Russia identified the dismantlement of nuclear-powered submarines as one of its two top priorities for the Global Partnership, the nonproliferation initiative launched by G8 leaders at their July 2002 summit in Kananaskis, Canada.

The Russian submarine dismantlement process is based on Russian Government Decree No. 518 of May 28, 1998 and the “Strategy for the Integrated Dismantlement of Nuclear-Powered Submarines and Nuclear-Powered Surface Vessels.” The principal contractor undertaking submarine dismantlement in the Russian Far East is the Zvezda Far Eastern Shipyard, a state federal unitary enterprise. Of 38 scrapped Pacific Fleet nuclear submarines, 31 were dismantled at Zvezda. In addition to Zvezda, there are two other shipyards in the region with dismantlement capacities: Shipyard 49K (in Seldevaya Bay, Kamchatka) and Shipyard 30 (in Chazhma Bay, Primorye), which are both Russian Defense Ministry enterprises (Zvezda Shipyard is subordinate to the Federal Industry Agency). The main submarine dismantlement technique, resulting in three-compartment units, requires the following operations:

- Unloading spent nuclear fuel (SNF) from submarine reactor cores at Zvezda Shipyard’s on-shore defueling facility, loading the SNF into specialized Type TK-18 (TUK-108/1) containers, and temporarily storing them until they can be sent in a special train echelon to the Mayak Production Complex for reprocessing;
- Removing solid radioactive waste (SRW) and liquid radioactive waste (LRW) from dismantled submarines, its temporary storage and eventual treatment;
- Cutting the submarine hull and forming sealed three-compartment units made up of the reactor compartment and two adjoining compartments, so that the reactor may be temporarily held in floating storage at a special floating storage site;
- Scrapping the fore and aft submarine compartments.

Between 1998 and 2001, with the support of U.S. funding (and, for LRW management, Japanese assistance), the infrastructure needed to undertake nuclear submarine dismantlement was created at the Zvezda compound. It included three specialized facilities:

- An on-shore SNF unloading and handling facility;
- A radioactive waste management facility;
- A facility for cutting submarine hulls and processing scrap metal.

To guarantee nuclear submarines are dismantled at the required rate, the timely defueling of decommissioned vessels, and the temporary storage and shipment of SNF
for reprocessing, an **on-shore defueling facility** was commissioned in April 2003 that can defuel four submarines per year. The facility includes the following assets:

- A plant where SNF is loaded into TK-18 (TUK-108/1) containers, outfitted with loading equipment; demag cranes (overhead bridge cranes); power supply systems; occupational safety, radiation, technological control, and physical protection systems; and sanitary inspection sites;
- Equipment for defueling the nuclear submarines, consisting in a versatile set of equipment for unloading SNF from submarine reactors and filtration units;
- Equipment for loading SNF into TK-18 and TUK-108/1 containers, for drying, for leakage tests, and for container decontamination;
- Hoisting and conveying machinery used to transport containers from the loading facility to the temporary storage site;
- Sites for the temporary storage of 80 containers. Temporary storage, according to design parameters, is supposed to last 6-24 months.
- Railways for the loading, stand-by, and formation of echelons of TK-VG-18 container railcars;
- The railroad from the on-shore technical base to Bolshoy Kamen station;
- Electric power supply and physical protection facilities.

The Zvezda On-Shore Defueling Facility was commissioned by an Act of the Government Acceptance Committee on January 30, 2003, and confirmed by the Russian Shipbuilding Agency.

The **radioactive waste management facility** includes the following assets, which have been built and commissioned:

- The *Landysh* floating LRW treatment facility;
- The low-level liquid radioactive laundry wash/rinse water treatment facility, with a capacity of 2,599 m³ per year;
- The solid radioactive waste (SRW) conditioning (decontamination and compacting) facility;
- An SRW storage facility, 1,500 m³ in volume, for the temporary storage of concentrated, solidified wastes from the *Landysh*, laundry water treatment facility, and SRW conditioning facility, which are transferred in 200-liter canisters.

The *Landysh* (in Japanese, *Suzuran*, or “lily of the valley”), was built with Japanese financing and commissioned in 1999. It ensures the treatment of LRW from nuclear submarines; the liquid remaining after the treatment of LRW is so clean that it can be discharged back into a fishery. The *Landysh* is the only LRW treatment facility in the Russian Far East that has gone through a state environmental impact examination and was accepted into service by a government commission.

The floating plant is a ship with a displacement of 5,000 tons, on which an LRW cleaning (treatment) plant built by the U.S. firm Babcock & Wilcox Nuclear Environmental Services is mounted. The ship was designed by the Vympel Design Bureau and the Krylov Central Scientific Research Institute, and built at the Amur Shipyard.
Measures were taken during the design of the floating treatment plant to ensure that it met Russian legal requirements for the observance of standards for the radiation safety of personnel, the general public, and environmental protection. At the same time the possibility of extraordinary (emergency) situations during the use of the floating plant, which can be used in other off-shore locations in the Sea of Japan, was taken into account. There is a system for monitoring the external environment. The design also included plans for the decommissioning of the plant.

The newly built facilities for handling radioactive wastes and SNF are equipped with automated radiation control systems that enable real-time monitoring of the radiation environment.

The **submarine hull cutting facility** includes:

- A guillotine with 2,000 tons of shearing force to cut hull structures of great and medium width, including the submarine pressure hull;
- A baler for compacting and packaging light-gauge metals;
- Hoisting truck-mounted cranes and truck trailers;
- A gantry crane and crawling tractor crane;
- Excavators with shears to cut structures of medium width;
- A conveyor system and scrap metal containers;
- Oxyacetylene torches, equipment for gas-powered and plasma-arc cutting;
- Tools and equipment for pneumatic mechanical cutting;
- A concrete pad and transformer substation to support the guillotine;
- A facility to process the cables stripped from the submarines;
- Scaffold;
- Occupational safety systems.

Thus, between 1998 and 2001 a complete nuclear submarine dismantlement capability was established that can defuel four and scrap up to eight decommissioned Pacific Fleet submarines each year, while ensuring the nuclear and radiation security of the population and surrounding environment.

**Difficulties in Realizing the Global Partnership Program in the Russian Far East**

From 1989 to 1996 Zvezda Shipyard dismantled 11 nuclear submarines, in 1997-1998 – none, in 1999 – two boats, in 2000 – three, in 2001 – three, in 2002 – two, in 2003 – three, and in 2004 – four. One of the reasons for the cessation of dismantlement activity in 1997-1998 was that the boats could not be defueled due to the decommissioning of the Project 326-class floating service vessels used to refuel/defuel submarine reactors, a ban on transporting SNF in type TK-11 containers that were manufactured in 1971-1972, and the deterioration of loading equipment, as well as several other factors.

After a two-year hiatus in 1997-1998, when no submarines were defueled, SNF was unloaded from two boats in 1999. In 2000, three boats were defueled, in 2001 – three boats, in 2002 – three boats, in 2003 – four boats, and in 2004 – two boats. In total, between 1999 and the end of 2004 Zvezda Shipyard offloaded SNF from 17 nuclear submarines.
The efficient execution of dismantlement tasks in the region during 1999-2003 was largely due to the financial support of the U.S. Department of Defense through the Cooperative Threat Reduction (CTR) program. To compare: in 2001 Zvezda received a Minatom (now Rosatom) state order for the maintenance and dismantlement of nuclear submarines, use of the Landysh floating LRW treatment facility, and capital investment totaling 88 million rubles, and in 2002 – 123 million rubles, while under CTR contracts the shipyard completed 520.7 million rubles worth of dismantlement work in 2001, 444.8 million rubles worth in 2002, and 198.4 million rubles worth in 2003.

In 2003 Zvezda completed the dismantlement of ballistic missile submarines (SSBNs) funded by the U.S. CTR program in Russia in accordance with the Strategic Arms Reduction Treaty (START Treaty). At present, the shipyard is chiefly dismantling first- and second-generation multipurpose submarines, which are supposed to be scrapped under the Global Partnership program.

However in practice, despite the existence of the necessary infrastructure, the establishment of the Global Partnership program, and the announcement by G8 leaders that they would spend $20 billion dollars to rid Russia of its “Cold War legacy,” the Russian Far East appears to be outside of the program.

And while Zvezda Director Yury Shulgan believes that “the Global Partnership program does not work in the Russian Far East,” it is our view that the program has not even begun in the region, bogged down somewhere between the CTR program and the Global Partnership initiative. In the three years since the establishment of the partnership, only one nuclear submarine has been dismantled in the Russian Far East, with Japanese funding. Negotiations over the scrapping of an additional five boats with Japanese funds are progressing only with great difficulty.

In addition, Japan’s sluggishness in solving issues related to the Global Partnership has “hung up” the funding promised by Australia (over U.S. $7.5 million) that is being donated through the Japanese program because of the lack of a Russian-Australian intergovernmental agreement. On top of this, after the completion of SSBN dismantlement in 2003, the United States began to remove some of the equipment that it had provided earlier (as is well known, the United States is not funding the dismantlement of multipurpose submarines). Under these circumstances, the sole source of funding for submarine dismantlement in the region is the federal government. However, this funding is clearly not enough to pay for the dismantlement of all 36 decommissioned nuclear submarines in the region.

It is clear that given current financing levels, submarine dismantlement cannot be completed by 2010, as is envisioned by the Strategy for the Integrated Dismantlement of Nuclear-Powered Submarines.

Another critical issue in addition to the financial one is the reconstruction of the railway between Smolyaninovo and Bolshoy Kamen, without which even federally funded submarine dismantlement is under threat. After the completion of the tasks specified in the 2005 State Order, the on-shore temporary SNF storage sites will be 85% full, and in 2006 Zvezda’s defueling facility could defuel another 1-2 submarines. The further use of the defueling facility will be possible only after TUK
containers of SNF are sent to Mayak. However, the 29-kilometer railway between Smolyaninovo and Bolshoy Kamen was built in 1934-36, is currently in unsatisfactory condition, and is restricted to light loads. In comparison, the entire railway from Zvezda to Mayak is 7,500 kilometers. The Vladivostok branch of the Far Eastern Railroad prohibited the shipyard from sending out special railcars with TUK-18 containers over this section of rail due to its technical condition on May 17, 1998 (order No. P-7/68).

The reconstruction of the railway spur was debated at a session of a Russian Security Council interagency commission in August 2002. The Russian government charged the Russian Shipbuilding Agency, Ministry of Atomic Energy, and the Ministry of Railways with undertaking immediate measures to finance and reconstruct the railway in order to ensure that spent nuclear fuel from dismantled nuclear submarines could be removed.

However, to this day Japan has not signed an implementing arrangement for this project, despite the fact that in 2001 the General Secretary of the Russian-Japanese Cooperation Committee, Toshiyuki Kawakami, even named a concrete schedule for the completion of this task: 3 years. Thus, the use of the on-shore defueling facility will be impossible after 2005 without the reconstruction of the rail spur. The alternative – using Russian Defense Ministry floating service vessels to unload SNF – will mean increased federal expenditures or the increased use of the funds of donor countries helping to solve submarine dismantlement issues.

Rosatom is currently looking for budget moneys to solve this problem. But it is clear that if this is done with federal funds, it will result in a reduction of funding in other areas approximately equivalent to the amount needed to dismantle one nuclear submarine.

Yet one more problem in the region that must be solved in the very near future is the transportation of nuclear submarines that are no longer hermetically sealed from the bases where they are laid up to the dismantlement site.

At present the Pacific Fleet has 36 decommissioned submarines subject to dismantlement. Fifteen of these boats are in Primorye, all with nuclear fuel on board.

About half of all of the submarines have been laid up for 10 or more years, which makes it difficult to maintain them as they await dismantlement. The technical condition of the hulls of first generation decommissioned submarines, built from the late 1950s through the early 1960s and in operation for more than 40 years, is generally unsatisfactory. All of them have main ballast tanks that are no longer hermetically sealed, are listing, and have a trim difference fore to aft, caused by the deterioration of the materials used for the tanks, damage incurred under sail, and the failure to observe maintenance schedules.

Given the maximum capacity of Shipyard 49K – the dismantlement of three submarines per year (and in the opinion of civilian experts, two), the question arises regarding the need to transport some of the submarines laid up in Kamchatka for dismantlement at Zvezda, which cannot be affected by towing, given the condition of the boats.
In addition, we must not forget the growing need to dismantle the nuclear service boats, a question that must be considered together with submarine dismantlement. However, the dismantlement of the nuclear service boats has several important differences from submarine dismantlement:

- Their dismantlement requires the provision of radiation safety and the creation of strict exclusion areas the full length of the decommissioned vessels;
- The dismantlement of nuclear service vessels creates a large volume of SRW. Practically speaking, the quantity of SRW is equivalent to the mass of the vessel being dismantled;
- Virtually the entire nuclear service vessel is contaminated with radiation;
- There are no technologies for the decontamination of nuclear service vessel hardware; therefore, all parts of the dismantled vessel can be considered SRW;
- The infeasibility of decontaminating any part of the vessel means that access is difficult.

Accordingly, in the Russian Far East the Global Partnership should undertake the development of design and technical documentation for dismantling each nuclear service vessel class, analogous to those developed for the dismantlement of submarine classes.

Also, in the near future the problem of decreasing the volume of SRW must be tackled. The dismantlement and defueling of one submarine results in approximately 30 m³ of SRW. Given that the dismantlement program financed by Rosatom involves the scrapping of 4-5 submarines per year, the yearly generation of SRW makes up about 150 m³, while the volume of the temporary storage facility (Building 131) is 1,500 m³, enough for this program’s needs for 10 years.

Though existing capacities can solve the problem of nuclear submarine dismantlement, the dismantlement of nuclear service vessels remains an open question. The dismantlement of nuclear service vessels that have already been decommissioned or will be decommissioned in the next two to five years will create a significant volume of radioactive waste, including high- and intermediate-level wastes of irregular shapes. This means that the use of traditional SRW treatment techniques will not be possible.

Scrapping a nuclear service vessel results in a quantity of SRW dozens of times greater than submarine dismantlement. In practical terms, the mass of the resulting SRW is close to the mass of the vessel that is dismantled. The schedule for nuclear service vessel dismantlement at Zvezda indicates that the additional SRW created will total about 4,000 m³. The storage facility (Building 131) will not be able to handle the temporary storage of these volumes of SRW. This means there is a demand for the creation of radioactive waste handling infrastructure in the Russian Far East – storage and disposal facilities, radioactive waste transportation and packaging facilities, and means to transport TUK containers with radioactive waste to storage and disposal facilities.

Besides this there are two damaged nuclear submarines floating in Pavlovsk Bay, that cannot be safety dismantled at the present time. They have already been in floating
storage with nuclear fuel on board for 15-20 years. Their safety is being ensured by the Russian Navy, but with each year this is becoming more and more difficult. Therefore, in the near future a decision about the way to mothball these vessels must be made.

Otherwise the vessels may sink, with consequences, according to Fleet experts, that will be felt by the residents of all of the countries in the Far East. According to various estimates, the cost of these projects is $10-40 million dollars.

There is much to be done: the infrastructure for the creation of one-compartment units must be built, so that reactors may be put in long-term storage, and a site for the temporary storage of these units must be created in Razboynik Bay, which is part of the territory of the Rosatom enterprise DalRAO. The creation of a similar long-term storage facility and related infrastructure for the Northern Fleet is being created with German funding, at a cost of €300 million.

**What is to be Done?**

Given the current situation in the Russian Far East, it is critical that urgent measures are taken to ensure that the Global Partnership is active in the region, and the following dire scenario described by Federal Atomic Energy Agency Deputy Director Sergey Antipov does not come to pass: “We could find ourselves in the situation where all of the problems associated with nuclear submarines and SNF in the Russian Northwest are solved, but the problems in the Russian Far East remain for many long years. From the point of view of possible threats, primarily terrorist threats, this would be not simply a regional problem, but a problem for the entire global community.”

Top priority measures that must be singled out include:

- The intensification of Japanese funding, which was promised at the relatively modest level of $200 million, and to date has only been expended on the dismantlement of a single submarine;
- Finding alternative ways for countries that do not have a relevant bilateral agreement with Russia to finance the dismantlement of submarines in the Russian Far East, given that Japan has set political conditions for the provision of assistance to Russia. In particular, some way must be found to make use of the over $7.5 million that Australia has given to Japan for the dismantlement of submarines in the Russian Far East;
- The reorientation of donor countries to solving dismantlement problems in the Russian Far East. There is already some positive movement in this direction. After a visit to the Russian Far East in November 2004, German officials agreed to supply transport equipment for use in Razboynik Bay, where the temporary one-compartment reactor storage facility will be built, analogous to the equipment that will be used in Northwest Russia’s Sayda Bay to transfer reactor compartments onto shore. In addition, the Germans promised to consider providing the Russian Far East with a special heavy-lifting crane for moving containers of SNF, to be paid for by German grant aid.

An additional alternative funding source is Canada, which has broadened its interest in the Russian Far East as a whole. In April 2005, Russian Prime Minister Mikhail Fradkov signed an order on the opening of a Canadian general consulate in
Vladivostok. Of the Canadian $300 million (approximately U.S. $240 million) committed to submarine dismantlement, Canada has only determined how it will spend U.S. $150 million (for submarine dismantlement at Severodvinsk’s Zvezdochka Shipyard).

Of the practical measures needed to implement submarine dismantlement, primacy should be given to the reconstruction of the Smolyaninovo-Bolshoy Kamen rail spur, needed to send SNF to Mayak so that the entire dismantlement process does not come to a complete standstill in 2006. The estimated cost of this project is $7 million.