Komsomolets Submarine Disaster
Cover-ups and Plutonium Soup

1. The Issue

On 7 April, 1989, after thirty-nine days at sea, the Soviet nuclear sub Komsomolets sank in the Barents Sea off the coast of Norway. Forty-two officers in the Soviet navy perished, while most of the officers who did survive escaped with serious injuries. The Komsomolets was unique among submarines in the Soviet navy. It was a 6400 ton forerunner of a new class of nuclear submarines. The Komsomolets also had capabilities beyond those of American submarines. It was able to dive deeper than its predecessors and the advanced nuclear reactor propelled it to speeds faster than any other submarine. It was made of titanium, a stronger metal than conventional materials, but also more expensive. On 7 April, however, none of the supposedly superior aspects of the submarine prevented it from disaster. When fire broke out in the stern of the ship, it quickly spread to other compartments. After surfacing, the intense pressure from the fire was too much for the titanium hull as high pressured oxygen ruptured the hull. The ship sank to the bottom of the sea bed, 1700 meters below the surface. In the ensuing months, specialists initially concluded that the wreck posed little threat to the surrounding ecosystem. But as the years passed evidence of potential environmental damage mounted, pushing officials to announce structural deficiencies in the wreck, and the possibility of plutonium leakage into the sea by 1995. The potential damage to the local ecosystem is enormous and irrevocable. It is one of the richest fishing areas in the world; trade in fisheries, valued at billions of dollars annually, is in jeopardy.

2. Description

The Komsomolets is not the only nuclear submarine to experience such a major accident. Four other Soviet nuclear subs and two American vessels are supposedly resting at the bottom of the sea. While the other accidents have been mostly forgotten by the press and public, the Komosomolets still demands public scrutiny because of its location and potential environmental damage. It is feared that leaks from the nuclear reactor and torpedoes could imperil rich arctic fisheries, causing massive losses in revenue for several nations.

It was only in the last couple of years that the potential damage from the ship was recognized. As late as April of 1993, Russian officials were still claiming (not without warrant) that leaks were "insignificant" and posed no threat to the surrounding environment. It was around this time, however, that environmental repercussions from the accident were first being realized. In an interview on Russian television, Tengiz Nikolayevich Borisov, Chairman of the Specialized Underwater Work of the Russian Federation Government and a primary scientist tasked with examining the accident, discussed the problems with the wreck. After several underwater submersible missions to the site, it became apparent that sea water was eroding the casings of the warheads and the hull of the submarine. This erosion was perpetuated by rapidly shifting currents, which hastened the corrosive process. Borisov frankly admitted there was a real danger of leakage, originally not predicted (if at all) for many years. The reason, ironically, lies in the construction of the submarine itself. Steel components and alloys based on magnesium and aluminum corrode at enormous speeds in the presence of titanium; thus plutonium is predicted to enter the sea at some point in 1995.

Borisov predicted that in the summer of 1994, scientists might be able to "buy some time," because a massive operation to either raise the submarine or somehow remove the weapons would take years to plan. Previous expeditions which examined the possible extrication of the sub, concluded this would likely not be possible because of structural decay and corrosion. If the ship breaks up in the process, it might exacerbate any environmental damage. Therefore a mission was planned to seal some of the cracks during the summer of 1994 and forestall the predicted seepage in 1995. This precluded some damage and gave scientists more time to plan another scheme to eradicate the problem.

When the expedition reached the wreck during the summer of 1994, scientists were surprised to discover some plutonium leakage. One of the sub's two torpedoes equipped with nuclear warheads appeared to have broke, releasing twenty-two pounds of plutonium into direct contact with the ocean. The expedition was successful in closing some of the holes in the hull of the sub. However, although radioactive levels were low last summer, expedition scientists warn that the rest of the sub must be sealed soon, or else plutonium may show up in the food chain.

Norwegian authorities, who have vested trade interests in the region, and scientists concur with this point. It was previously argued that the severe depth of the submarine would preclude detrimental effects to organisms. But scientists have since articulated a plausible scenario illustrating the damaging effects. They are most concerned with the alternating cold and warm ocean currents that can transport contaminated plankton from the depths around the wreck toward the surface where the organisms can be eaten by fish. They are also worried about sea water flowing between the inner titanium and outer steel shells of the material. Additionally, the torpedo casings are especially vulnerable and dangerous. The plutonium released can likely attach to titanium flakes and spread throughout the sea.

Scientists are currently considering three options to eradicate the problem. The first and most expensive proposition is to raise the sub. A Dutch firm estimates that this could cost somewhere in the range of $1 billion dollars. But more importantly, most analysts believe this option to be the most hazardous. The submarine has corroded to a point where it is unlikely to stay intact during such an operation. This would worsen environmental problems if it were to break up on its ascent. The second option is to raise only the bow of the craft (section with the torpedoes). But this option has been set aside, since the leakage has rendered the weapons unstable. Because of corrosion, movement of the weapons could cause them to explode. The third and most likely option is to encase the submarine by hermetically sealing it with a jelly substance from crustacean shells containing one to two percent chitosan. It is postulated that this chitinous gel can bind radionuclides better than concrete, as originally postulated A few years after this operation, the warheads could be safely removed. Scientists stress that the warheads must be removed; half-life for plutonium-239 is 24,000 years. The interim sealing process will give scientists time to devise such a plan. The sealing operation will commence in the summer of 1995.

The effects of the Komsomolets accident go beyond ecological consequences. There are trade repercussions also. Several European nations fish in the region very close to the exact location where the wreck is submerged. Ecological consequences threaten billions of dollars in revenue from sales of fish to Russia and Europe. There has already been a decrease of fishing in the area, due to minor contamination levels and the perceived threat of future, more extensive, contamination. Once the encasing operation is completed, fishing operations should return to the area in a relatively short period of time. Russia has since been heavily criticized, not so much for the accident itself (accidents of this sort do happen), but because it could have been prevented and more should have been done to rectify the situation.
Nevertheless, efforts to quash the potential ecological side-effects are proceeding. It remains to be seen, however, whether or not such efforts will be successful. The aforementioned operation to seal the warheads is scheduled for this summer.

3. Related Cases:

CHERNOB case
ARCTIC case
JAPANSEA case
MURUROA case
JAPANPL case
TEMELIN case

Keyword Clusters

(1): Trade Product = FISH
(2): Bio-geography = OCEAN
(3): Environmental Problem = Species Loss Sea [SPLS]

4. Draft Author: Vincent P. Bonner

B. Legal Filters

5. Discourse and Status: Disagreement and Incomplete

The loss of a nuclear sub is a unique event, and as such, is not covered by an international agreement. Any means of solving a subsequent problem (such as potential pollution by the Komsomolets), must be worked out on an ad hoc basis. In this example, Russia is primarily working with Norway, which has the most to lose if said pollution effects the environment as forecasted. Since there has been minor damage to the environment thus far, most analyses are only informed speculation at best. This will probably prove to be an important consideration in the future as different parties may adhere to different extremes of the exact nature of the problem.

6. Forum and Scope: Russia and Unilateral

At this point there is no deliberative body that can broker a solution. Russia and Norway are directly involved and hence will be the primary parties in discussing the future course of action. Other European nations, such as Finland, Sweden, the United Kingdom, and Iceland fish in the Barents and Norwegian Seas and therefore have a stake in the situation. The United States has a vital interest in the Komsomolets also, though not for environmental or trade reasons. The US is interested because they to have lost nuclear subs and are intrigued by methods to salvage the operation.

7. Decision Breadth: 2 (Russia and Norway)

In addition to Norway and Russia, some other nations utilize resources from the Barents Sea area. They include, but are not limited to, European nations.

8. Legal Standing: Law

Given the capricious state of Russian affairs, one might easily envisage legislators demanding some sort of action depending on what experts predict. They could easily be swayed by nationalism or by the populace as a whole. The Russians are also concerned that a salvage operation may result in a diffusion of sensitive technology to other nations.

C. Geographic Filters

9. Geographic Locations:

a. Domain: EUROPE
b. Site: Northern Europe
c. Impact: Russia

10. Sub-National Factors: No

11. Type of Habitat: COOL

D. Trade Filters

12. Type of Measure: Regulatory Standard [REGSTD]

Because the full extent of any contamination has not been determined, a precise measure of trade damage is not yet possible. Additionally, it is only in the last year, that some contamination is being reported. There has been some effect thus far on trade patterns. Norway however, has reported that some importers, such as France, have raised questions regarding the quality of its marine exports from the Barents Sea region. And, tens of thousands of workers are potentially affected by the pollution.

13. Direct versus Indirect Impact: Direct

14, Relation of Trade Measures to Resource Impact

a. Directly related: NO
b. Indirectly related: YES FISH
c. Not related: NO
d. Process related: YES Habitat Loss

15. Trade Product Identification: FISH

The discharge of plutonium-239 from the torpedoes warheads, assuming it occurs, will take place in bursts and will continue for several years. Its consequences will be catastrophic. This section of the world ocean is one of the most biologically productive. Eighty percent of the fish caught in the Barents and Norwegian Seas are caught precisely in the region where the Komsomolets went down. Since plutonium has a half-life of 24,000 years, this part of the sea may by unsuitable for fishing for 600-700 years.

16. Economic Data

There is no precise data available as yet. Estimates vary somewhat, depending on the source. Most sources claim that the financial damage to Norway alone will be a loss of revenue in the range of hundreds of millions of dollars annually, hopefully paid by Russia. Over a five year period, the damage to the fishing economy of the region is estimated to be around 3.5 trillion rubles (roughly $3 billion in 1993 prices). This would be added to the $500 million annually that will have be disbursed to Norway to recoup sustained lost revenue.

17. Impact of Trade Restriction: LOW

The estimated loss in revenue to certain nations which fish in the effected areas is the only indication of the potential consequences that might arise.

18. Industry Sector: Fish

19. Exporter and Importer: NORWAY and MANY

Norway has the most to lose from the pollution. At stake is the rich fishing industry, and by extension, the fish processing industry in the area, which brings in at least $500 million annually and employs thousands of workers. Other nations also fish in the area, including Russia.

E. Environment Filters

20. Environmental Problem Type: Habitat loss

Those who believe that the situation is exaggerated point to the great depth of the submarine. They rightly emphasize that few fish have their habitat at these depths. But according to environmental experts, this misses a crucial factor. Leaking plutonium will be absorbed by phtoplankton, thus instigating a possible uncontrollable spread of radioactivity. This spread is further exacerbated when fish in the Barents and Norwegian Seas feed on the plankton. Experts also reckon that levels of radioactivity would be 10,000 times more toxic then arsenic. This would render the area unsuitable for fishing operations for hundreds of years.

21. Species

Name: MANY
Type: MANY
Diversity: 150 higher plants per 10,000 km/sq (Russia)

22. Resource Impact: High and Product

The potential impact is high, effecting the marine environment for centuries. According to a report to Russian President Boris Yeltsin from the Atomic Energy Ministry, the area is one of the productive spawning grounds for fish in the world.

23. Urgency of Problem: High and Hundreds of Years

Some plutonium-239 has been observed leaking from the submarine already, and, when coupled with potential absorption by phytoplankton and subsequent movement through the food chain, thus presents an imminent problem. Furthermore, if the situation is not remedied soon, the potential damage can last hundreds of years.

24. Substitutes: LIKE Products

25. Culture: No

26. Human Rights: No

27. Trans-Boundary Issues: Yes

The issue affects Russia and Norway the most. The success or failure of the operation to halt potential environmental damage will have a direct effect on Norway.

28. Relevant Literature

Baiduzhy, Andrei, "Russia has only a year left to render the Komsomolets harmless," Current Digest of the Post-Soviet Press, 27 October, 1993, v. 45, n. 39, p. 24.

Boston Globe Editorial, "Nuclear Sub Corroding in Barents," 24 January 1993, p.16.

Broad, William, J. "Russians Seal Nuclear Sub on Sea Floor," New York Times, 8 September 1994, A7.

Elliott, Lawrence, "Mayday on a Nuclear Sub," Reader's Digest, November 1993, Vol. 143, No. 859, pp. 95-101.

Kurchtov, Col. A., "They Want to Behead the Komsomolets: Our Descendants are Unlikely to Forgive us For the Execution," Moscow Rossiyskaya Gazeta, 11 October 1994, p.3, translated by the Foreign Broadcast Information Service, London.

Lean, Geoffrey, "Russian Dumps 20 N-Reactors at Sea; Yeltsin Learns Full Scale of Horror," London Observer, 11 April 1993, p. 1.

Mozgovoy, Alexsander, in the Moscow Rossiyskaya Gazeta, First Edition, p. 2, 26 January, 1993, translated by the Foreign Broadcast Information Service, London.

Nenashev, Sergei, "Raising the Komsomolets," Soviet Life, November 1991, n. 11, p. 58.

Westerwoudt, Theo, "Sealing a Radioactive Grave," World Press Review, December 1994, Vol. 41, No. 12, p.44.

"Heavy Costs for Russia is Sunken Komsomolets Leaks," Moscow 2x2 Television, 16 June 1994.

"Sunken sub corroding, could release "plutonium soup," Moscow Ostankino Television First Channel, 20 November 1993.

"Program to waterproof Komsomolets to continue in 1995," Moscow Interfax, 23 July 1994, translated by the Foreign Broadcast Information Service, London.

"Expedition to Study Submarine's Warheads, Moscow Ostankino Television First Channel, and Orbita Networks, 3 August 1993.

Federal Broadcast Information Service, London, Moscow Interfax "Exclusive" Report, 4 November, 1993.

The Komsomolets Disaster

George Montgomery

Some five years ago the Russian nuclear attack submarine Komsomolets sank in the Norwegian Sea. The event caused consternation in the Soviet Navy, high interest in NATO maritime and intelligence circles, and apprehension among environmentalists. This concern arose particularly in Norway, for the submarine's broken hull holds two nuclear reactors and at least two torpedoes with nuclear warheads containing plutonium, one of the most toxic substances known to man. Since the sinking, Russian authorities have elicited to an unprecedented degree scientific assistance from other countries and used remote sensors and minisubmersibles to find Komsomolets, measure radiation leakage, and assess the stability of the wreck. Ironically, the architect of this instrument of war who designed it to hunt US and Norwegian ships is asking for and receiving assistance in surveying the submarine and assessing its stability from Komsomolets' intended victims.

Komsomolets--One of a Kind

Komsomolets means "member of the Young Communist League." She was launched in May 1983 in Severodvinsk, a closed Soviet city on the Barents Sea with the world's largest shipyard. She was 400 feet long, 37 feet high and 27 feet in beam with a submerged displacement of 8,000 tons--a very large sub indeed. Komsomolets had two nuclear reactors, long thought to be of revolutionary design (liquid-metal coolant) but actually water-cooled. Her inner pressure hull was titanium, light and strong, making her the world's deepest diving submarine, and her operating depth below 3,000 feet was far below that of the best of US subs. She was manned by about 70 men and could carry a mix of torpedoes and cruise missiles with conventional or nuclear warheads. NATO dubbed her type Mike and expected the unit to be first of a class of large attack submarines. She became operational in late 1984 but no further Mikes were built. Although a prototype, she went on operational patrols and was described as an antisubmarine warfare unit in May 1989.

The Sinking

It is 7 April 1989. Komsomolets, of the Soviet Northern Fleet, is cruising at 1,250 feet below the surface of the Norwegian Sea, some 100 miles southwest of Bjornoya (Bear Island) and 200 miles to the north of the Norwegian mainland. She has been on patrol for 39 days.

At 11:00 a.m. Seaman Nodari Bukhnikashvili reports all well in Compartment 7, the location of steering and the aftmost space on the ship. Moments later, a high-pressure air line connecting to main ballast tanks allowing the submarine to control its depth bursts its seal in the seventh compartment. Somehow a spray of oil hits a hot surface there, and a flash fire begins in the high pressure oxygen-rich air. Three minutes later Capt. Third Rank Vyacheslav Yudin, Komsomolets' watch engineer in the control room, notes a sharp rise in temperature aft. He calls Bukhnikashvili on the intercom, but receives no reply. Lt. Igor Molchanov notes the time in the deck log.

Chief Engineer Valentin Babenko and Commanding Officer Captain First Rank Yevgeniy Vanin are now in the control room. Babenko recommends Vanin smother the apparent fire with freon, a nonflammable gas. Vanin delays, knowing the gas would smother the seaman as well as the fire. But soon he reluctantly orders the system activated. The high-pressure air line is feeding the fire in Compartment 7 like a blast furnace. Bukhnikashvili is the first of the crew to die. The fire is now beyond containment.

Pressure aft forces oil into Compartment 6, and the fire arcs through cableways despite closed hatches. Turbine generators here wind down, the emergency system to protect the nuclear reactors from overload kicks in, and the propeller shaft stops. Fearing a meltdown, the reactor officer shuts down the submarine's main source of power. Now Komsomolets is powerless. With no way on and at a depth of 500 feet, she loses vital lift. Interior communications cut off. At 11:13 a.m. oil pumps shut down and the sub loses hydraulic pressure to control surfaces. The vertical rudder jams, and the stern diving planes cannot be controlled. Captain Vanin orders the main ballast tanks blown, and Komsomolets rises to nearly 300 feet. Here he repeats the procedure. Somehow, by blowing extra water ballast, Vanin manages to bring the sub to the surface. As she founders, he signals an encoded SOS to his headquarters.

But surfacing has not put Komsomolets out of danger. By 11:21 a.m., the fire has spread through cableways to all aft compartments and has reached nearly 2,000° F. The rubber coating on the outer hull designed to muffle acoustic detection begins to slide off in strips.

Vanin orders all hands not engaged in damage control topside. Those fighting to save the ship don masks using the emergency breathing system. But with the loss of high-pressure air, fumes from Compartment 7 have brought carbon monoxide (CO), a tasteless, odorless, and toxic gas, into the system. Men get dizzy and doctor Lt. Leonid Zayats suspects something wrong. He rips off his mask and tests the air. A fatal concentration of CO is detected. Now most of the crew will fight for their ship in a swelter of smoke and foul air.

Vanin continues signaling Northern Fleet Headquarters. By 11:41 a.m. his message is received, but garbled--a Soviet submarine somewhere is in trouble, and air crews are alerted.

By noon the fire reaches forward compartments. Nothing is heard from the nine crewmen manning the reactors in Compartment 4. Yudin and another officer don self-contained breathing gear, open the hatch, and enter. Miraculously, they find two officers still alive in the smoke-filled compartment and bring them out. More rescuers try to ventilate Compartment 5 and bring out two crewmen. One survives. In Compartment 3 Seaman Roman Filippov tries to restart a diesel generator to provide ship's power. He succeeds but becomes ill and is ordered topside. Capt. Third Rank Anatoliy Ispenkov takes over and continues to man the post.

At 12:19 p.m. Vanin abandons security protocol and sends a message in the clear giving the submarine name, location, and dire circumstances. The Navy responds. Fleet Admiral Chernavin, the senior Soviet naval officer, is alerted while at a conference at the Defense Ministry. He orders his headquarters to take all steps to rescue the crew, including assistance from Norway. Fleet Headquarters finds three Soviet ships within 70 miles of Komsomolets and orders them to the scene. The first Red Banner Northern Fleet rescue aircraft takes off from the Kola Peninsula at 12:43 p.m. But M-12 amphibians are not dispatched, and no one alerts the Norwegians. Nonetheless, they know of the alert through intercepted communications, but delay sending help because it is unclear whether a practice rescue is under way.

At 2:20 p.m. the rescue aircraft radios Vanin and hears that the fire is not spreading. Most men assemble on the weather deck. At 2:40 p.m. the rescue aircraft breaks through the clouds and spots Komsomolets dead in the water. Visibility is fair, sea state moderate. The men are heartened by the sight of aircraft. Thinking that surface help will arrive soon, they do not don wet suits, although the water is cold enough at 36° F to kill them in 15 minutes. In a short time the wind begins to kick up, seas rise to 4 feet, and the men hang on to the slippery deck. For the next two hours everything seems under control. The crew clears Compartment 5, and the ship is not taking on water. Surface rescue is expected to arrive at 6:00 p.m. Most of the crew are now on the weather decks as the smoke inside the ship is becoming intolerable. In the control room visibility is less than 6 inches. Few now remain inside. Vanin, Yudin, and Molchanov in the control room, Ispenkov manning the generator, and Warrant Officers Slyusarenko, Krasnobayev, and Chernikov remain inside to save the ship.

For more than four hours Captain Vanin has been attempting to right his ship. Upon surfacing he corrects an initial port list by counterflooding. Two hours later a starboard list develops. Vanin is handicapped by damaged equipment, hazardous conditions, and a nearly complete lack of information from his instruments.

About 4:30 p.m. Vanin orders two port ballast tanks blown to trim the sub. This does not work and serves only to accelerate taking on water. Komsomolets' after ballast tanks are not equipped with kingston valves that would close under water, and her pressure hull has been breached. She begins taking on water quickly astern. No damage control measures can save her now. At 4:42 p.m. Captain Vanin orders the crew to abandon ship and minutes later sends his last radio message.

At 5:00 p.m. two life rafts are inflated on the bow, and the aircraft drops a rescue pod. Men begin to enter them. The captain goes below to get the last of his crew, but now Komsomolets is sinking fast. The last man on the bridge shuts the hatch as water pours over the conning tower. The water would drown those still inside if he left the hatch open. Komsomolets is equipped with an escape capsule, and perhaps they can use it. At 5:08 p.m. Komsomolets begins to sink stern first. It will be an hour before surface help arrives.

The self-rescue is not going well. One life raft overturns. Men crowd aboard, but some have to cling to the sides. The second raft goes down with the sub, breaks free, but too far for the men to reach. More small rafts are dropped from the rescue aircraft, but there are not enough for the 50 men in the water. On the large raft, men's hands are getting numb. Doctor Zayats tells them to hang on by their teeth. Some succeed, but in the next hour more than half, including Babyenko and Filippov, slip away and drown.

Inside the sinking Komsomolets six men are still alive. Captain Vanin guides them to their last hope, the escape capsule. American submariners would not have this option. They close the hatch. Vanin counts . . . himself, Yudin, Slyusarenko, Krasnobayev, Chernikov . . . one is missing . . . Ispenkov. They hear a knocking, try to open the hatch, but it is too late. The outer compartment's walls collapse. Komsomolets goes down 300, 500, 1,000 feet. At 1,300 feet the scale no longer records, but the sub continues down. The men desperately try to release the capsule but without success. Another explosion rocks the ship, and suddenly the escape capsule breaks free--flying to the surface. Once there, the hatch blows off. But only Slyusarenko is able to get out, as the capsule floods in the rough seas. Vanin, Yudin, Krasnobayev, and Chernikov sink in the capsule to rejoin Komsomolets more than 5,000 feet below.

Shortly after 6:00 p.m. a fishing boat arrives and picks up 30 crewmen. Of the 69 crewmembers, 39 are already dead. Molchanov is recovered and feels fine, but the smoke inhaled while keeping the deck log in the control room and the water's chill have taken their toll. He and two more will soon die. Doctor Zayats and Warrant Officer Slyusarenko are among the survivors.

The Aftermath

Komsomolets did not die quietly. In the era of glasnost this incident could not be covered up, even in the Soviet media. Moreover, the Norwegians observed the rescue attempts and were worried about radioactivity released in their economic zone. Recriminations mounted. The Norwegians claimed they could have reached the scene by air or surface two hours before the submarine sank. Within a week a blow-by-blow account appeared in the widely circulated Soviet newspapers Komsmolskaya Pravda and Sovietskaya Rossiya with detailed time-events from the rescue aircraft point of view. Within a month the crew, dead and alive, was awarded the Order of the Red Banner, and more stories explained why it took so long for help to arrive. Two months after the sinking, the oceanographic rescue ship Akademik Mstislav Keldysh using submersibles found Komsomolets a mile down.

The Russian Oceanographic Fleet and the Keldysh

If effort expended at sea is any criterion, the Russians lead the world in oceanographic research. From a humble beginning of one wooden schooner in 1922, the Soviet research fleet grew to over 300, more than the rest of the world combined. At the peak of its efforts, the Institute of Oceanology of the Academy of Sciences oversaw 15 separate institutes in acoustics, geophysics, biology, and other marine-related sciences. Although most of these institute's scientific ships were involved in fishing research, at least 120 were hydrographic in nature. Some of these were subordinated to the Navy and manned by military personnel, but most had a mixture of naval and civilian mariners and technicians, and the hulls were constructed outside the USSR. With the reduction in naval units and overseas operations now being experienced by the Russian Navy, oceanographic operations at sea are also being drawn down. But impressively capable ships still operate.

One of the most capable of Russian oceanographic research ships is Akademik Mstislav Keldysh. At 400 feet in length and over 5,000 tons displacement, Keldysh is the world's largest oceanographic research ship, with 18 laboratories and space for additional special-purpose rooms. A crew of 50 supports the efforts of over 80 scientists-technicians. The outstanding specialty of the Keldysh is as the mother ship of the Mir submersibles.

The 1991 Survey

The international outcry following the sinking of Komsomolets forced the Soviet and its successor Russian Government to take serious steps to determine the dangers posed by the disaster. They apparently wished to avoid another Chornobyl' cover-up. The USSR Council of Ministers approved a government commission's recommendation to examine and raise the submarine a year after the sinking. They gave the lead to Igor D. Spasskiy, head of the Russian Bureau that designed Komsomolets. Besides surveying the ship, he wanted to determine the reason it sank and to measure any radiation hazards and propose solutions. Spasskiy devised a program comprising efforts of hydrography, fishing, and oceanography institutes with the research ship Keldysh as the centerpiece featuring experts in ocean sciences and nuclear reactors and weapons.

In August of 1991, Keldysh returned to the scene. She used towed sonar arrays, probes, trawls, and core-samplers for site measurements of the water and sea bottom in the mile-deep area of the wreck. But most of the detailed measurements were taken by her on-board submersibles Mir 1 and Mir 2.

The remote TV was able to look inside the hull in some places. It appeared as if there had been an explosion in the bow section, causing concern because this compartment houses the torpedoes with their nuclear warheads and lethally poisonous plutonium. Experts preliminarily concluded that this explosion was from gas fumes in Compartment 1 and not from high explosives in the torpedoes. The following conclusions were drawn from the 1991 survey:

Settling of the submarine between the 1989 and the 1991 surveys was not excessive.

The inner (pressure) hull had been breached in a number of places.

The reactor was venting somewhat, and the torpedo tube doors were open but the torpedoes appeared intact.

Radiation leakage was minimal, but corrosion might cause future increases.

Raising the submarine would be difficult.

It might be possible to seal the wreck hermetically on the bottom.

Further surveys were absolutely necessary.

The 1992 Survey

In April 1992 the Russian government approved another expedition to clarify and further delineate the damage to Komsomolets. Because Keldysh was not available during the July-August weather window, a shorter May time frame was scheduled. A total of 286 people took part, including one Norwegian and 56 Russian scientists. The expedition used many of the same devices from the year before, but added some deep-water remote viewing equipment. The Mirs conducted more than 75 hours of manned bottom time.

The expedition looked at the rescue chamber about a half-mile from the hull, checked out the bow of the submarine, and took extensive samples of water, bottom sediments, and organisms. Poor weather limited the time available for collection.

Damage was more extensive than noted earlier. The inner or pressure hull had been breached near the bow. It had cracks running lengthwise. The Russians acknowledged the presence of torpedoes with nuclear warheads in the bow, but they stated that tests revealed no concentrations of radiation in excess of established drinking water standards. Further, the hull did not appear to be suffering additional damage from deterioration.

The scientists concluded that the loss of hull integrity precluded raising the submarine, that the hull should be monitored periodically for leaks, and that perhaps the hull should be sealed or the torpedo compartment cut off, raised, and buried. In any case, more expeditions were needed.

Mir Submersibles

Mir-1 and Mir-2 are the most capable manned submersibles in the Russian inventory. Only the United States, France, and Japan also have craft capable of carrying special instruments and a crew of three to below 20,000 feet, allowing first-hand observation of 98 percent of the ocean floor. The Mirs were built in Finland in 1987 for the Academy of Sciences and have been engaged in oceanographic research for over six years, often with international crews.

Mirs usually operate in pairs so that one can serve as a rescue vessel for the other. Ballast is adjusted, and predive checks are conducted much like a preflight. The pilot, copilot, and scientist climb into the tight 6-and-a-half-foot-diameter sphere that can withstand pressures of 2,000 atmospheres (30,000 pounds/square inch). A Mir is lowered by crane into the water, unhitched, and towed away from Keldysh by small boat. Then it is ready to descend untethered at 80 feet a minute, or about one hour to drop a mile. It can move at 5 knots underwater and has air for 20 hours.

Mir has three lights and can record visual images with both photographic and video cameras and make numerous electronic and hydrologic recordings with other sensors. It has two arms capable of lifting 150 pounds and cans for storing tools or bottom samples. Mir has navigation, communications, and recording systems and can obtain exact position fixes from beacons set in the sea bottom.

In addition to dives on Komsomolets, international crews have conducted Mir dives in abysses off the American Pacific coast and on the Titanic wreck in the North Atlantic.

For the Komsomolets mission, the Mirs had been equipped with dosimeters and special absorbing pads for radionuclide measurements. From 23 to 31 August 1991 the Mirs made six 10- to 13-hour dives together on Komsomolets with crews of hydronauts, scientists, and navy officers. The first dive determined that radioactivity around the wreck did not pose a hazard to the surveyors. Subsequently, the crews inspected the hull and debris; took water, bottom, and biologic samples; and took photos and videotapes.

The survey determined that the reactor's hermetic seal was broken but that radiation emission was so minor that people and the environment were not endangered. Subsequent corrosion, however, might damage the organisms found around the site.

The 1993 Survey

The Russians published results of the 1991 and 1992 surveys, including their rather benign prognosis of radioactive seepage. As plans for the next mission were under way, they changed their tack, handing out increasingly dire warnings of radiation hazards from the wreck. Whether these warnings were based on more recent findings from the earlier survey or were attempts to elicit Western cooperation and funding for measurements and cleanup is not clear.

Academician Spasskiy warned the Commissioner for External Relations of the European Community in May 1993 that two years of research revealed that plutonium leakage could begin in a couple of years, could disperse a "toxic danger" quickly, and spread radioactive contamination as much as 60 miles along undersea currents, poisoning edible sea life. His warnings reached a large audience--readers of The New York Times Op Ed page.

Eventually Dutch, Norwegian, and American specialists joined the Russians in Keldysh for an extensive survey. Sensors used were even more elaborate than those in 1992 as foreign governments contributed expertise and equipment--including robots and a high resolution video camera developed by the Woods Hole Oceanographic Institution and Sony.

Results of the August 1993 survey suggested that waters at the site were not mixing vertically, and thus the sea life in the area was not being rapidly contaminated. Slow currents were moving north, not toward Europe, and were remaining at the 1-mile depth. Dr. Charles Hollister, an expert on deep-sea storms from Woods Hole, doubted that the heavy plutonium, bonding with clay, would cause significant contamination, but noted further study was needed, inasmuch as underwater storms can move mud equal to the annual discharge of the Mississippi River.

Russian engineers found the escape capsule that had separated from the submarine and later sunk. They wanted to recover logs and data books inside for further research into the causes of the disaster. As they were raising the capsule, however, the cable broke, and another attempt was not made on this cruise.

The 1993 survey detected radioactive cesium 137 from the corroding reactors but determined that contamination from the reactors remained slight.

The most startling discovery of the 1993 survey was a hole over 20 feet wide blown in the forward torpedo compartment. If this hole was noted during earlier surveys, it was not reported in the open press. Current speculation is that an explosion of hydrogen from storage batteries caused the damage. The entire compartment was deformed, and at least two of the nuclear torpedoes were "mashed up" in their tubes and could not be safely recovered. Leakage of plutonium was not immediately evident but would be unlikely to spread far.

Biologic, sediment, and water samples were sent to laboratories of all cooperating countries. Preliminary results showed environmental impact to be slight and that deep currents in the area were weaker than previously believed. Spasskiy nonetheless asserts that Komsomolets continues to corrode and that radioactive release will increase. Damage to human health is not significant now, but monitoring will be needed to ensure that any future threat is forewarned.

In mid-September 1993, after Keldysh returned but too soon for extensive research on recovered samples, Tengiz Borisov, head of the Russian Special Committee for the Conduct of Underwater Work, told reporters that his committee had decided to seal the corroding torpedoes in place in summer 1994. He added, "If there is a leak, fishing will be impossible in the Norwegian Sea for between 600 and 700 years." The discrepancy between this statement and more benign findings on site was not explained.

Epilogue

Near the end of 1993, a decision was finally reached. The Russian Government's Special Committee for the Conduct of Underwater Work found that radioactive seepage was at that time insignificant but that deterioration of the torpedoes could cause serious consequences in two to three years. Therefore, it would be necessary to seal the bow of Komsomolets, using a special compound yet to be developed, entombing it in a special sarcophagus.

A Reuters wire release from Moscow on 12 July 1994 stated, "Russia said yesterday it had sealed a sunken nuclear submarine off Norway to prevent radioactive leaks. The Komsomolets . . . is now embedded in mud in international waters."

Komsomolets lies broken a mile deep in a quiet part of the Norwegian Sea. Natural sediment drifts down slowly burying the wreck, its debris, and most of its crew. Few artifacts have been raised. One of them, the ship's clock, was sent to the Central Naval Museum in Leningrad. It stopped at 5:43 p.m. on 7 April 1989.

Sources

Komsomolets' history and general description are from Jane's Fighting Ships 1989-90. Information on

her reactors, torpedoes, operating depth, and prototype status was obtained by the author at the Center for Naval Analyses in an open conversation on 21 October 1993 with Academician Igor Spasskiy, head of the Rubin Design Bureau and designer of Komsomolets.

This year, an article in Morskoy Sbornik ("The Tragedy of a Ship and the Honor of Her Crew," by V. Krapivin, No. 4, 1994, pp. 44-56) presented for the first time in the open press the Russian Navy's version of the causes of the sinking, based on recovered logs, interviews with all survivors, and examination of the hull and debris. In answer to the many articles blaming the Navy's inadequate maintenance and damage control training for the tragedy, Krapivin, a Captain First Rank in the Navy's technical service, reconstructs the accident from beginning to end and, in the process, exonerates the crew. The day of the patrol, the depth of the submarine, the damage control stations and duties of crew members and their actions, and the technical explanation of how Komsomolets caught fire, flooded, and foundered are drawn from this source.

The description of the sinking also is based on the following primary sources:

An article in Sovietskaya Rossiya ("The Last Order," by N. Domkovskiy, 15 April 1989, p.6) gives the point of view from the rescue aircraft.

The 13 May 1989 issue of Krasnaya Zvezda (pp. 1-2) lists the full names and survivor status of the crew, and it also contains an interview of Fleet Admiral V. Chernavin, who gives the view of the Main Navy Staff and provides background information on the cause of the fire.

An article in Sovietskaya Voin ("At the Deserted Mooring," by N. Cherkashin, January 1990, p. 12) gives time-lines and individual activities aboard the submarine, based on logs and personal testimony.

**The Wall Street Journal of 14 March 1990 (p. A-1) provides the length of the patrol, the compartment layout, Norwegian reactions, and time-lines after the sinking.
A fully footnoted version of this article is available from the author on request.**