depolyment of a nuclear reactor just kilometers away from Russia's 2nd biggest city

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China

- As part of it's 13th Five-Year Plan for innovative energy technologies, **China announced construction of the first FNPP** at Bohai shipyard in November 2016 for trial operation in 2019, supplying power and desalination [3]
- This is only the beginning of a series of fNPPs to come, **20 are pledged to be deployed in the South China Sea**
    - ✓ China's stance: deployment is justified for providing energy to citizens with little or no access to the mainland
    - ✓ Stance neighboring nations: The deployment of **20 fNPPs is only necessary in terms of powering the Chinese military** and it's grip on the currently disputed region

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02. Problems of fNPPs

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Environmental Hazard

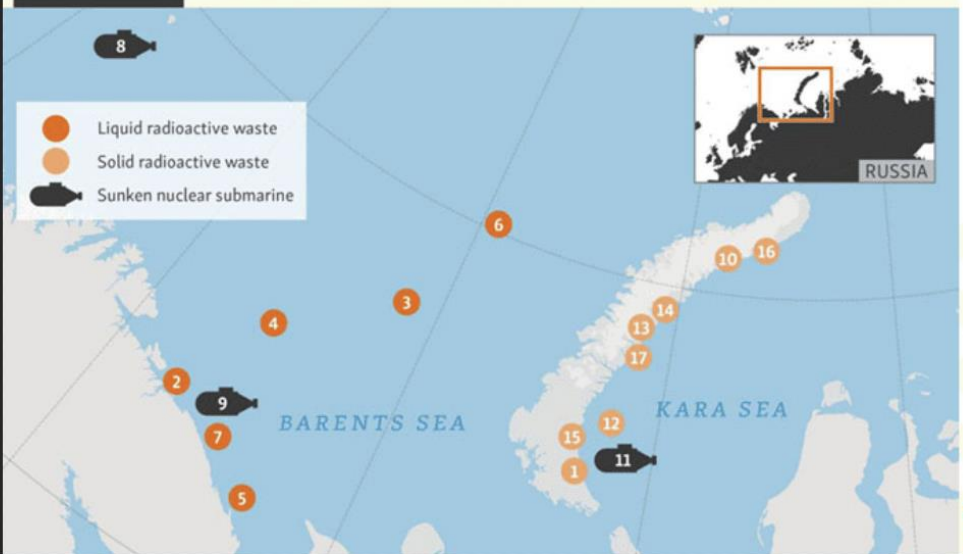
1. Catastrophic repercussions[4]

- **Nuclear waste**
  - ✓ Degradation of nuclear waste takes up to thousands of years. The problem is amplified when the parameter of contingency changes from land to water. Though the exact effects of nuclear leakages at sea are still highly debated upon, the general agreement is that they are disastrous.
- **Ecosystem**
  - ✓ The effect of nuclear waste on the ecosystem is also catastrophic. Although not fully understood, instances such as Fukushima show us the detrimental effects on the environment.
- **Human harm**
  - ✓ Nuclear waste and its effect on the ecosystem hits humans the hardest. Radiation levels rise as it moves up the food chain, where humans are.

Environmental Hazard

Nuclear Waste In The Arctic

Soviet submarine Komsomolets, which sank in the Barents Sea in 1989, is not the only piece of nuclear waste in the Arctic Ocean. There are plenty more nuclear dumping grounds.



LOCATION	AREA #	YEARS	VOLUME	NOTES
Abrosimov Fjord	1	1966–1981	646 containers	
Andreeva Fjord	2	1982–1986	9,000 m^3	Leaks from storage facility
Barents Sea	3	1960–1990	66,811 m^3	
	4	1966–1989	53,300 m^3	
	5	1966–1992	49,838 m^3	
	6	1968–1989	15,639 m^3	
	7	1975–1991	8,507 m^3	
	8	1989		Komsomolets (K-278) submarine — In 2019, Norwegian scientists discovered radiation levels around the sunken submarine were 1 million times higher than normal.
	9	2003		K-159 submarine
Blagopoluchiya Fjord	10	1971–1972	992 containers	
Kara Sea	11	1982		K-27 submarine
Novaya Zemlya Trough	12	1967–1991	4,824 containers	
Oga Fjord	13	1968–1983	2,190 containers	
Sedova Fjord	14	1982–1984	1,100 containers	
Stepovogo Fjord	15	1968–1975	1,917 containers	
Techeniya Fjord	16	1982–1988	194 containers	
Tsivolky Fjord	17	1964–1978	5,242 containers	

RadioFreeEurope RadioLiberty

Note: Recovered submarines not included.

Kristyna Foltynova | Sources: Arctic Monitoring And Assessment Program, media reports

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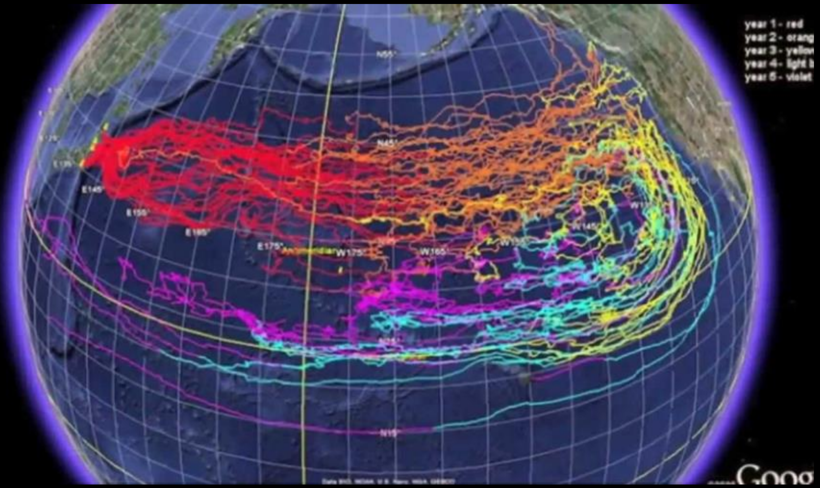
Environmental Hazard

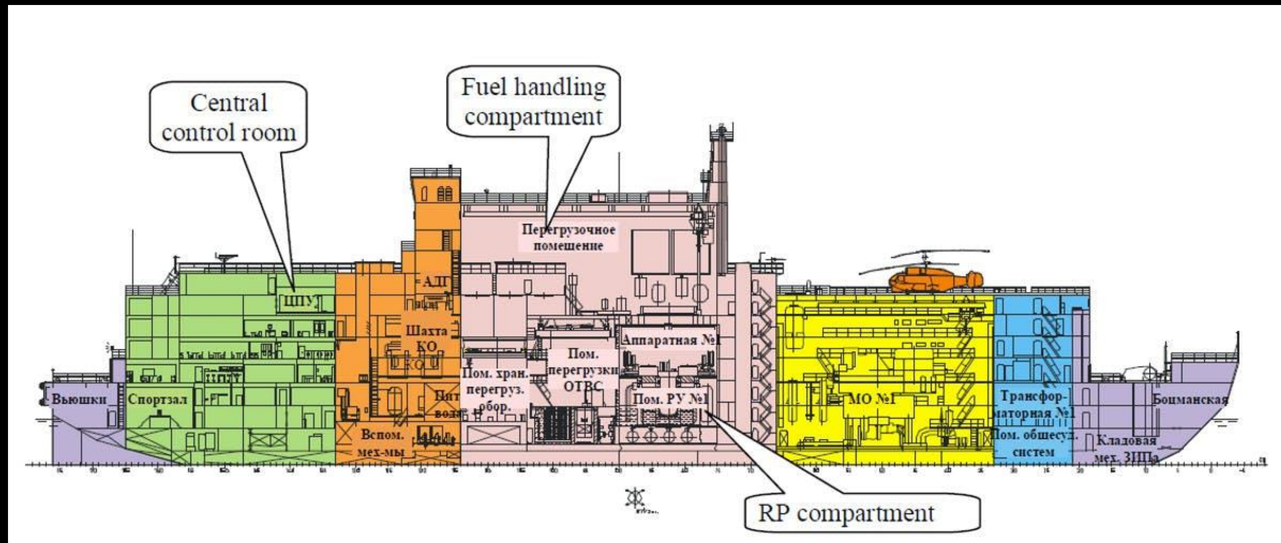


2. High susceptibility to natural disasters

- fNPPs’ buoyancy renders them susceptible to underwater earthquakes and tsunamis. Capsizal of floating nuclear power plants is especially detrimental because they carry years worth of used nuclear waste.

- Lack of information hinders the ability to respond to sudden contingencies. This aggravates the problem because nuclear disaster in one area affects its surrounding nations.

Environmental Hazard



3. Design Dysfunction

- fNPP's current vulnerability towards natural disasters lies within its design. Landlocked nuclear reactors have thick containment walls of concrete to seal in any radiation. fNPPs lack this kind of impermeability.
- The fact that used nuclear waste is stored on board of fNPPs stacks up the risk of any contingencies.
- All of these dysfunctions are fault to the absence of an official standard that manufacturers must abide to. fNPPs are inapplicable to any current conventions due to its unfamiliar qualities.

03. Why IMO?

2018-2023 Strategic Directions

The Strategic Directions:

SD 1 - Improve implementation

SD 2 - Integrate new and advancing technologies in the regulatory framework

SD 3 - Respond to climate change

SD 4 - Engage in ocean governance

SD 5 - Enhance global facilitation and security of international trade

SD 6 - Ensure regulatory effectiveness

SD 7 - Ensure organizational effectiveness

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References

1994 Convention on Nuclear Safety[5]

CHAPTER 1. Objectives, Definitions and Scope of Application

ARTICLE 2. Definitions

For the purpose of this Convention:

(i) "nuclear installation" means for each Contracting Party

(ii) any land-based civil nuclear power plant under its jurisdiction including such storage

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1948 Convention on the IMO[6]

PART I. PURPOSES OF THE ORGANIZATION

ARTICLE 1

The purposes of the Organization are:

(a) (…) to encourage and facilitate the general adoption of the highest practicable standards in matters concerning the maritime safety, (…) prevention and control of marine pollution from ships;

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References

“Prevention of marine pollution from ships”

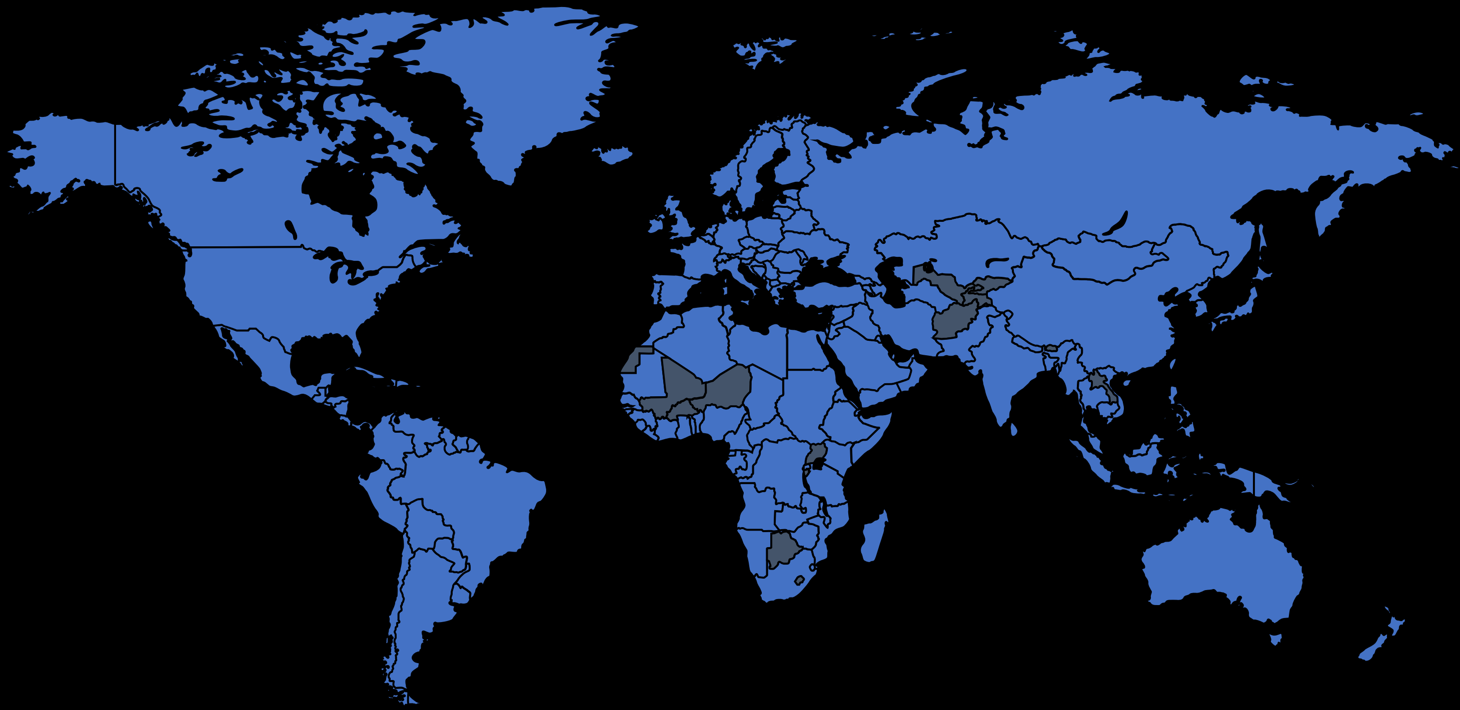
Definition of “Ship”

IMO MEPC.207(62)[7]

2. Definitions

Ship means a **vessel** of any type whatsoever operating in the aquatic environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft, fixed or floating platforms, floating storage units (FSUs) and floating production storage and off-loading units (FPSOs).

IMO Member States



- It has the largest number of member states compared to other related organizations[8]
- It has the largest number of ocean bordering countries as its members.

04. Proposition

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Amendments to the INF Code

CONVENTION ON OFFSHORE NUCLEAR ENERGY GENERATION

Classes of INF Ship[9]

Class of ship	Class INF 1 ship	Class INF 2 ship	Class INF 3 ship
Criteria	Ships which are certified to carry materials with an aggregate radioactivity less than 4,000 TBq*	Ships which are certified to carry irradiated nuclear fuel or high-level radioactive wastes with an aggregate radioactivity less than 2 x 10 6 TBq and ships which are certified to carry plutonium with an aggregate radioactivity less than2x105 TBq	Ships which are certified to carry irradiated nuclear fuel or high-level radioactive wastes, and ships which are certified to carry plutonium with no restriction on the aggregate radioactivity of the materials

INF Ship Criteria

Ship class	Damage stability		Fire protection		Temperature control of cargo spaces	Structural considerati ons	Cargo securing arrangem ents	Electrical supplies	Radiological protection equipment	Management, training and shipboard emergency plan
	Passenger ships*	Cargo ships	Passenger ships*	Cargo ships						
INF 1	1	1	5	5	8 + 9 +10	11	12 +13	14	18	19
INF 2	2	3	7	7	8 + 9 +10	11	12 +13	15 + 16	18	19
INF 3	N/A	4	N/A	6 +7	8 + 9 +10	11	12 +13	15 + 16 + 17	18	19

Class 4 INF Ship

Class of ship	Class INF 4 Ship
Criteria	Ships which are certified to generate electricity and desalinate waters using an onboard nuclear reactor

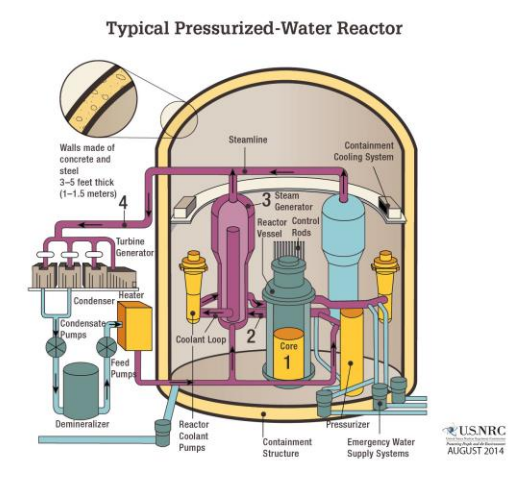
Amendments to the INF Code

Damage Stability

Current Standards

Complying with requirements for Type 1 ship survival capability and location of cargo spaces in chapter 2 of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) or, regardless of the length of the ship, the requirements in part B-1, chapter II-1 of SOLAS 74 with subdivision index RINF. as given below:

For Class 4 INF Ship



- Class 4 INF Ships will have to meet all conditions required to be a Class 3 INF Ship, and additionally, must meet:
- Concrete-reinforced walls, surrounding reactor and nuclear waste containment facilities, 3-5 feet(1m – 1.5m) thick[10]

Amendments to the INF Code

Radiological Protection Equipment

Current Standards

Depending upon the characteristics of the INF cargo to be carried and upon the ships, additional arrangements or equipment for radiological protection shall, if necessary, be provided to the satisfaction of the relevant government bodies.

For Class 4 INF Ship

- Class 4 INF Ships will have to meet all conditions required to be a Class 3 INF Ship, and additionally, must meet:
- As set by the US Department of Homeland Security, minimum of Level B equipment worn by related officials, and Level A equipment prepared for contingencies[11]

Management, Training and Shipboard Emergency Plan

- Current Level 3 standards are adequate for direct application to Level 4 ship standards.

- Management, training and shipboard emergency plan for a ship carrying INF cargo shall be to the satisfaction of the Administration, taking into account developments in the IMO. Every ship carrying INF cargo shall carry a shipboard emergency plan.

CONVENTION ON OFFSHORE NUCLEAR ENERGY GENERATION

Article 3

MULTILATERAL ALERT SYSTEM

1. Contracting parties shall participate in the establishment of a multilateral alert system in which parties in common regions will share real time information on functioning fNPPs and their status such as, but not limited to
   a. core temperature of reactors on fNPPs
   b. current volume of energy generated by fNPPs
   c. weather conditions in fNPP deployed regions
   d. current level of accumulation of nuclear waste stored on fNPPs
2. In the occurrence of any contingencies specified in annex 1, the multilateral alert system will act as an early alert system in which affected parties will maintain an emergency line where:
   a. information on developments of the contingency will be shared between parties
   b. joint operations between parties such as, but no limited to evacuations sequences will be initiated

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CONVENTION ON OFFSHORE NUCLEAR ENERGY GENERATION

Article 6

APPROVING AND LICENSING

1. Contracting parties will cooperate with the convention in licensing mandating examination of newly built fNPPs in order to guarantee quality and safety, in methods among the following :
    a. accepting investigation panels from at least 5 contracting parties other than the concerning party for examination
    b. accepting an investigation panel from the IMO for examination
2. Licensed fNPPs must be submitted to maintenance examination every 5 operational years, the method of the examinations pertaining to Article 6 -1
3. Only licensed fNPPs shall be eligible for operation

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