



MULTI-PURPOSE NUCLEAR ICE BREAKER  
UAL-60 (project 22220)  
*experience of joint development of innovation  
product of Rosatom State Corporation and JSC USC*

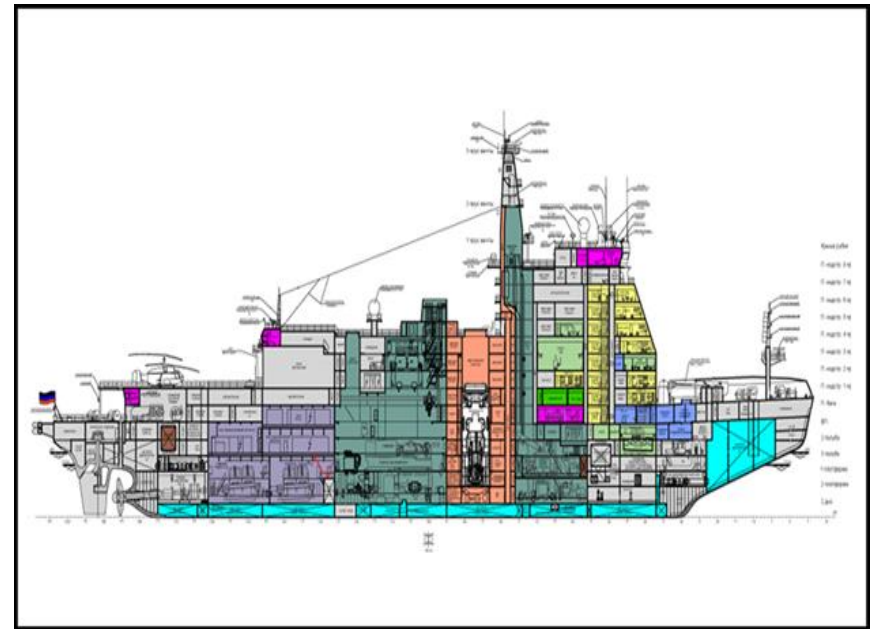


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## ENGINEERING DESIGN AND APPLICATION OF UAL – 6o

The engineering design of multi-purpose nuclear ice breaker (project 22220) is executed on the basis of the State contract No. 206 of June 7, 2006 between JSC CDB «Aysberg» and "Direction of State Customer for development programs of sea transport« Federal State Institution according to the Specification for development of the sketch design approved by the Head of Federal Agency for Sea and Inland Water Transport.



## ENGINEERING DESIGN AND OPERATION OF UAL – 60



Areas of operation:

- constantly - in the Western region of the Arctic, including the Barents, Pechora and Karsky Seas, on shallow areas of Yenisei (year-round escort of vessels carrying oil products and general cargoes (container transportations) for transportation of oil raw materials from fields of the Yamal and Gydan sky peninsulas, off-shore of the Kara Sea to markets of countries of the Asian-Pacific region.
- during the summer-autumn period – in the Eastern region of Arctic

## Specific requirements for the project of the ice breaker UAL– 60

The necessity of escort execution is stipulated by the need of "two draft" rule (draft on the way - 10,5m and in the shallow water - 8,5 m), and long operation in Eastern region of the Arctic and year-round operation in Kara Sea demands 2,8 – 2,9m icebreaking capability. The second type of draft gives a possibility to come to shallow areas of the mouth of Yenisei and Gulf of Ob rivers.





## Icebreaking capability and sea-going of the ice breaker UAL – 60

- Pilot studies of ice breaking characteristics of the multi-purpose ice breaker were conducted in the ice model testing pool of Federal State Unitary Enterprise Krylov Shipbuilding Research Institute and control - in the pool of Aker Arctic Technology Inc. (Finland). Tests were carried out in equal continuous ice and in hummocky ices. Thickness of equal ice in terms of natural conditions of 2.85 m (only flat ice).
- During operation at deep water under designed draft and rated power on shafts the thickness of the continuous solid flat ice overcome by ice breaker at continuously steady speed of 2 knots makes approx.. 2,9 m
- During operation at shallow water under minimum draft and rated power the thickness of the ice overcome by ice breaker at continuously steady speed of 2 knots makes approx. 2,4 m
- Ice performance at rear mode motion is equal to forward course.
- Sea-going abilities. Course speed on deep water. The calculations executed on the basis of towing model tests in the hydrodynamic pool of Federal State Unitary Enterprise Central Research Institute of the Academician A.N. Krylov have shown that the speed of a full speed of the ice breaker at designed draft on deep water makes 22 knots. At the movement of the ice breaker in similar shallow conditions in mouths of the rivers, in particular in the mouth of the Yenisei River where salinity of water is insignificant, the movement of the ice breaker with a speed no more than 5-6 knots is admissible.

## New reactor RITM-200 and its main advantages over reactors of the using nuclear ice breakers



- High equipment life, on-stream period, minimum quantity of overloads of reactor core, low level of own energy consumption provide the most economic operation of UAL
- New reactor RITM-200 has the best technical and commercial characteristics and higher level of ecological safety in comparison with OK-900A reactors

Характеристика	Значение
Тепловая мощность, МВт	175
Паропроизводительность, т/ч	248
Параметры первого контура: температура на входе в активную зону, °С температура на выходе из активной зоны, °С давление, МПа расход, т/ч	277 313 15,7 3250
Параметры второго контура: температура питательной воды на входе в ПГ, °С температура пара на выходе из ПГ, °С давление пара за ПГ, МПа (абс.)	105 295 3,83
Эксплуатационный диапазон изменения мощности, % $N_{ном}$	10—100
Количество изменений мощности	600 000
Скорость изменения паропроизводительности, %/с: нормальная допустимая (при необходимости срочного увеличения паропроизводительности)	0,1 1,0
Назначенный срок службы, лет: незаменяемого оборудования заменяемого оборудования	40 20
Назначенный ресурс, ч: незаменяемого оборудования, не менее заменяемого оборудования	320 000 160 000
Количество средних ремонтов за срок службы	1
Интервал между перегрузками топлива, лет	4,5 (7) *
Коэффициент использования установленной мощности	0,65
Период непрерывной работы, ч	26 000



## *New innovative technologies at construction of ice breaker UAL-60 (project 22220)*

- *Application of essentially new low-temperature steels 500W RSD, specially designed for operation in Arctic conditions*
- *On UAL-60 transition from system of electric motion on a direct current on alternating current is carried out*
- *Experience of national and international (CONVERTIM) makers were used to design electric propulsion systems at total power 60 MW on shafts*
- *A new generation of electrical motors for propulsion systems as well as converter equipment were designed and put in production.*
- *The system of the emergency movement at the failure of nuclear reactor was applied for the first time in the history of icebreaker construction*
- *A new double-staged steam turbine was designed based on long-term experience of no-failure operation of nuclear ice breakers in the Arctic conditions.*



## Baltic Plant Shipbuilding LLC

- The plant is located in the western part of St. Petersburg, on Vasilyevsky Island, in the mouth of Big Neva. 100% affiliated structure of JSC OSK. Possesses all licenses necessary for nuclear and military shipbuilding. The production site occupies the territory more than 65 hectares. For a vessel construction the plant has three shipbuilding places - two building berths and the covered shed. The biggest building berth 350 meters long in Russia allows the enterprise to build vessels with a deadweight up to 100000 t
- The plant specializes in construction of surface ships of the 1<sup>st</sup> rank, courts of an ice class (ice breakers, multi-purpose supplying courts, courts of technical ensuring works on the shelf) with nuclear and diesel electric power plants, nuclear floating power units, floating desalination complexes
- The plant produces a wide range of products of ship power and mechanical engineering, as for equipment of the ships and courts of own construction, and for deliveries to other ship-building enterprises. In the machine-building nomenclature of plant there is a heat exchange equipment for nuclear power plants, the boiler equipment, equipment for ship mechanical engineering: screws, shaft, ship fittings and many other things





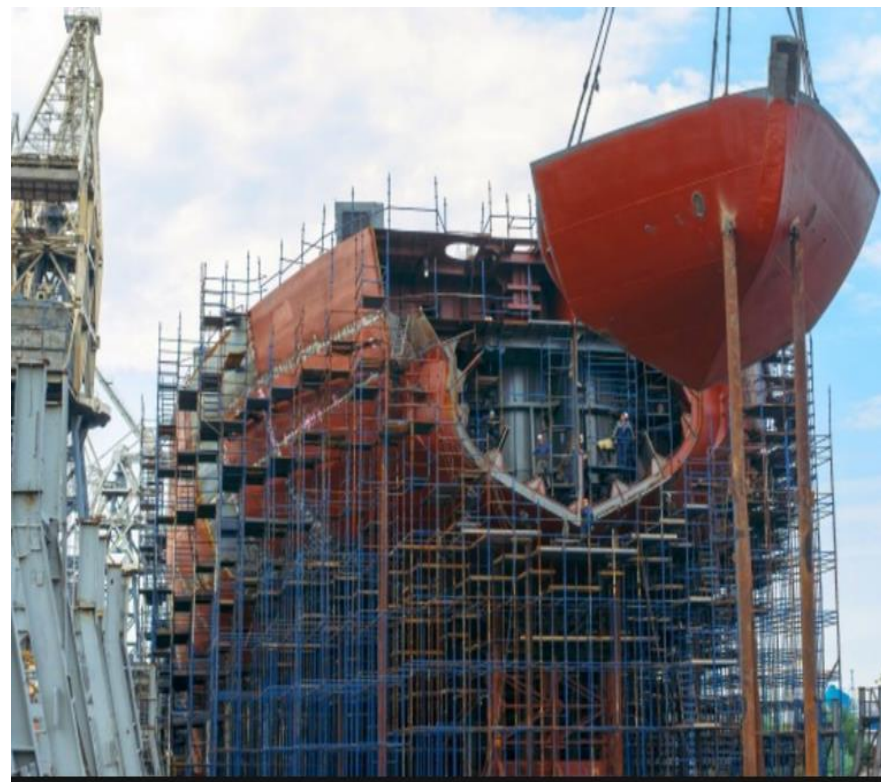
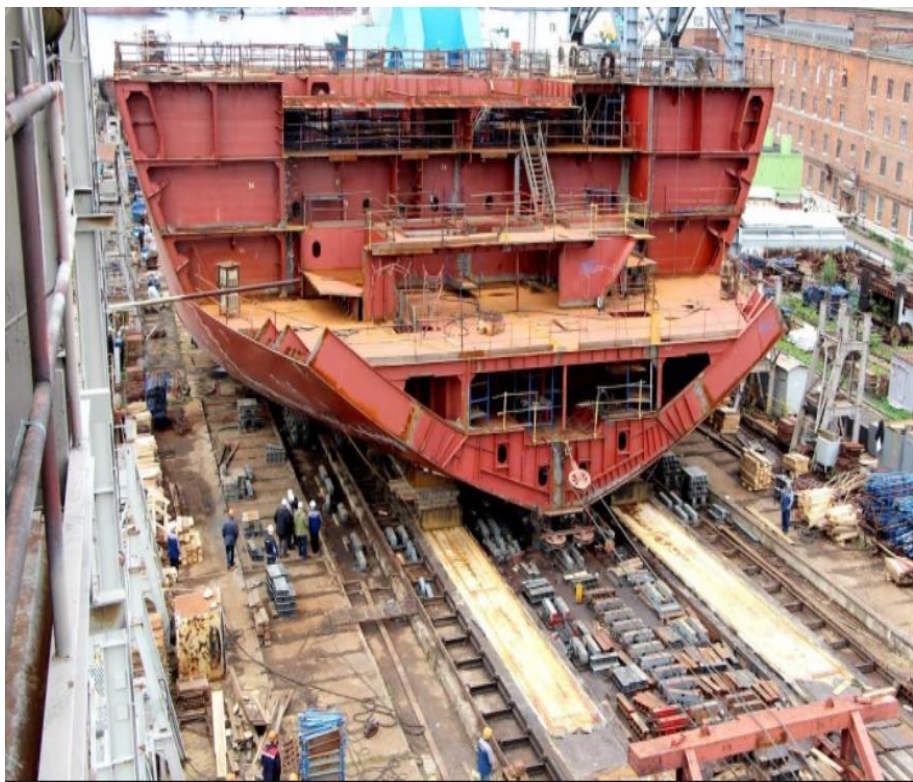
## Baltic Plant Shipbuilding LLC

- In 2013 the head nuclear ice breaker of the project 22220 with nuclear installations of the new RITM-200 type with a power of 60 megawatts, developed by request of Rosatom state corporation especially for development of the Arctic shelf is put
- In 2015 the construction of the first serial ice breaker of this project was begun
- In June, 2016 descent to water of the head nuclear ice breaker of the project 22220 which has received the name "Arctic" is planned
- LLC Baltic Shipyard — Shipbuilding current stock orders makes about 150 billion rubles
- The largest orders: three nuclear ice breakers of 60 MW, the diesel - electric ice breaker of 25 MW, the floating power unit of the first-ever floating nuclear thermal power plant, a mechanical engineering product



## Baltic Plant Shipbuilding LLC

*The size of existing building berth “A” allows to build two nuclear ice breakers at the same time. The first hull can be constructed entirely and another one under control descent from the slipway*





*Thank you for your attention!*



