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# **Soviet Union**

***FOREIGN MILITARY REVIEW***

No 10, October 1988

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**Soviet Union**  
**FOREIGN MILITARY REVIEW**  
 No. 10, October 1988

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[The following are translations of selected articles from the Russian-language monthly journal ZARUBEZHNOYE VOYENNOYE OBOZRENIYE published in Moscow by the Ministry of Defense. Refer to the table of contents for a listing of any articles not translated]

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## FOREIGN MILITARY REVIEW

No 10, October 1988

**October and the New Political Thinking**  
*18010303a Moscow ZARUBEZHNOYE VOYENNOYE  
OBOZRENIYE in Russian No 10, Oct 88 (signed to  
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[Editorial]

[Text] The Great October Socialist Revolution went down in history as the most prominent event of the 20th century, an event which heralded the beginning of a new era in mankind's life. It became an unparalleled flight of creativeness of the popular masses, who broke the chains of oppression and exploitation. Those unforgettable legendary days marked the beginning of an irresistible process, the replacement of capitalism with a new communist social-economic formation.

The October Revolution was predestined to accomplish world-historic tasks. Problems both of national and world significance had interlaced in a tight knot in Russia. The proletarian revolution—a breakthrough to a new social order—represented the only way out of that abyss of oppression, calamities and sufferings into which the people of Russia had been plunged by their own and foreign exploiters and by the predatory imperialist war. The Great October showed the ways to resolve not only the national, but also the world crisis. The CPSU Central Committee Address to the Soviet people in connection with the 70th anniversary of the Great October Socialist Revolution noted: "Time thoroughly revealed the permanent importance of the Revolution and highlighted the gigantic opportunities opened up by socialist social development."

The Soviet people's accomplishments in building and defending a socialist homeland became possible thanks to the leadership of the Communist Party, the inspirer and organizer of the masses' creativeness and the directing and guiding force of our society. This was convincingly demonstrated by the course which the party set toward restructuring, which was a direct continuation of the cause of October. Its objective is to implement the principles and ideals of socialist revolution purged of everything superficial, accelerate social progress, and transform all aspects of life based on V. I. Lenin's consistently and creatively developed teaching. The success of restructuring is unquestionable; it is guaranteed by the effective support of the popular masses and by their confidence in the correctness of the party's contemporary strategy. The CPSU analyzed the added features of the previous decades frankly, openly, and in a thorough and realistic Leninist manner; uncovered reasons for mistakes and omissions; and aroused the people to purge the progressive movement of everything stagnant and to get rid of recognized inhibiting mechanisms.

The party began the restructuring with itself, with a reinterpretation of the work style and methods of party entities in light of urgent tasks, and with a radical renewal of its policy. The banner of Leninism was proudly raised on high and a decisive turn was taken toward deepening the restructuring process at the 27th Party Congress, the 19th All-Union CPSU Conference and the July 1988 CPSU Central Committee Plenum.

The situation which existed in our country was subjected to a critical analysis which allowed developing a course based on the restructuring and acceleration of social-economic development and a renewal of all spheres of life. The Soviet people understood and accepted this course. Restructuring set society in motion. Broad masses of workers realize that it was made necessary by growing contradictions in society's development which essentially assumed precrisis forms after building up gradually and finding no prompt resolution.

Restructuring essentially signifies the following.

First, it means decisively overcoming stagnant processes, scrapping the inhibiting mechanism, and creating a reliable and effective mechanism for accelerating Soviet society's social-economic development. Our strategy's principal concept is to join the achievements of the scientific-technical revolution with the economic system and set the entire potential of socialism in motion.

Second, it means reliance on the lively creativeness of the masses and a steady increase in the role of intensive factors in the Soviet economy's development; a decisive turn toward science and its businesslike partnership with practical experience in order to achieve highest end results; and priority development of the social sphere and ever fuller satisfaction of Soviet citizens' needs.

Third, it means vigorously ridding society of the distortions of socialist morality and consistently implementing principles of social justice; ensuring unity of word and action, and of rights and obligations; and ennobling honest, high-quality labor and overcoming unwarranted leveling trends in wages.

Restructuring leads to a profound renewal of all aspects of the country's life, gives socialism the most advanced forms of social organization, and permits uncovering the humanistic nature of our system most fully.

The CPSU's wise, bold course is based on the Soviet people's great historic achievements in building a new society and on scientific concepts of ways to improve socialism. Here the party takes strict account of the international situation and the need to organize a reliable defense for the cause of building communism and establishing a firm peace on Earth.

That development of events in our country never has suited (nor does it now suit) international reaction headed by imperialism's aggressive circles. Therefore

from the first days of the Soviet state's existence they undertook desperate efforts to destroy socialism. Documents of the 27th CPSU Congress emphasize that "capitalism greeted socialism's birth as a 'mistake' of history which had to be 'corrected'; corrected no matter what, by any method, without a second glance at law and morality: by armed intervention, by economic blockade, by subversive activity, by sanctions and 'punishments,' and by refusal of any cooperation whatsoever." It was the aggressive, counterrevolutionary course of governments of capitalist states that predetermined the need for the Soviet people to decide economic, social, political, spiritual and defense issues in dialectical unity.

The supreme service of V. I. Lenin, founder of the Communist Party and Soviet state, was that he promptly substantiated the possibility of peaceful coexistence of states with a different social system.

The workers' and peasants' state emerged from foreign political isolation in just one and a half to two years after the end of the Civil War. Treaties were concluded with contiguous countries and then with Germany. The Soviet Republic was recognized by Great Britain, France, Italy, Sweden and other capitalist states. The first steps in arranging equitable relations with states of the East—China, Turkey, Iran, Afghanistan—relate to that same time.

Under present-day conditions international problems must be solved with consideration of new factors determining the current situation. This is why a very important theoretical conclusion was drawn in the Soviet Union about the need for new political thinking. The CPSU is attempting to transfer it vigorously into the plane of practical actions, and above all into the sphere of disarmament. This dictated the USSR's foreign policy initiatives.

Just what are the problem areas of the new political thinking?

Above all, policy must be built on realities. The most serious reality in today's world is the concentration of large arsenals of arms, including nuclear arms, in the United States and Soviet Union. An enormous responsibility rests with these two great powers, on which the fate of the world and elimination of the threat of a nuclear catastrophe depend.

The Soviet Union is prepared to cooperate with the United States in all directions on the basis of equality and mutual respect. This is an objective need of all mankind stemming from present-day conditions.

The dialectics of development are such that a contradictory world that is diverse in the social and political sense but that is interrelated and largely integral is forming as a result of the struggle of opposites. The important factor is a growing trend toward the interdependence of states of the world community.

The obvious reality of our time is the emergence and sharpening of global problems, which also are assuming vital importance for the fate of civilization. It is a question of resolving issues involving environmental protection, the struggle against terrible diseases, joint work in gaining knowledge of outer space and the ocean, and so on.

Activity to normalize international relations must proceed on the basis of internationalization. The new way of thinking and way of acting essentially consist of this. Contemporary political thinking demands recognition of the axiom that security is indivisible. It is the result of a profound comprehension of the modern world's realities and an understanding that a responsible attitude toward policy demands its scientific substantiation.

At the same time, in learning lessons from the past it is impossible not to recognize that command-administrative methods also have not bypassed the foreign policy area. It has happened that the most important decisions were made by a narrow circle of persons without a collective, comprehensive examination and analysis, and sometimes also without proper consultation with colleagues. This led to inadequate reaction to international events and to other states' policies or even to erroneous decisions. Unfortunately, what a particular variant of actions being undertaken would cost the people and how it might turn out was not always weighed.

The 27th CPSU Congress spelled out the new foreign policy concept in a developed form. The important factor is that our firm aim toward peace was reflected in actions, in all behavior in the international arena, and in the style of foreign political and diplomatic work. The new thinking with its criteria common to all mankind and its orientation toward reason and openness began to force its way into international affairs, destroying stereotypes of antisovietism.

The most important milestone in post-October world history is the emergence of the world socialist system. Socialism has been the common destiny of many peoples and a most important factor of modern civilization for four decades now.

The socialist system and the searches and experience which it has tested in practice have a significance common to all mankind. It offered the world answers to basic questions of human existence and approved of its humanist and collectivist values with the working person at their center. Socialism instills a sense of dignity and of being the country's proprietor in the working person and it provides social protection and confidence in the future.

The new political thinking suggests that, guided by general principles of building socialism, every socialist country proceeds in practice from its own national and historical features.

Life convincingly confirms that the new thinking is not a closed, finished concept. It is dialectical, and this permits constantly improving policy in accordance with a change in the situation and of course in accordance with our socialist ideology and Leninist principles.

Efforts of the CPSU and Soviet government have given our foreign policy dynamism and permitted advancing a large number of major initiatives. They include the program for phased elimination of nuclear weapons by the year 2000, a comprehensive system of international security, freedom of choice, a balance of interests, a "pan-European house," restructuring of relations in the Asiatic-Pacific region, defensive sufficiency and a nonoffensive doctrine, reduction of the level of arms as a way to strengthen national and regional security, recall of troops and bases from foreign territories, confidence-building measures, international economic security, the idea of direct inclusion of the authority of science in world politics, and the "Warsaw plan" for conventional arms reduction.

The basis of USSR contacts at the interstate level was a dialog, and in the sphere of disarmament it was a readiness for thorough reciprocal verification. This permitted extending the range of trust far beyond the customary ideological spectrum.

The USSR's sincere, open invitation for joint reflections and explorations encountered a wide response in the world. Glasnost and restructuring are giving a material persuasiveness to Soviet foreign policy ideas and initiatives. The entire international situation is changing under their influence.

"It will be fair to say that practically all Americans recognize the far-reaching changes occurring in Soviet society," said U.S. Secretary of Defense F. Carlucci. During his recent visit to the USSR progress was achieved in arranging contacts between our countries along the military line, and the two countries' decisions on preventing dangerous military activity were discussed.

"Today the Soviet leadership displays a readiness for cooperation in all areas. This historic chance should be used to the full extent and is something we intend to do," declared FRG Minister of Foreign Affairs H.-D. Genscher in an interview by Deutsche Welle radio.

The new political thinking in the sphere of world development represents a decisive break with narrowly dogmatic concepts of the modern world and processes occurring in it, and with an underestimation of contemporary mankind's global problems. The development of Marxist-Leninist theory on problems of war and peace permitted creating a new ideological-theoretical base for foreign policy and for the struggle for prevention of war, for the survival of mankind, and for creating a comprehensive system of international security and a nonviolent world.

Views and practical approaches to global military-political relations, to military organizational development, and to preparation of the USSR Armed Forces and the Soviet people for defense of the socialist homeland have changed thanks to the new political thinking. The conceptual application of the new political thinking to the military-defense sphere is embodied in the document "O voyennoy doktrine gosudarstv—uchastnikov Varshavskogo Dogovora" [Military Doctrine of Warsaw Pact Member States] adopted at the May 1987 conference of the Warsaw Pact Organization's Political Consultative Committee.

The awareness of the Soviet people and of Armed Forces personnel is being restructured and developed. Its characteristic features are an attitude toward problems of war and peace based on the new political thinking, a genuinely democratic approach to questions of disarmament, and a reduction in levels of military might of great powers and existing military-political alliances. At the same time, realism in assessing the existing military-political situation is typical of the socialist defense awareness.

Plans of achieving military superiority are alien to defense awareness based on the new political thinking. This awareness inherently aspires to ensure high reliability of defense at the level of sufficiency.

Life attests that the new thinking is forcing its way into the world arena as a result of efforts by socialist countries and the realism displayed by various states. "But guarantees of the irreversibility of these processes have not yet taken shape," emphasizes USSR Minister of Defense Army Gen D. T. Yazov, "and there has been no fundamental improvement for the better. The world situation remains complicated and contradictory. Imperialist sources of aggression and wars continue to exist." NATO plans for "final armament" and "compensation" and the doctrines of "direct confrontation" and "flexible response," which are aggressive in their essence, have not been removed from the agenda.

All this is considered by our party. The orientation in military organizational development above all toward qualitative parameters, as pointed out at the 19th CPSU All-Union Conference, is in strict conformity with defensive military doctrine. It is dictated by the necessity of making the positive trends in world development irreversible and reducing the cost and increasing the effectiveness of protective measures; it is dictated by the capabilities for countering the policy of force, capabilities which open up approaches (based on the new political thinking) to a solution to problems of strengthening international security and peace.

Our society is an offspring of the October Revolution. Today's affairs and the plans of the CPSU and Soviet people are a direct continuation of the great Lenin's

ideas. To follow the new political thinking means to affirm these ideas for the sake of peace and humanism and for the good of all mankind.

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**Military-Strategic Partnership of the United States, Japan and South Korea: A Threat to Peace in the Far East**

18010303b Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 7-11

[Article by Capt 1st Rank V. Snegov]

[Text] The Soviet Union is persistently and consistently implementing 27th CPSU Congress resolutions in the foreign policy sphere by directing efforts at strengthening peace and international security. In accordance with the new political thinking, the Soviet government put forth a set of specific proposals and initiatives for normalizing interstate relations. Our country is striving for fastest elimination of the threat of nuclear catastrophe hanging over mankind, and for mutually advantageous cooperation with states of all world regions on an equitable basis. Great attention is being given to the Asiatic-Pacific region, and particularly our Motherland's far-eastern borders.

In July 1986 Comrade M. S. Gorbachev gave a speech in Vladivostok which presented a long-term program for establishing a firm peace and a comprehensive system of security in Asia and the Pacific Ocean basin. The proposals it contains call for settling regional problems, stopping the spread of nuclear weapons, reducing armed forces and conventional arms to limits of reasonable sufficiency, decreasing the activity of navies, and taking steps for building confidence and for the nonuse of force in the region. The signing of the New Delhi Declaration, which advanced the concept of a nuclear-free and nonviolent world, followed as a development of the Vladivostok initiative during the Soviet-Indian summit meeting. The speech by CPSU Central Committee General Secretary, Comrade M. S. Gorbachev in Krasnoyarsk in September 1988 filled the package of Soviet peace proposals on a restructuring of relations among Asiatic states with rich new content.

To counterbalance Soviet peaceful policy the United States, which strives to achieve military superiority over the USSR in Asia and especially in the Far East, is making active efforts to strengthen military-strategic partnership with Japan and South Korea, i.e., with countries near the Soviet Union's borders. Bound by bilateral treaties which consolidate the political basis of relations, Washington, Tokyo and Seoul lately have stepped up military cooperation among themselves in all directions. Primary emphasis in this "triangle" is being placed on developing military-political ties and military-technical cooperation; improving the infrastructure for deploying groupings of armed forces and a command

and control system; building up American military presence on Japanese territory and in the southern part of the Korean Peninsula and combat capabilities of the armed forces of Japan and South Korea; and common planning for the employment of armed forces and for joint operational and combat training.

The development of military-political ties among the United States, Japan and South Korea is being accomplished through the conduct of a unified policy and through coordination and interworking in developing an approach to solving regional problems in the Far East. By means of consultations at regular security conferences and at meetings (including summit meetings) of leaders, Washington, Tokyo and Seoul are working out measures together to oppose the Soviet Union's peaceful policy and to "intimidate" the Democratic People's Republic of Korea. While the United States is pursuing "geopolitical interests," Japan and South Korea are taking advantage of Washington's protection in an attempt to satisfy nationalist ambitions after having set a course toward increasing their role in organizing a "new international order" in the Western Pacific. Based on the premise that former overwhelming U.S. military and economic superiority has decreased and there has been a weakening of its military position, which in turn led to a strengthening of the "Soviet military threat," Tokyo and Seoul are actively unfolding wide-scale military preparations in the Far East. A graphic example of "triangle" coalition policy was the development of joint measures by the three countries' leaders to "ensure safety" of the Summer Olympics in Seoul in the fall of 1988. These measures provided for building up groupings of air and naval forces in the vicinity of the Korean Peninsula, increasing troop combat readiness and organizing coordination in case of the appearance of "emergency conditions."

In an attempt to shape a favorable military-strategic situation in the Far East area the United States is creating preconditions for strengthening the less developed component of the "triangle" (which means Japanese-South Korean relations in the military sphere) and urging Japan and South Korea to establish closer military ties with the objective of subsequently forming the "Washington-Tokyo-Seoul" triple militarist alliance. Washington strategists proceed from the assumption that an expansion of military ties between Japan and South Korea and creation of a trilateral alliance is necessary for the United States "in case of the outbreak of a war in which it will have to conduct military operations in several theaters simultaneously." The idea being pushed here is that South Korea's security is "of vital importance" for Japan's security.

One other aspect of the strategic partnership of the three countries is the shifting of a portion of the U.S. financial-economic burden for maintaining "order and stability" in Asia onto Japan and South Korea. This in fact signifies inclusion of the far-eastern allies in a more active participation in solving regional problems in an American way. A special role is placed on Japan in this respect. Speaking before the U.S. Senate Budget Committee in 1987, U.S.

Secretary of State G. Shultz stated that Japan must assume part of the economic burden of assisting "strategically important states." Meeting the wishes of the senior partner halfway, Japan has moved into second place in the capitalist world in recent years based on the size of such assistance.

Lately the **military-technical cooperation** of the United States, Japan and South Korea also has a strategic coloration, as predetermined by the increased economic capacities of Tokyo and Seoul.

Against the background of progress in the Soviet-American dialog on nuclear disarmament and under the pretext of countering a "potential threat on the part of the USSR," Japan began to declaim for taking steps (based on the latest achievements in technology) to expand capabilities of the armed forces, and above all to create contemporary models of conventional arms having high casualty-producing properties. Together with the United States, Japan is continuing the arms race, developing a weapon system based on new physical principles, and developing cooperation in aircraft and missile armament production. The principal forms of partnership have become an exchange of military technology and joint developments of the most sophisticated kinds of weapons and military equipment. While previously Japan basically borrowed American experience and purchased licenses to produce, for example, F-15 fighters, P-3C land-based patrol aircraft, and Nike-Hercules and Hawk surface-to-air missiles, now with the growth in its own S&T potential it is already acting in the role not of a junior partner, but essentially of a military ally with equal rights.

In the assessment of foreign specialists the Japanese have the capability of independently developing the principal kinds of weapons and military equipment, and in some R&D areas they have gone far beyond the United States. Therefore the latter has shown an immediate interest in Japanese military technology. Japan is accelerating basic research in the sphere of arms that is aimed at achieving superiority over the enemy. Great importance is attached to development of the latest technology, which can be used with equal effect both for civilian and military purposes. This concerns above all electronics (especially microelectronics), opto-electronics, computer engineering, robot building, the aerospace industry, and production of new materials. Japan has surpassed its competitors in the world market in certain kinds of science-intensive products. Therefore the United States hastened to exert influence on its partner in order to take advantage of the latter's achievements for its own purposes. Having concluded an agreement in 1983 about exchange of military technology and subsequently a number of other agreements, the United States created machinery for cooperation in the military-technical sphere. The latter includes regular consultations, an exchange of delegations of military-industrial and scientific circles, and formation of a joint commission on military technology.

To please the United States Japan joined in the research under the American "star wars" program and in a study of possibilities of creating a regional ABM defense system with space-based components. According to an estimate by Japanese specialists, creation of an expanded ABM defense system which would be capable of effectively intercepting various enemy missiles will be an important means on the path toward achieving military superiority. They assert that although actual deployment of such a system, including SDI elements, still is a matter of the distant future, technical innovations and especially development of detection equipment will play a useful role in increasing the effectiveness of "deterrence."

Thanks to technical cooperation with the United States, South Korea has developed its own military industry to such an extent that Washington decided to stop military assistance and arms delivery to the Seoul regime on a credit basis. Seoul presently is building up its military potential independently and producing modern kinds of arms right down to operational-tactical missiles.

The **infrastructure is improving** constantly in Japan and South Korea in the interests of deploying force groupings and expanding springboards near the Soviet Union's far-eastern borders. Suffice it to say that there are more than 2,000 military installations on the territory of these countries at the present time, of which over 200 have been placed at the American command's disposal. It deployed the headquarters of U.S. Armed Forces in Japan, of the American-South Korean Joint Command, of the 8th Army and of a joint American-South Korean field army; and headquarters and large units of the IX Army Corps, 2d Infantry Division, 5th and 7th air forces, U.S. Navy commands in Japan and South Korea, Seventh Fleet, and of the 3d Marine Division in accordance with the "forward positions" concept. In addition, major airfields and naval bases, nuclear weapon depots, and installations of the logistic support system (Table 1) have been prepared. Stationing and basing facilities of the 90,000-person grouping of American Army and Navy forces located here are screened by the national air defense systems of Japan (the BADGE automated control system) and South Korea, as well as by the forces of naval areas.

**Table 1 - Number of U.S. Military Installations in Japan**

Military Installations	Number
Command and control system installations	27
Airfields	13
Naval bases and ports	8
Ammunition depots and various military property depots	19
POL depots	8
Ranges	26
Military posts	29
Total	130

Components of an integrated command and control and communications system which includes hardened command posts, radio-relay and tropospheric communication lines, and centers for controlling tactical aviation and naval forces are being built or planned for construction to improve the effectiveness of command and control of the three countries' armed forces. The airfield network is being modernized, reinforced shelters for combat aircraft are being built at air bases, and the network of ammunition depots and POL storage areas is expanding. Agreements have been reached on establishing reserve stores of arms and military equipment in Japan (island of Hokkaido) and South Korea to support a build-up of the grouping of American troops in the Western Pacific. Under pressure from Washington the allies are increasing their appropriations each year for maintaining American troops and military installations on their territory. Japan's 1988 expenditures for these purposes already have grown to \$2.3 billion and those of South Korea exceeded one billion dollars.

**Build-up of American military presence and combat capabilities of the armed forces of Japan and South Korea.** In order to establish force ratios in the region in its favor, the United States is taking steps to build up the grouping and combat capabilities of armed forces in the Western Pacific and simultaneously is assisting a growth in Japan and South Korea's military potential. In recent years the American command has additionally stationed some 50 F-16 tactical aircraft on the Japanese islands (Misawa Air Base) and a battery of Lance missiles in South Korea and increased the number of ships equipped with Tomahawk cruise missiles.

According to foreign press data, the overall grouping of U.S. Armed Forces in the Western Pacific, Japan and South Korea numbers over one million persons, 38 divisions, 10 separate brigades, over 1,000 combat aircraft and more than 200 ships, which represents a serious threat to peace in the Far East.

The false theses snatched up by Tokyo about a growth in the "Soviet military threat" and about "USSR superiority in conventional arms" served as substantiation of the need for building up Japanese military potential. The country's government removed restrictions on military expenditures, which for a long time comprised one percent of the GNP. According to a statement by Prime Minister N. Takeshita, from now on the military budget will be determined only "by requirements in the defense area." The foreign press reports that the next stage may be a rejection of constitutional provisions prohibiting the employment of Japan's "Self Defense Force" outside their own country and prohibiting arms trade.

Japanese military potential is growing in accordance with the "National Defense Program" adopted in 1976. A program for building armed forces for 1986-1990 is in the stage of fulfillment; results of its realization will exceed control figures established in 1976. For this five-year period military expenditures will reach 18.4

trillion yen (counting their average annual increment of 4.5 percent). In 1987 they exceeded 3.5 trillion yen and in 1988 will comprise 3.7 trillion yen, or \$27 billion (5.2 percent higher than in 1987). Development of a new "defense program" for 1991-1995 has begun. In the course of its implementation it is planned to equip Army and Navy forces with new types of missile weapons, tactical aircraft and ships as well as to increase the fighting strength of all branches of the armed forces, which presently include five armies, 430 combat aircraft of the Air Force and Navy, and over 100 ships.

South Korea's military potential is growing. Each year it spends 30 percent of the state budget for military purposes, which exceeds six billion dollars. Each year military expenditures rise 14 percent. The Seoul regime keeps its armed forces in constant combat readiness (three armies, 350 combat aircraft and over 40 ships) and outfits them with contemporary weapons both from purchases in the United States and from its own military production.

**Operational planning.** The United States views achievement of close interworking of the commands of the three countries' armed forces as a major "strategic plus" in opposing the Soviet Union. Plans for operational employment of the armed forces in wartime are coordinated and an exchange of intelligence has been arranged among them.

The United States devotes special attention to developing variants for joint employment of its own and Japanese armed forces in the initial period of a war in the Far East in accordance with a general plan of military operations approved in November 1984. Following the development of a scenario of the "enemy unleashing direct aggression against Japan", in January 1986 the Japan Defense Agency and Headquarters of U.S. Armed Forces in Japan began compiling a new version—"the spread to Japan of a war which began on the Korean Peninsula." Studies conducted since 1983 concluded in late 1986 on the joint conduct of operations with the objective of defending sea lines of communication under the scenario of "the spread to the Far East of a war which broke out in the Near East." In the course of planning, the following missions usually are assigned to Japan's armed forces: engagement of enemy submarines in coordination with the U.S. Navy; defense of convoys on the sea transit and blockade of the La Perouse, Tsugaru and Tsushima straits; participation in combat escort of American carriers; and winning air supremacy.

Operations plans are developed for armed forces of South Korea and the American contingent stationed on its territory by the American-South Korean Joint Command, which in wartime will have all armed forces of the Seoul regime and the grouping of American troops on the Korean Peninsula subordinate to it.

Plans for employing Japanese and South Korean armed forces in the vicinity of the Korean Peninsula also are



being coordinated. The interworking of air defense personnel and equipment as well as of fleet forces in surveillance of the air and sea situation in the Sea of Japan already has been organized. Options are being considered for assigning forces for a blockade of the Korean Peninsula.

**Joint operational and combat training.** Plans for joint employment of armed forces are tested annually in practice during intensive operational and combat training. Each year the number, scope and scale of joint exercises grow. Japanese-American exercises now are held not only by branches of armed forces but also on an integrated basis involving practice of operations of an initial period of war, which was graphically shown in operational-strategic Exercise Keen Edge. The overall number of operational activities of U.S. and Japanese armed forces during the year exceeded 20. Not only tactical aviation and ships of the U.S. Seventh Fleet but also American Army and Marine units already are taking part in them.

Each year Exercise Team Spirit, the largest American-South Korean exercise, is conducted in the vicinity of the Korean Peninsula. The number of its participants exceeds 200,000 persons (Table 2). As a rule, Japanese observers are present in these exercises and they adopt experience of organizing large-scale military adventures.

The United States is bending efforts to bring the missions and methods of training personnel of Japan and South Korea's armed forces closer together and to strengthen in the personnel's awareness the commonality of problems to be solved, and it is creating preconditions for organizing joint exercises of troops of the three countries. It is with this objective, for example, that U.S.

**Table 2 - Indicators of American-South Korean Exercise Team Spirit**

Year	Time Period	Length, days	Number of Participants	
			Total	Including from USA
1976	June	11	46	6
1977	March-April	17	87	13
1978	March	11	100	22
1979	"	17	160	20
1980	March-April	52	134	10
1981	February-April	70	161	34
1982	"	73	166	32
1983	"	76	191	73
1984	"	75	207	60
1985	"	75	200	60
1986	"	75	209	69
1987	"	75	220	80

aviation based at airfields in South Korea is being used for Japanese-American exercises.

The development of military-strategic partnership of the United States, Japan and South Korea; the nurturing of plans for creating a new aggressive alliance in the Far East with their participation; and the desire to achieve military superiority over the USSR are in sharp contrast with Soviet peace initiatives in Asia and clearly show who bears a threat to peace and stability in the region.

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**Efficiency, Cost Effectiveness of Simulators in NATO Armies**

18010303c Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 15-18

[Article by Lt Col V. Alipov and Maj I. Vodyanin: "Simulators in Armies of NATO Countries"]

[Text] Training personnel by using simulators to substitute for combat equipment is taking an ever greater place in the combat training system of NATO armies. This is explained above all by economic considerations as well as by the high effectiveness of the training, during which it is possible to re-create and repeat the drill process many times, saturating it with the most complicated situations that are at times close to emergency situations. Referring to the experience of operating weapons, the foreign press emphasizes that they have a rather great proportion of failures due to personnel error. As shown by statistics on the use of military equipment abroad, 40 percent of the total number of failures during missile launches and tests in ground forces, over 60 percent in naval forces, and 70 percent in aviation occurs because of operator error. The wide use of simulators as models in designing weapon systems permits increasing the effectiveness of arms being created with a simultaneous reduction in time and material inputs for their development.

At the present time a trend toward using integrated simulators is seen in armies of capitalist states. In contrast to specialized (individual) simulators intended for the trainees' acquisition of specific skills, integrated simulators permit training specialists as part of crews (teams), platoons, companies and other subunits as well as in performing the full scope of their functional duties.

Tactical simulators have begun to be used widely in the United States and other principal NATO countries for training officers, chiefly for practicing methods of tactical employment of weapon systems in accomplishing different tactical missions. Large and small unit commanders practice methods of command and control of personnel and equipment in the battle or operation on operational-tactical simulators. Such simulators are very complex in design and require great inputs for fabrication, but specialists believe these expenditures to be justified.

The economic effectiveness obtained from using simulators and their obvious advantages compared with other training equipment dictate the high saturation of NATO troops with modern simulators manufactured with consideration of the latest achievements of science and technology, which in the final account affects combat readiness. In the assessment of foreign military experts, for example, their use just for training flight crews enables a 25 percent reduction in expenditure of aircraft flying life and in time periods for the initial training of pilots and other air force specialists.

A feature of modern simulators is that they include computer equipment, which allows substantially expanding training capabilities and the assessment of skills being acquired. Specialists emphasize that even specialized (individual) simulators are outfitted with sophisticated instruments. For example, previously simulators included a film projector, screen and control device (with a successful "hit" on the target the film projector is stopped, which permits assessing the accuracy of the round fired) for teaching the firing of small arms and antitank weapons in the ground forces; now they make wide use of laser and computer technology. For example, the U.S. Army uses a semiconductor laser to teach rifle firing. With such a simulator present in exercises it is not necessary for people to be present to count targets hit, since when the laser beam hits the target a device is triggered signaling a hit. The simulator's computer permits recording data about who was firing, who was put out of action and what was the degree of damage. The computer records data on wounded and killed as well as the time they were put out of action. In the assessment of western specialists, all this substantially improves the effectiveness of exercises.

In tank simulators a moving mock-up of the driver's space is fitted with an electronic device which includes a computer, hydraulic system, and terrain model with movable television camera. Indicators of the tank's performance features, engine characteristics, moments of inertia, resistance to motion for different road sections, and suspension vibrations are programmed in the computer. The trainee sees an image of the terrain on the screen of a TV unit. The effect of tank motion is created by the moving terrain image and by simulation of engine and track noise as well as of cabin vibrations.

Specialized simulators which include laser and computer equipment also are used for practice in firing tank weapons. Their merits include relatively low cost of "rounds" and the capability of automatic objective monitoring of firing accuracy and of recording ammunition expenditure.

Naval simulators usually are used in training naval personnel in NATO countries to practice skills in maneuvering and in employing weapons under conditions simulating a real naval battle. The tactical situation and weapon employment are simulated by a computer. Programs loaded in the computer permit specifying

enemy targets, the sequence of enemy actions and the path of missile or torpedo motion as well as displaying them on the indicator screen. For example, a submarine weapon system simulator for naval schools includes a mock-up of the control room, work stations for trainees and instructors, a large screen with laser projector and a computer. The latter simulates the alignment of enemy combat formations, operating tactics, and an assessment of the capabilities of his weapons and of acquisition and target designation equipment. Previously to simulate navigation the instructor would use either conventional controls (switches and potentiometers) or a visual slide projector, film projector or video tape recorder. This equipment did not provide high training effectiveness and hampered the work of instructors. The scenario reproduced in this manner was limited to a set of written versions that could not be corrected in the course of practice, which was preplanned and depended little on trainee actions.

To simulate sailing under nighttime conditions and in bad visibility the firms of Marconi and Solartron are developing television image generators to provide a color picture which takes account of changes in a ship's speed. The high-speed computer permits displaying on screen the motion of up to 32 vessels, of which 8 are friendly. The TV images are fully synthesized by the computer without television cameras, analogs and video recordings. A scenario re-created in this manner provides a dynamic picture that changes depending on the ship's course and speed. Moving objects (from small combatants to large ships and vessels) can be easily introduced to the scenario and monitored by the instructor. A situation displayed on the screen also can include smaller details: channels with buoyage, port approaches, the coastline or open sea, and so on.

The firm of McDonnell Douglas developed a Harpoon guided missile simulator based on microcomputers. It provides an opportunity to simulate the launch of a missile from a submarine in a normal and an emergency situation, as well as to evaluate the actions of combat crews.

Radar simulators being developed by the British Navy are being used for training some specialists and ship crews. For example, the computer of the Marine Radar Simulator reproduces a radar situation; it displays the position of ships and the coastline and takes into account the direction of tidal currents and a course deviation.

Mechanical flight simulators have existed since the 1940's; those in which analog computers were used appeared as early as the 1960's. In mathematical simulation the latter used black-and-white or three-color slides and plotters of a model of the terrain viewed using computer-controlled television cameras. Such simulation, however, did not meet many requirements of the Air Force command. In particular, the radar slide simulators did not provide an opportunity to create a situation of real aerial combat for a crew. These deficiencies

dictated the transition in the 1970's to simulators with digital computers which permitted re-creating a near-real air situation.

Prospective air simulators being developed are supplied with several computers both for supporting the simulator-functioning algorithm and for generating images observed by the pilots. For example, these simulators must permit re-creating dynamic flight conditions and simulating a nighttime carrier landing, aerial refueling, a weapon's action, and clouds. They are used to practice the following missions: navigation, piloting at extremely low altitude under low-light conditions, and the employment of weapons.

More than 200 failures can be introduced on the Reflectone firm's simulator in the process of training in aircraft survival problems. Each signal of such a failure acts on corresponding aircraft systems and indicators through the computer and causes the reproduction of vibration, jolting and sound which might accompany the given failure in a real situation. Also simulated are failures such as full or partial malfunctioning of one engine, a pressure drop in a machinery oil system, and malfunctions of controls. The aircraft simulator cockpit is supplied with television screens on which synthesized images of the terrain and of enemy aircraft are reproduced by the computer. A digital generator permits representing terrain in the simplest case in the form of a chessboard. When the aircraft descends the board's cells increase in size and assume the shape visible obliquely from lesser altitude. Thus the pilot receives an impression of height above the ground. In aerial combat training the computer simulates the flight trajectory of a projectile and of missiles depending on the mutual position of the two aircraft and characteristics of weapons employed. The instructor monitors the course of aerial combat from the TV screen, to which the picture of aerial combat and aircraft flight trajectories are sent. The picture of aerial combat can be recorded for playback during a critique.

Simulators for training spacecraft crews are the most saturated with computer equipment. The Shuttle spacecraft simulator developed by the firm of Singer Link under contract with NASA is intended for simulating all flight phases and permits training both astronauts as well as mission control center personnel. Specially created mathematical models provide a description (with a specific degree of adequacy) of the characteristics of all on-board systems, movement dynamics of the craft and object (target), the systems for tracking it and obtaining telemetry, as well as a simulation of failures in various on-board systems. Therefore the simulator includes several tens of computers with different power and purpose. With an average load the central computer is capable of performing two million operations per second; 14 minicomputers with a speed of 350,000 operations per second simulate tracking of the craft; five minicomputers are part of flight simulators; and several computers are intended for simulating images in the rear and upper window.

The effectiveness of using the simulators and complexity of their development served as the reason for the transition from the solution of purely applied problems to conduct of basic research in this area of instrument making. The U.S. Armed Forces have special programs for work in this direction and appropriations for performing this work increased almost eightfold over the last 20 years. Specialized agencies (Navy Training Equipment Center, Air Force Research Directorate, Army Simulator Directorate and so on), firms that develop arms, and training institutions (universities of the states of Texas, Florida, Colorado and others) are engaged in developing and fabricating simulators. The Armed Forces' requirement for simulators resulted in their production abroad turning into one of the most rapidly developing sectors of the economy. A majority of firms have scientific laboratories and qualified cadres for performing basic research. The period from the beginning of development of sophisticated simulators until their delivery to the client is 3-4 years, with the bulk of the time spent developing prototypes.

Foreign specialists identify several basic directions in developing the physical base of simulators. In their opinion one of the most promising is the creation of specialized computers having a high speed (hundreds of millions of operations per second) as well as large main and read-only memory. For example, the American corporation of Electronic Associated developed a computer for simulators with a speed of 200 million operations per second using high-level languages; the computer may find use in simulating an operational-tactical situation during major exercises involving various combat arms.

The use of general-purpose computers is another important direction in developing the physical base of simulators. The overwhelming majority of series-produced simulators include one or more general-purpose computers, the peripheral equipment of which is being constantly being improved. For example, virtual memory units expanded to several tens of gigabytes are being widely used.

The main NATO countries have created independent scientific societies to stimulate theoretical and S&T developments in the sphere of building simulators. They organize conferences and symposia, participate in publishing special literature, and publish the works of scientists on theoretical and applied questions of building simulators intended above all for the armed forces.

In the overall set of measures for increasing the combat readiness of armed forces, the U.S. and NATO commands place considerable emphasis on creating simulators meeting modern demands as well as on introducing them to troops and training institutions.

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**Combat Training in the U.S. Army**  
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[Article by Col Yu. Groshev, candidate of military sciences: "Combat Training in the U.S. Army (Training Principles and Forms of Organizing the Training Process)"]

[Text] The U.S. Army command sees one of the ways to successfully accomplish tasks of training subunit and unit personnel and improve the quality of their field training, and as a result improve the combat readiness of troops, to be the following: a constant improvement in the methodology of organizing and conducting combat training, and particularly the fullest realization of training principles in developing and adopting sensible forms of organizing the training process; development and improvement of existing training forms; a search for the most advisable teacher/trainee activity ratios (in developing training methods); the incentive of trainees; and the determination and practical use of measures aimed at increasing the effectiveness and intensification of the entire training process.

#### TRAINING PRINCIPLES.

The theoretical sources on which U.S. military pedagogy is based are the views of philosophers representing different directions (idealists, pragmatists, behaviorists, Taylorists, Freudists and others) which exert a substantial influence on forming troop training principles. According to the first ones the fundamental idea in training the masses consists of ensuring immediate and unconditional obedience, which is achieved basically by coercion, threat, intimidation, prohibitions and punishments. The second ones define the essence of training as the development of instincts and impulses contained in a person. The leading idea of this theory is the thesis "Know how, but not why," which eliminates awareness from the training process and gives preference to drills and practice. The Taylor system has become widespread in the U.S. Army. One of its principal components is the idea of material incentive or reward for performing one's functional duties. Its basic content is considered to be dissociating people and influencing them singly. Adherents of the behaviorism theory believe that training must be conducted with the minimum participation of the trainee's awareness. The important element is coaching, mechanical memorization, and the development of automatic habits, i.e., creation of a soldier who would be capable of executing any orders faultlessly without feeling either guilt or pangs of remorse for his activity.

Based on these theories the troop training process in the U.S. Army is carried out in accordance with six basic principles: motivation (incentive), purposefulness (rationality), practice, realism, reliance on trainee experience, and significance.

The principle of motivation consists of developing the serviceman's interest in training. In the opinion of American specialists, without desire there can be no thought of any kind of training despite the fact that in the Army servicemen perform service voluntarily (by contract) and receive pay depending on specialty. Therefore all pedagogic rules are reduced to one unified recommendation: always show the trainee the benefit provided him by the training course or by a specific lesson; if it is possible to represent the cost of the lesson in dollars, do so, pointing out the possibility of an out-of-order career advancement in case of good training, and so on. Various increments servicemen receive for mastering related specialties (for example, receiving a Ranger or parachute instructor qualification and so on) and raising a proficiency rating are the incentive for improving professional schooling.

To increase trainee interest in a specific subject or training material it is recommended that forms and methods of conducting classes be thoroughly thought out and chosen; that their category be taken into account without fail (their individual features, habits, curiosity, life experience and so on); that jokes, anecdotes and sensational newspaper stories be used in presenting material; and that trainees be motivated for competition. Coercive means of forming the motivation principle also are not discounted. For example, the following disciplinary punishments can be imposed on NCO's and privates in case of unconscientious attitude toward combat training classes: admonition or reprimand; up to 30 days in the guardhouse; restriction to the unit area for up to 45 days; extra details; demotion in military rank by two or more grades; a deduction from pay of up to 50 percent of monthly salary, but for no more than two months; and a delay in pay for up to 50 percent of salary, but for no more than three months.

In addition to material incentives, various measures of moral incentive are used both for individual servicemen and for subunits as a whole to increase the personnel's interest. For example, the best soldier of a subunit and of the small or large unit and the best squad (crew), platoon, company and battalion are determined regularly. Servicemen who distinguish themselves are commended and they receive memorial prizes, the right to special leave and so on.

The principle of purposefulness is ensured by assigning specific objective tasks which must be accomplished at a specific stage. Their performance determines the professional level of trainee preparedness, which is periodically checked during proficiency tests.

The principle of practice reduces to consolidating the skills received and taking them to an automatic state by means of repetitive mental and physical exercises. It is believed that the effect of such training depends on the duration and number of drills, which must be limited. If they are lengthy and held too often, American military

specialists believe this leads to trainee fatigue and generates apathy in them toward actions. Continuation of drills that are no longer necessary develops antagonism toward the subject and is a wrongful waste of time.

The principle of realism consists of training troops under conditions which approximate combat to the maximum, with complete or almost complete absence of conditionalities, with elements of risk present in a number of cases, and with the creation of crisis situations and dramatization of the situation in which servicemen might find themselves during combat operations. American military psychologists assume that personnel must be accustomed to an atmosphere of fire and death. An attempt must be made to ensure that the soldiers feel at home amidst fire, smoke and confusion and perform assigned missions with cool awareness of the presence of real danger and of the overcoming of a sense of panic and fear. Sets of drills have been worked out for this purpose which develop a special mood of readiness for actions in combat.

The principle of reliance on trainee experience proposes conducting classes so that new material is tied in with that previously covered, and its presentation begins unflinchingly with a repetition of the basic provisions of past topics. It is also recommended that servicemen's skills acquired in the training process be taken into account.

The principle of significance presumes a unity of training and indoctrination and determines the indivisibility of the process of personnel training and brainwashing. It is believed that in addition to theoretical and practical military knowledge, servicemen must develop high fighting and mental qualities.

Contemporary bourgeois military pedagogics considers all these principles not as starting guidance provisions, but as a sum of training rules and procedures which act as working tools and help coach soldiers to perform necessary duties.

#### FORMS OF ORGANIZATION OF THE TRAINING PROCESS.

Placing principal emphasis on collective training, the American command focuses primary attention in combat training on organization of troop field training. The foreign press reports that in recent years the following forms of organizing the training process for Army subunits and small and large units are prevalent in the combat training of Army troops: field problems, training cycles (training courses), classes with a reverse (inverted) cycle, and specialized training.

Field problems represent combined practical training of subunits and small units of different combat arms. For example, in U.S. Army divisions a mechanized or tank battalion receives a tank or mechanized company, one or two artillery batteries, and engineer and other subunits

in temporary subordination every six months and goes to a training center for 3-4 weeks of combined training. Classes are held in phases. Usually one training mission is practiced for a week's time. Classes at platoon and then company strength are held for the first three days of each week. Mission execution concludes with the conduct of a two-day battalion task force exercise. In training platoons and companies the force commander divides it into platoon and company tactical elements, the organization of which changes several times in the course of training depending on the kind of combat operations being practiced and missions being accomplished.

Field problems for platoons (three days a month) and companies (two weeks a quarter) are accomplished in a similar manner. It is recommended that they be held each time on unfamiliar terrain. The training fields and ranges of neighboring large units are used with this objective, and training sessions are held on the territories of allied countries in the NATO bloc.

American specialists believe that the use of a form such as field problems in the training process provides broad opportunities for personnel to practice and improve practical skills in performing assigned missions in different kinds of combat and to develop teamwork and coordination in subunit actions. The most important factor is that tasks of maintaining close coordination of combat arms subunits and their coordinated operations in any situation are accomplished in such field problems, since in their opinion not one weapon system, not one combat arm and not one branch of the Armed Forces can achieve success in modern combat independently.

**Training cycles (training courses).** This form of organization of the training process is used for training subunits (squads, platoons and more rarely companies, battalions and brigades) in special procedures and methods of operations and practicing some of the complex lessons, tactical missions or topics over a brief time. For example, special sessions of 3-5 days are conducted with each squad for training servicemen to operate under *real conditions* of a combat situation. Here tasks of the personnel's operations in the offensive with live fire are practiced: first the individual soldier, then two soldiers on the battlefield, and then as a squad under fire of an "enemy" shooting live cartridges over the attackers' heads.

Training sessions are organized at the platoon level and run in three phases. The following is organized in the first phase: preparation of gear for moving at a crawl and for making dashes; training in procedures for camouflaging personnel and weapons; a study of conditions of battlefield operations; and movement at a slow pace first of individual soldiers, then of groups of 2-3 persons and the entire squad with the firing of blank cartridges. In the second phase there are drills in moving on the battlefield by the numbers (with live fire) by pairs of soldiers and by the squad as a whole under "enemy" fire.

Special attention is given to the third phase, in which the actions of a squad are practiced in a tactical situation in the offensive with live fire. It begins with a check of squads' readiness for the exercise. Each serviceman is issued two magazines with 30 cartridges and a live hand grenade. Then the platoon commander places the trainees in the tactical situation and issues the operation order. At the director's signal the squad begins stealthy movement forward toward the assault objective. The "enemy" opens fire as soon as the forward movement is detected from checkpoints. At this same time mortar and artillery burst simulators are activated and targets denoting personnel and weapons are displayed. The squad deploys into combat formation. Maneuvering between the "bursts" of artillery and mortar rounds under the whistle of bullets flying over them, the personnel fire authorized weapons and advance to the forward edge of the battle area, negotiating obstacles and obstructions and lobbing hand grenades at the "enemy" from a distance of 20-40 m. After overcoming the defensive position the squad repels a tank counterattack by firing antitank weapons. The exercise ends with this and the platoon commander holds a critique in which he evaluates the actions of each soldier and the subunit as a whole.

Mechanized subunits are trained to *fight tanks* at 5-7 day antitank training courses. Classes are held for squads and platoons with live fire from antitank weapons and with the throwing of antitank grenades.

Combat teamwork training of mechanized, tank and reconnaissance battalions as well as brigades in training to conduct combat operations in the European Theater is accomplished during a training course at the U.S. Army National Training Center at Fort Irwin, California. It is designed for 2-3 weeks and is conducted according to previously developed scenarios for offensive and defensive operations.

Battalion training is accomplished in a sequence approximating real plans for reinforcing a U.S. Army force in overseas theaters of operations. Ten days before the beginning of execution of the first mission, a forward brigade element arrives at the training center to draw equipment, ammunition and POL and to resolve organizational matters. Four battalion sets of weapons and combat equipment (for two mechanized and two tank battalions) and field artillery and air defense equipment are stockpiled at the center for this purpose. Three days before the beginning of the exercise aircraft deliver the personnel (a brigade headquarters operations group, two battalions and necessary support subunits), who demothball the materiel and accomplish all preparatory activities. One day is used for briefing the subunits and assigning missions for the first training phase. On the day the exercise begins the brigade is made operationally subordinate to a control element simulating a division combat operations control center, and the battalions begin working missions in their designated zones.

A critique of trainee actions is held at the end of the training course. Battalion and company commanders are

given video-audio cassette recordings of all missions worked for a subsequent detailed analysis and for preliminary preparation of other subunits of that division at the training center.

Special training (the so-called "survival" cycle) is conducted with servicemen of all U.S. Army combat arms. Its basic content is a study of procedures and methods of survival in a combat situation and under various climatic conditions. In training sessions the personnel practice survival missions in encirclement without water, food and ammunition. They are trained to escape from captivity and prepare food from plants, reptiles and insects. Servicemen are taught to hide and to signal aircraft and helicopters. Days of silence and hunger; lengthy, immobile and patient waiting in bad weather and freezing temperatures; and so on are arranged for them.

The training of subunits of the former 9th Infantry (now 9th Mechanized) Division conducted under winter conditions (air temperature was below -30 degrees Centigrade) can serve as an example. The program provided for working the following lessons: first week—servicemen's individual training, terrain orientation by map and compass, survival methods under low-temperature conditions, and actions as part of squads and platoons; second week—ski training with live fire of individual weapons, and company tactical exercise; third week—brigade tactical exercise including National Guard subunits.

The airborne training course (three weeks) provides for studying parachutes and instructions on their use, mastering the technique of emplaning and of an airborne assault, practicing parachute jumps from 20-m and 80-m towers, and actually making five jumps from a C-130 military transport aircraft.

Personnel and subunits are trained to fight in *built-up areas* during a weeklong course which provides individual and group training for squads, platoons and companies as well as for the battalion as a whole.

American military specialists believe that organization of subunit and unit training in the form of training cycles (training courses) permits focusing attention on studying a specific range of missions, procedures and methods of operations where the quality with which they are practiced in conducting other forms of training sessions does not ensure attaining the desired training level. This promotes development of a uniformity of views in an approach to training in individual lessons, topics and subjects; permits a more detailed study of the procedure for accomplishing a small number of specific missions; and makes it possible to promptly remedy identified deficiencies.

**Sessions with a reverse (inverted) cycle.** The essence of this form of combat training consists of shifting a portion of daytime sessions to nighttime. The cycle begins with evening sessions which last until the following

morning. They end at dawn, a critique is held and a daytime rest is arranged. Sessions resume with the onset of darkness. In accordance with methods recommendations of the ARTEP 7-15 troop combat training and combat readiness evaluation, training missions are practiced as follows. First familiarization sessions are organized in conducting combat operations at night, and then they are worked by the numbers. Subsequently the process is made more complicated: the personnel learn to act as a platoon and company in different kinds of combat, including with night field firing. The cycle concludes with a tactical exercise. The program envisages training in that form for three eight-hour sessions a month and one daylong session a quarter with the squad (crew, team); continuously for 3-5 days with the platoon; 5-7 days once a half-year with the company; and 7-10 days once a year with the battalion. If a company "specializes" in conducting night combat operations sessions are held quarterly for 5-7 days.

In the American command's opinion, organization of training in the form of sessions with a reverse cycle permits making fuller use of the nighttime for combat training, studying problems of conducting night combat more thoroughly and broadly, adapting the personnel's mindset to night operations to some extent, reducing their fatigue and improving working ability.

**Specialized training** of subunits as a form of organizing the training process consists of having each of a battalion's companies assigned a training specialty: for example, A Company—conducting night combat operations; B Company—fighting enemy tanks; and C Company—fighting in a city. Each of them is assigned the mission of attaining a high level of training, and then to train other subunits with the help of consultants and instructors from among these companies' personnel. Specialists believe that this form of training reduces training time, makes the special training of subunits of better quality, and predetermines the uniformity of the personnel's understanding and actions in performing missions under various situational conditions.

#### Footnotes

1. Continued from ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 2, 1987, pp 23-28, and No 12, 1987, pp 22-24—Ed.

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**French Army Mechanized Regiment**  
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[Article by Lt Col A. Simakov]

[Text] Mechanized regiments are part of armored divisions (two in each). In addition to accomplishing conventional missions in all forms of combat operations,

they also can be assigned missions of engaging enemy tanks and antitank weapons in the interests of tank regiments and conducting combat operations on rugged terrain as well as in built-up areas. The French command believes that successful combat operations of mechanized regiments must create favorable conditions for committing a division's tank regiments.

The **mechanized regiment** (a total of 1,000 persons) consists of five companies: headquarters, service and support company; tank company; and three mechanized companies. According to the latest western press reports, it has in its inventory 17 AMX-30B2 tanks, 48 AMX-10P infantry fighting vehicles [IFV's], 14 VAB armored personnel carriers [APC's], 6 120-mm mortars, 18 Milan ATGM launchers, over 50 shoulder-fired antitank rocket launchers and over 90 motor vehicles.

The **headquarters, service and support company** (330 persons) includes seven platoons: communications and headquarters, reconnaissance, mortar, chemical defense, administrative, medical, and technical. It has a total of 10 VAB APC's, 6 120-mm mortars and up to 50 motor vehicles.

The **tank company** (around 100 persons) consists of five platoons: headquarters and service platoon (AMX-30B2 tank and VAB APC) and four tank platoons (four tanks each). It has a total of 17 tanks, a VAB APC and up to 10 motor vehicles.

The **mechanized company** (around 190 persons) has six platoons: headquarters and service (AMX-10P IFV, a VAB APC, and 10 motor vehicles), four mechanized platoons (33 persons and 3 AMX-10P IFV's each), and an antitank platoon (3 AMX-10P IFV's and 6 Milan ATGM launchers). The company inventory consists of 16 AMX-10P IFV's, a VAB APC and 10 motor vehicles.

**In a meeting engagement** regimental subunits will attempt to preempt the enemy in deploying by delivering fire damage and strikes against his flank and rear.

**In the offensive** the mechanized regiment usually operates in the first echelon of an armored division, usually aligning the combat formation in two echelons: a tank company and mechanized company in the first echelon and two mechanized companies in the second. If the enemy's antitank defense has not been neutralized, two mechanized companies may operate in the first echelon. The width of the regiment's offensive sector is 3-6 km and the depth of the combat formation's alignment is 5-6 km.

The army command element recommends avoiding classic forms of combat in organizing and conducting the offensive. Operating tactics of the regiment as a whole and equally of its subunits must be such that the enemy constantly feels the pressure of its personnel and equipment. In particular, it is deemed advisable to execute a breakthrough of enemy defensive positions by taking



advantage of his vulnerable places and breaches in combat formations with the subsequent delivery of brief strikes against his facilities in the depth of the defense. In some instances the regiment's personnel and equipment can be used for conducting reconnaissance in the interests of the higher command authority.

In the defense the regiment may receive missions of repelling an enemy offensive by conducting a static or mobile defense as well as delaying actions. In defensive combat it is recommended to plan counterattacks and the organization of ambushes and antitank screens. The regiment's defensive area in conducting a static defense reaches 3-5 km in frontage and up to 8 km for a mobile defense or delaying actions. The regiment's combat formation on defense is aligned in two echelons (mechanized companies in the first). The combat formation is 5-6 km deep. Mechanized companies organize and conduct ambushes and screens on the most likely avenues of enemy advance using the terrain's protective features. As a rule a company operates in a 1.5-2 km zone, aligning its combat formation in a single echelon 2-3 km deep. Surprise fire assaults, strikes against the enemy flank and rear, and rapid withdrawals to new lines make up the basis of combat operations.

In the French command's assessment, the regiment has sufficient firepower and high mobility. At the same time, its principal deficiencies are high vulnerability to strikes by nuclear and conventional weapons on open terrain as well as an inability to conduct lengthy combat operations and relatively weak air defense. In this connection the regiment is forced to conduct combat operations by constantly maneuvering personnel and equipment so as to accomplish its assigned missions.

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### FRG Armored Equipment

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[Article by Col N. Fomich]

[Text] It is common knowledge that the FRG is an active participant in the NATO bloc. Along with carrying out various measures with respect to building up combat power of the armed forces, the Bundeswehr command element gives great attention to outfitting them with new, more effective models of weapons and combat equipment.

The foreign press emphasizes that West Germany presently holds one of the leading places among capitalist states in the sphere of modern arms development and production. Its industry almost completely satisfies Bundeswehr requirements for basic kinds of weapons and combat equipment, including armored equipment.

After the Bundeswehr was established in the mid-1950's, its ground forces were outfitted chiefly with American models of armored equipment, above all the M47 and M48 tanks. The former subsequently were replaced by West German Leopard 1 tanks, and the latter (650 tanks) were transferred to the territorial forces after modernization (a 105-mm rifled gun and a diesel engine were installed).

Until recently the Leopard 1 tanks of various modifications comprised the basis of the FRG ground forces' tank inventory. There is a total of over 2,430 of them. Then they were supplemented by 1,800 new Leopard 2 tanks, deliveries of which were completed in mid-1987.

The Leopard 1 tank (Fig. 1 [figure not reproduced]), created by the West German firm of Krauss-Maffei, was adopted by the Bundeswehr in 1963. It also exists in the armies of eight NATO bloc countries and Australia.

The tank has a classic configuration. The hull is of rolled armor plate and the turret is cast. Maximum thickness of the hull front plate is 70 mm (at an angle of 60 degrees).

The tank's main armament is the British L7AZ 105-mm rifled gun. The unit of fire (60 rounds) includes armor-piercing discarding-sabot projectiles, hollow-charge projectiles, and armor-piercing high-explosive projectiles with plastic explosives. One 7.62-mm machinegun is coaxial with the main gun and a second is installed on a ring mount ahead of the loader's hatch. Grenade launchers are mounted along the sides of the turret for laying smoke screens.

The gunner uses a stereoscopic monocular rangefinder and telescopic sight, and the commander uses a panoramic sight, which is replaced by an infrared sight in hours of darkness.

The foreign press notes that the tank has relatively high mobility, provided by use of an 830 hp V-10 diesel engine and hydromechanical transmission. The running gear has torsion-bar suspension and the tracks have a rubber-metal track-shoe linking.

The tank is fitted with an air filtration and ventilation system and a firefighting equipment system. Water obstacles up to 4 m deep can be negotiated using equipment for underwater operation.

A family of armored vehicles for different purposes was created on the basis of the Leopard 1 tank, including the Gepard self-propelled [SP] AAA mount, the Standart armored recovery vehicle, an armored vehicle launched bridge and the Pionierpanzer 2 combat engineer tank.

The FRG carried out a phased modernization of the Leopard 1 tank in the early 1970's to improve combat qualities. The improved version, the Leopard 1A1 (there are now 1,845 of them) differs from the original chiefly



by the presence of a horizontal and vertical gun stabilizer. In addition, turret armor has been reinforced on the Leopard 1A2 (232 tanks) and light-gathering and amplifying passive night vision instruments are used.

A new welded turret with spaced armor has been installed on the Leopard 1A3 (110 tanks) and Leopard 1A4 (250 tanks). A new fire control system is used on the latter version which includes an electronic ballistic computer, commander's combination (day and night) panoramic sight with stabilized line of aim, and the gunner's main sight with stereoscopic rangefinder.

The Leopard 1A1 tank is being further modernized in the 1A5 version at the present time. Up to 1992 it is planned to deliver 1,300 such vehicles to the Bundeswehr. The principal work consists of outfitting the tank with more up-to-date fire control system components, particularly a gunner's sight with built-in laser rangefinder and thermal imaging channel. Some improvements were made to the gun stabilizer. Replacement of the 105-mm rifled gun with a 120-mm smoothbore gun is possible in the future.

New Leopard 2 tanks created by Krauss-Maffei began to arrive in FRG Army tank brigades in 1979. They received a total of 1,800. The Leopard 2 tank also is in the inventory of armies of the Netherlands (445) and Switzerland (346 of 380 will be manufactured under license).

The Leopard 2 tank (Fig. 2 [figure not reproduced]) is considered by foreign specialists to surpass the Leopard 1 by approximately 1.5-2 times in its combat performance characteristics. It was being developed essentially at the same time as the American M1 Abrams tank.

The Leopard 2 tank's hull and turret are welded and the armor is multilayered. It has a system of protection against weapons of mass destruction.

A 120-mm smoothbore gun stabilized in two laying planes is mounted in the armored turret. A 7.62-mm machinegun is coaxial with it. A second machinegun of the same caliber is mounted above the loader's hatch. Smoke grenade launchers are on the sides of the rear part of the turret. The gun's unit of fire includes 42 fixed rounds with fin-stabilized projectiles of two types: armor-piercing discarding-sabot and multipurpose (hollow-charge and fragmentation-HE). The fire control system includes a gunner's binocular sight with built-in laser rangefinder and thermal-imaging channel, the commander's panoramic periscopic sight with stabilized line of aim, an electronic ballistic computer, as well as various sensors of nonstandard firing conditions.

The engine and transmission compartment is in the rear part of the hull, where the MB 873 Ka-501 liquid-cooled turbo-supercharged multifuel V-12 engine and HSWL-354 hydromechanical transmission are mounted. The

high unit power rating (over 27 hp per ton) provides the Leopard 2 with good mobility, including over broken terrain.

The running gear includes seven road wheels and three track support rollers on each side and tracks with rubber-metal track-shoe linking. The track pins have detachable rubber pads. There is torsion-bar suspension and it has disc friction shock absorbers on the first, second, third, sixth and seventh road wheels.

The tank is equipped with an automatic firefighting equipment system, heater and radio communications equipment. Use of underwater operation equipment is envisaged for crossing water obstacles up to 4 m deep.

Judging from western press reports, the West German firms of Porsche and Krupp-MaK Maschinenbau are developing the Bergepanzer 3 armored recovery vehicle based on the Leopard 2 tank. It will be outfitted with powerful special equipment.

At the present time the FRG is working to create a next-generation tank, tentatively named the Leopard 3. Configuration layouts, methods of armoring, type of armament and a number of other aspects have not yet been determined once and for all, but the desire to make maximum use of the latest S&T achievements in this combat vehicle is quite obvious. Foreign experts believe that the new West German tank will be fitted with the latest automated systems permitting surveillance and effective fire to be conducted day and night under all weather conditions. The use of an automatic gun loader is possible. The firm of Rheinmetall already has begun creating new types of ammunition for 105-mm and 120-mm tank guns, including guided subcaliber fin-stabilized projectiles. One of them, intended for engaging combat helicopters at ranges of 2,500-5,000 m, will be fitted with a homing head; another will be guided to a target by laser beam during fire (up to 5,000 m).

The FRG became the first country in the West to create an infantry fighting vehicle. The Marder IFV (Fig. 3 [figure not reproduced]) was adopted by the Bundeswehr in 1971 (a total of 2,436 were delivered).

The vehicle's hull is welded from steel plates. The frontal armor provides protection against 20-mm projectiles. Two compartments are accommodated in its forward part: driving (on the left) and engine-transmission. The diesel engine and hydromechanical transmission are made in a common block which can be replaced in 30 minutes under field conditions.

A mounting with a 20-mm automatic gun and coaxial 7.62-mm machinegun is on the two-place armored turret. A second machinegun of the same caliber is on a rotating mount with remote control. The gun can be fired either by the gunner or the commander. Both of them have periscopic sights, which are replaced by night infrared sights during hours of darkness. The gunlaying

drives are electrohydraulic. Smoke grenade launchers are mounted on the carriage and a visible-light and infrared searchlight is attached to it. Ports for conducting small arms fire without leaving the vehicle are along the sides of the assault compartment. There are hatches on the assault compartment roof and there is a ramp in the stern with a hydraulic drive that folds downward.

The vehicle's running gear includes six road wheels and three track support rollers on each side. The driving sprockets are located forward. There is torsion-bar suspension, with hydraulic shock absorbers on two forward and two rear road wheels.

The Marder IFV is fitted with an air filtration and ventilation system, an automatic firefighting equipment system, and radio communications equipment. The vehicle is nonamphibious. It can negotiate fords up to 2 m deep after brief preparation. It can negotiate deeper water obstacles only with the help of a special detachable flotation device (pneumatic floats). It moves on the water at a speed of up to 6 km/hr by churning the tracks.

The Marder IFV was partially modernized in the early 1980's. Its firepower, including the capability of engaging armored targets, was improved by mounting a Milan ATGM launcher on the carriage (to the right of the main gun). The main gun is supplied with an improved double-belt ammunition feed system permitting shifting rapidly from one type of projectile to another. Infrared sights on approximately 1,000 vehicles were replaced by thermal-imaging sights. Future use of an automatic 25-mm gun is possible.

The tracked IFV chassis is used in the all-weather Roland 2 SP surface-to-air missile system and the SP air search radar. Production of the TAM tank and the VCTP infantry fighting vehicle, also created on the basis of the Marder IFV, was organized in Argentina with the help of the West German firm of Thyssen-Henschel. The TAM tank (combat weight 30 tons) is armed with a 105-mm rifled gun. The Argentine Army received around 300 such tanks and IFV's.

At the present time the principal means for transporting the infantry are American M113 and M113A1 APC's. Including the special vehicles created on their basis, they number around 2,600. HS-30 tracked APC's previously in the inventory of the FRG Army were replaced by Marder IFV's.

The **Fuchs TPz-1 wheeled (6x6) APC** (Fig. 4 [figure not reproduced]), created by the aforementioned firm of Thyssen-Henschel, was adopted in 1979. Around 1,000 of them have been delivered to the Bundeswehr. The bulk of them are special-purpose vehicles (command and staff, transport, radiation and chemical reconnaissance, engineer, with the Rasit radar, and with EW equipment).

The design of this APC uses some elements of series-produced military vehicles. The armor of the welded hull

provides protection against bullets and fragments. A driving compartment accommodating a driver and commander is in its front, behind it is the engine-transmission compartment, and further on the assault compartment (ten fully equipped infantrymen).

The APC is armed with a 7.62-mm machinegun. Smoke grenade launchers are mounted along the sides of the hull. There is an air filtration and ventilation system. The Fuchs TPz-1 crosses water obstacles without preliminary preparation. Movement and control afloat is accomplished by screw propellers located in recesses in the vehicle stern.

In the early 1980's the firm of Krauss-Maffei created and tested six prototypes of the **Wildcat SP AAA mount** (Fig. 5 [figure not reproduced]) on the wheeled base of this APC. It is armed with two Mauser 30-mm automatic guns installed on the sides of a rotating armored turret. Maximum effective slant range of fire is 3,000 m. A pulse-Doppler radar (effective range up to 18 km) is used to detect airborne targets. A selected target is tracked with the help of television gear. The fire control system includes a laser rangefinder and electronic ballistic computer. The last two prototypes of the SP AAA mount also were equipped with a tracking radar.

The FRG's military industry also produced other wheeled APC's. For example, the firm of Thyssen-Maschinenbau produced over 1,000 **UR-416 wheeled (4x4) APC's**, the bulk of which were exported to countries of South America and Africa as well as to Greece, Spain, the Netherlands and Turkey. This APC, used basically in police subunits, has thin armor and is armed with a 7.62-mm machinegun. By the mid-1980's this firm had produced over 200 amphibious **TM-170 wheeled (4x4) APC's**, which went to border guard troops. In 1981 Thyssen-Henschel began producing amphibious **Kondor wheeled (4x4) APC's**, later delivered to armies of Malaysia (459), Turkey, Uruguay and Ecuador.

Luchs wheeled combat reconnaissance vehicles (408 of them) are employed for performing reconnaissance in the FRG Army. They replaced obsolete SP1A tracked APC's.

The **Luchs wheeled (8x8) combat reconnaissance vehicle** (see color insert [color insert not reproduced]) was created by the firm of Thyssen-Henschel in the early 1970's. Its feature is the capability of moving forward and backward at the same high speed (90 km/hr), and so the rear part of the hull has a second driving compartment and the radio operator performs the functions of driver.

The vehicle hull is welded of rolled steel plate. Frontal armor protects against 20-mm projectiles. The combat reconnaissance vehicle is equipped with an air filtration and ventilation system.

The two-place armored turret accommodates the commander and gunner. The main armament is a 20-mm

automatic gun (unit of fire of 375 projectiles). A 7.62-mm machinegun is mounted above the commander's hatch. Four-barrel smoke grenade launchers are mounted along the sides of the turret.

The multifuel V-10 engine is made in a common block with the hydromechanical transmission. The engine and transmission compartment is in the hull mid-section and is well insulated. Special sound-absorbing partitions have been used on the combat reconnaissance vehicle. It is noted that the moving vehicle is almost inaudible at a distance of 50 m. Before being ejected, exhaust gases are mixed with air to lower their temperature.

The running gear has a bogie suspension, with coil springs and hydraulic shock absorbers. All wheels are driving wheels and steerable. There is a centralized tire inflation system. The vehicle is amphibious, with movement and control afloat accomplished using two screw propellers accommodated in recesses of the hull stern section.

The Luchs combat reconnaissance vehicle is equipped with a navigation system, communications equipment, and automatic firefighting equipment system for the engine and transmission compartment.

The firm of Porsche created the **Wiesel light tracked combat vehicle** for the FRG Army's airborne troops. Four of its improved prototypes underwent field trials in 1986.

The vehicle's welded armor hull protects against bullets and fragments of artillery and mortar rounds. The driver is accommodated in its right front section and the engine-transmission compartment is on the left. The five-cylinder diesel engine is made in the same block as the automatic transmission.

The running gear includes four road wheels and one track support roller on each side. It has torsion-bar suspension. The vehicle has good mobility on broken terrain and is distinguished by low noise during movement. Because of its small weight it can be moved by military transport aircraft and helicopters and is adapted for a parachute landing.

Two armament versions are provided: the American TOW ATGM or the Mk 20Rh 202 20-mm automatic gun installed in a single-place armored turret (Fig. 6 [figure not reproduced]). The gunner uses the PERI Z-16 periscopic sight, replaced in hours of darkness by a light-gathering and amplifying passive night sight, for observation and for conducting fire from the gun.

The Bundeswehr command plans to purchase 343 Wiesel light combat vehicles for its airborne troops, of which 210 will be armed with the TOW ATGM. Vehicle deliveries are to be made in the period 1989-1992. The

creation of a command vehicle and reconnaissance vehicle as well as a self-propelled Stinger surface-to-air missile system is possible on the basis of the Wiesel in the future.

In the early 1960's the West German firms of Hanomag and Henschel created the Jagdpanzer 90-mm SP antitank gun and the Raketenjagdpanzer SP launcher with SS-11 ATGM (manual guidance system) based on the standardized tracked chassis. There were 770 and 370 such pieces of combat equipment respectively delivered to Army antitank subunits.

After several years of operation a decision was made to refit these mounts as SP antitank missile systems to improve their combat capabilities. Thyssen-Henschel began on this. From 1978 through 1983 316 Raketenjagdpanzer mounts were rearmed with the more modern HOT antitank missile systems with a semiautomatic guidance system. This SP antitank missile system was designated the **Jaguar-1**. Its carried unit of fire consists of 20 HOT missiles (range of fire 4,000 m), which subsequently began to be replaced by the improved version, the HOT-2.

In the period from 1983 through 1985 162 of 770 Jagdpanzer SP antitank guns were rearmed with the TOW antitank missile system, and the others were transferred to territorial forces. The new SP set was called the **Jaguar-2** (Fig. 7 [figure not reproduced]). The launcher is depressed when shifted to a traveling position. The AN/TAS-4 thermal-imaging sight is used for supporting fire under nighttime conditions.

The armor protection of both SP antitank missile systems was reinforced by attaching additional steel plates to the frontal part and sides of the hull. There were 7.62-mm machineguns installed as additional armament. The systems are outfitted with air filtration and ventilation systems and have radio communications equipment. Maximum highway speed is 70 km/hr and they have a range up to 400 km.

Of the latest developments of armored equipment in the FRG, foreign specialists single out the **PUMA light multipurpose combat vehicle**, created on an initiative basis by the firms of Krauss-Maffei and Diehl. It is planned to produce an entire family of relatively inexpensive vehicles for various purposes on its basis, including a command and staff vehicle, reconnaissance vehicle, IFV, APC, light tank, SP antitank missile system, 120-mm SP mortar, SP AAA mount, SP surface-to-air missile system, minelayer, and armored recovery vehicle.

The tracked chassis of these vehicles will have a modular design. Three basic versions of them are planned depending on combat weight: 16-22 tons, 23-28 tons and 29-34 tons (four, five and six road wheels on a side respectively). The configuration provides for a forward location of the engine-transmission compartment. A 440

Specifications and Performance Characteristics of FRG Armored Equipment

Model Name, Year Operational	Combat Weight, tons	Dimensions, m: Height	Weapon Caliber, mm; Gun	Engine Power, hp	Maximum Speed, km/hr
	Crew (Mounted)	Length x Width	Machineguns		Range, km
Leopard 1 tank, 1963	<u>40</u> 4	<u>2.6</u> 7 x 3.3	<u>105</u> two 7.62	830	<u>65</u> 600
Leopard 2 tank, 1979	<u>51</u> 4	<u>2.76</u> 7.7 x 3.5	<u>120</u> two 7.62	1500	<u>72</u> 550
Marder IFV, 1971	<u>28.2</u> 3 (7)	<u>2.8</u> 6.8 x 3.2	<u>20<sup>3</sup></u> two 7.62	600	<u>75</u> 500
Fuchs TPz-1 wheeled APC, 1979	<u>16</u> 2 (10)	<u>2.3</u> 6.78 x 2.97	<u>—</u> 7.62	320	<u>87</u> 800
UR-416 wheeled APC, 1969	<u>7.6</u> 2 (8)	<u>2.2</u> 5.2 x 2.3	<u>—<sup>3</sup></u> 7.62	120	<u>85</u> 600
TM-170 wheeled APC, 1982	<u>11.2</u> 2 (10)	<u>2.3</u> 6.12 x 2.45	<u>—<sup>3</sup></u> 7.62	168	<u>100</u> 700
Kondor wheeled APC <sup>4</sup>	<u>12.4</u> 3 (9)	<u>2.79</u> 6.47 x 2.47	<u>20</u> 7.62	168	<u>100</u> 900
Luchs combat recon- naissance vehicle, 1973	<u>19.5</u> 4	<u>2.84</u> 7.74 x 2.98	<u>20</u> 7.62	160	<u>90</u> 800
Wiesel light combat vehicle, experi- mental	<u>2.75</u> 2 <sup>6</sup>	<u>1.9</u> 3.26 x 1.8	<u>20<sup>3</sup></u> —	86	<u>80</u> 200

Key:

1. Length is given for the hull.
2. It has a Milan ATGM launcher (unit of fire four missiles)
3. There are versions with a 20-mm automatic gun.
4. The APC was produced only for export.
5. A second version is armed with the TOW ATGM launcher (unit of fire seven missiles).
6. There is a crew of three in the version with the TOW ATGM launcher.

hp diesel engine is mounted in the first base version of the PUMA vehicle and a 600 hp engine is in the second and third.

Vehicle hulls are welded of steel armor plate. The design uses some elements, assemblies and machine units of armored equipment models already in the inventory. In the opinion of West German specialists, this reduces production and operating expenditures and provides high reliability and repairability. The vehicles will be equipped with systems for protection against weapons of mass destruction, automatic firefighting equipment systems, communications equipment and other equipment in accordance with the client's requirements.

At the present time prototypes of the infantry fighting vehicle and the 120-mm SP mortar have been created on the basis of the PUMA vehicle and have undergone testing. A two-place armored turret with Mauser 25-mm automatic gun has been installed on the IFV (Fig. 8 [figure not reproduced]). This vehicle also underwent comparative testing in Turkey, where the American AIFV and the British MCV-80 Warrior were represented along with it. Other models still are in the development stage.

It is evident from the above that the FRG is devoting considerable attention to questions of creating models of

armored equipment, above all tanks, and equipping the Army with them. The latest technological achievements are being used in their development and production. Enormous monetary and material resources are being expended for these purposes. A certain portion of military products is being exported to other capitalist countries, above all those belonging to the NATO bloc. Specifications and performance characteristics of the principal models of West German armored equipment are presented in the table.

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**Eskorter-35 Self-Propelled Air Defense Mount**  
18010303g Moscow ZARUBEZHNOYE VOYENNOYE  
OBOZRENIYE in Russian No 10, Oct 88 (signed to  
press 10 Oct 88 pp 32-34

[Article by Lt Col A. Tolin, candidate of military sciences]

[Text] The Swiss firm of Oerlikon developed the Eskorter-35 35-mm self-propelled [SP] twin AA mount intended for engaging low-flying aircraft and helicopters

at ranges up to 4 km and for firing against ground targets, including lightly armored ones. It is capable of performing reconnaissance of airborne targets while in movement and engaging them from a short halt. Foreign military specialists believe that this permits using it successfully for covering army units and subunits, including on the march.

The Eskorter-35 SP AA mount consists of the gun and a fire control system mounted on a rotating platform, which is installed on a wheeled (4x4) chassis created by the West German firm of Hydrokran (Fig. 1). The mount weighs around 24 tons. Its crew includes a commander, gunner and driver, who are accommodated in the cabin in a traveling position. When the mount is shifted to a combat position the SP chassis cabin (with the commander and driver in it) is lowered, enabling the platform to rotate for all-around fire (Fig. 2 [figure not reproduced]). The gunner takes his place in the fire control system cabin.

The gun portion includes two Oerlikon GDF-DO 3 35-mm automatic guns. There is a magazine with ammunition and an ammunition feed system on the outside of each of them. The guns have a sector of fire of from -5 to +85 degrees in the vertical plane.

The GDF-DO 3 gun, the automatic equipment of which operates on the blowback principle, is an improved version of the Oerlikon gun being used in the GDF-001 towed AA mount and the West German Gepard SP AA mount. Its rate of fire was increased from 550 to 600 rounds per minute.

The drum magazine holding 200 rounds is divided into 25 segments, which are loaded with the help of clips, each holding eight rounds and having the same type of projectiles (Fig. 3 [figure not reproduced]). The magazine is loaded with rounds having projectiles of two types; data on the type of projectiles in each of the segments is loaded in the fire control system computer.

When the gunner selects the necessary projectile type during firing the magazine automatically rotates and the closest segment with projectiles of the given type is connected to the ammunition feed system.

The gunner and driver reload the unit of fire of the SP AA mount, which includes 430 rounds (15 rounds are in each of the ammunition feed systems) in 6 minutes.

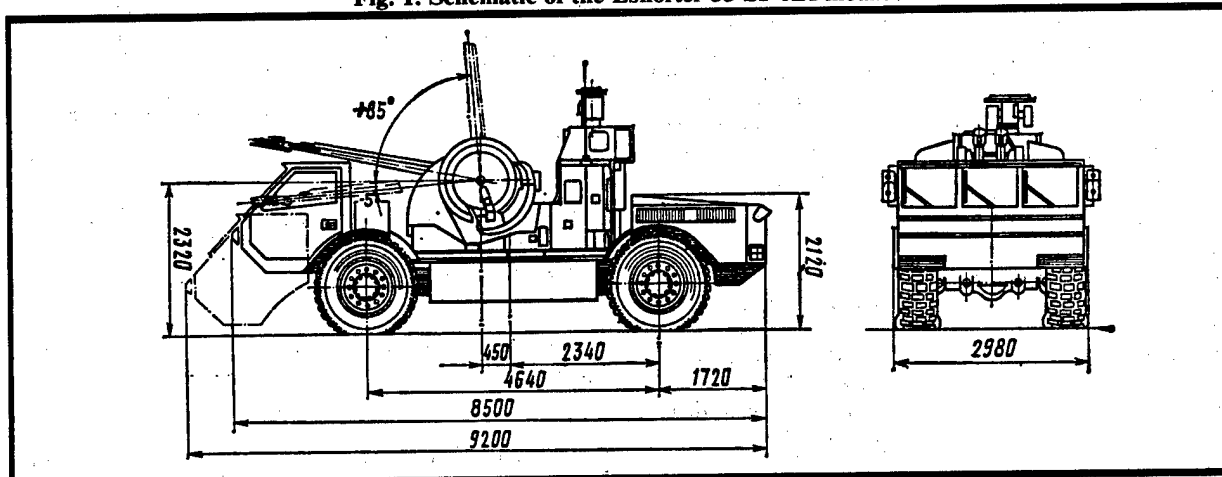
The SP AA mount can use rounds with fragmentation-incendiary and semiarmor-piercing-fragmentation-incendiary tracer projectiles (their muzzle velocity is 1,175 m/sec and flight time to a range of 4 km is around 6 seconds) for firing against airborne targets, and rounds with armor-piercing discarding-sabot tracer projectiles having a muzzle velocity of 1,385 m/sec for firing against ground targets. The armor-penetrating capability of such a projectile with an impact angle of 90 degrees to the target can reach 80 mm.

Judging from foreign press reports, a new fragmentation-incendiary projectile has been developed at the present time which provides a detonation time delay (for the time necessary for it to penetrate the target) as well as an intensified incendiary effect with a simultaneous reduction in weight of explosive and an increase in weight of fragments. Development of an armor-piercing-fragmentation-incendiary discarding-sabot projectile for firing both against airborne and lightly armored ground targets is concluding. The muzzle velocity of this projectile is 1,395 m/sec and the flight time to a range of 4 km is around 4 seconds.

The fire control system developed by the Swiss firm of Contraves includes a search radar, optoelectronic target tracking system, computer, controls and indicators.

The pulse-Doppler search radar is a modification of the radar developed by the Italian division of Contraves for the ADATS multipurpose missile system, differing from the latter chiefly by lesser antenna size. This radar is

Fig. 1. Schematic of the Eskorter-35 SP AA mount



capable of detecting low-flying targets against a background of reflections from the underlying surface and under active jamming conditions because of frequency retuning in the working band of 5.2-10.9 GHz, use of a traveling wave tube transmitter, and low level of radiation pattern side lobes of the antenna rotating at a 60 rpm rate. The radar permits detecting airborne targets at ranges up to 20 km and tracking up to six targets simultaneously in azimuth and range.

Data on the air situation received using the search radar is displayed on the plan position indicator of the control console at the crew commander's work station (Fig. 4 [figure not reproduced]). An evaluation of the degree of the targets' threat is made on the basis of these data (using the fire control system computer) and their engagement sequence is determined. Then the platform on which the gun and fire control system cabin are mounted rotates in the direction of the target, which is locked onto by the optoelectronic tracking system. The time from target acquisition to opening of fire does not exceed 5 seconds.

The optoelectronic target tracking system consists of an infrared servomechanism, optical sight and laser rangefinder. The optical subsystems of these devices are designed in the form of a tracking head mounted on the roof of the fire control system cabin (Fig. 5 [figure not reproduced]). After target lock-on, the target can be tracked automatically by the infrared servomechanism or manually by the gunner using the optical sight. But even with automatic tracking the gunner can monitor the operation of the infrared servomechanism gear and in case of a loss of automatic tracking perform another target lock-on with a subsequent transfer to tracking in the automatic mode. It is reported that the infrared servomechanism and laser rangefinder operate in the waveband of around 10 microns and have an effective range of up to 10 km under favorable weather conditions. The field of view of the periscopic optical sight with 8x magnification is 8 degrees.

The Eskorter-35 SP AA mount's digital computer, which is also used in the ADATS multipurpose missile system, calculates data for firing to a future position with consideration of ballistic characteristics and muzzle velocity of projectiles, meteorological conditions, angle of inclination of the SP chassis platform (it has no stabilization system), and other parameters based on current values of target coordinates and speed.

The SP chassis with 455 hp diesel engine has a march speed of 80 km/hr (top speed of 120 km/hr) and the range can be increased to 1,200 km. The engine compartment is located in the rear section of the hull.

The SP chassis cabin has armor protection against small arms fire and fragments of artillery projectiles (armored louvers on cabin windows are lowered manually). It is equipped with the Teldyx navigation system, mounted

between the crew commander's and driver's seats. The fire control system cabin and engine compartment also are armored.

All wheels of the SP chassis are steerable, and because of this the minimum turning radius is 6.2 m. Forward and rear wheels can rotate in one and the same direction, which makes it possible to move at an angle of up to 40 degrees relative to the chassis longitudinal axis. The wheels have independent hydropneumatic suspension. Tire pressure can be adjusted depending on road conditions.

In 1985 the Eskorter-35 SP AA mount was demonstrated at an exhibition of aerospace equipment in France and it underwent firing tests under conditions of the Near East in the summer of 1986. Oerlikon specialists believe that the high engineering level, substantially lesser weight, and lower cost of this mount in comparison with the Gepard SP AA mount will permit Switzerland to export it to other countries.

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#### Turkish Air Force

18010303h Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 35-40

[Article by Col G. Zhdanov, candidate of technical sciences]

[Text] The importance of Turkey's strategic position, which is determined by the commonality of borders with the Soviet Union and Bulgaria and by the possibility of monitoring the Black Sea Strait zone, was the chief factor exerting a decisive influence on the role and place of this state in carrying out aggressive schemes of U.S. and NATO militarist circles against countries of the socialist community from the south. Moreover, following unreservedly in the wake of American policy, Turkey also is being used to strengthen U.S. military presence in the Near and Middle East. The present Turkish rightist-conservative government sees a strengthening of its power in the country to lie in building a strong Army and having a close alliance with American imperialism.

Turkey is one of the most active bloc members. It is oriented totally on the United States and NATO in building the Turkish Armed Forces. Turkey's military doctrine provides for comprehensive development of all branches of the Armed Forces, including the Air Force.

According to military experts, even in peacetime the Turkish Air Force is sufficiently well prepared for military operations and is an important component of the bloc's air grouping in the Southern Europe Sector.

In accordance with basic provisions adopted in NATO about combat employment of tactical aviation, the Turkish Air Force is assigned the following missions: winning and maintaining air supremacy; air support of ground and naval forces; interdiction of battle areas; protection of administrative-political and industrial centers, force groupings and other very important installations against enemy strikes; movement of troops and cargoes and aerial reconnaissance in the interests both of its own Armed Forces and of the NATO Allied Forces as a whole.

In addition, Turkish Air Force units and subunits monitor the Black Sea Strait zone and sea lines of communication in the Eastern Mediterranean together with the Navy.

The composition, organization, combat training and basic directions of organizational development of the Turkish Air Force are covered below based on data published in the foreign press.

**Organization and effective combat strength.** A commander in chief heads the Air Force; he is directly subordinate to the chief of the Turkish Armed Forces General Staff. He exercises leadership of his subordinate units through his staff (located in the city of Ankara), which consists of several directorates: personnel, operations, logistics, planning, military intelligence and others.

The staff is the agency for operational direction of the Air Force. It plans, organizes and monitors operational and combat training, and mobilization and operational deployment on a national scale and decides questions of supplying materiel to units and subunits. Staff officers actively participate in drawing up plans for employing Turkish aviation in exercises conducted within the framework of the NATO Allied Air Forces in the Southern Europe Sector.

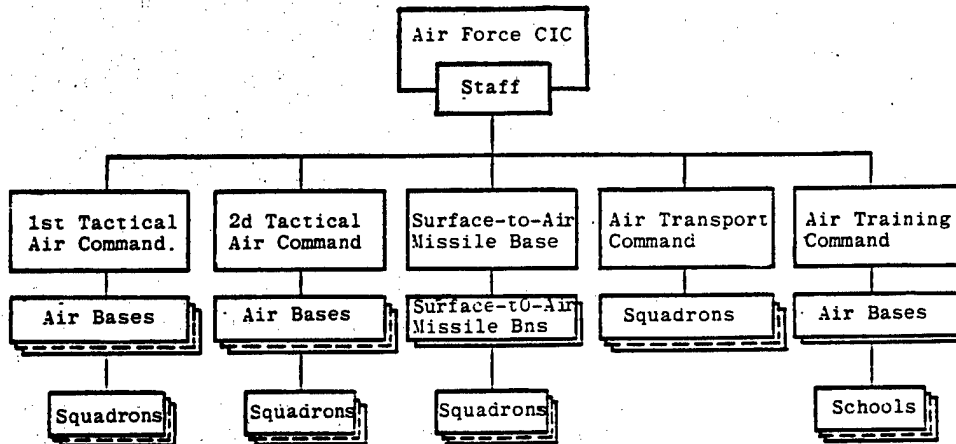
Organizationally the Air Force consists of two tactical air commands (1st and 2d), a surface-to-air missile base (according to the data of some foreign journals it is part of the 1st TAC), an air training command and an air transport command (Fig. 1).

The tactical air command is the Turkish Air Force's highest operational formation, intended for conducting air operations in one or two operational sectors. The TAC staff is responsible for maintaining high combat readiness of units and subunits, directs their combat training and participates in developing exercises to be held both on a national level and within the framework of the bloc. In wartime it organizes air operations and the coordination of aviation with ground and naval forces.

The TAC includes air bases, which are the principal air units and as a rule consist of two or three squadrons. The base commander is responsible for the personnel's combat readiness and flight training, the status of aircraft, and logistic support of his subordinate subunits. The basic combat subunit of the Air Force is the air squadron (it has 15-20 aircraft).

The *1st Tactical Air Command* (headquarters at Eskisehir) consolidates four air bases (Eskisehir, Murted, Bandirma and Balikesir) and one Nike-Hercules surface-to-air missile base (Alemdar). There are two fighter-bomber squadrons (equipped with F-100D and F-4E aircraft respectively) and one reconnaissance squadron (RF-5A and RF-4E) stationed at Eskisehir Air Base. Murted Air Base has two fighter-bomber squadrons (F-104G) and there is one fighter-bomber squadron (F-104G) and one reconnaissance squadron (F-5A and RF-5A) at Bandirma Air Base. One fighter-bomber squadron (F-104G) and two fighter squadrons (F-104S and G) are stationed at Balikesir Air Base.

Fig. 1. Approximate organization of the Turkish Air Force



The missile base at Alemdar includes two surface-to-air missile battalions (four squadrons each), which have 72 Nike-Hercules surface-to-air missile launchers. The battalions' mission is to provide air cover for the Black Sea Strait zone as well as for the country's important administrative-political center and naval base of Istanbul.

The 2d TAC (Diyarbakir) includes three air bases: Merzifon—two fighter-bomber squadrons (F-5A), Erhac—three fighter-bomber squadrons (F-4E) and Diyarbakir—two fighter-bomber squadrons (F-104G, Fig. 2 [figure not reproduced]) and one reconnaissance squadron (RF-5A).

Thus according to data published in the foreign press, the Turkish Air Force order of battle numbers 18 combat

aviation squadrons, including 13 fighter-bomber (attack), two fighter (air defense) and three reconnaissance squadrons. The Turkish Air Force has a total of some 580 combat and combat trainer aircraft.

The *Air Transport Command* (Etimesgut) has four squadrons, which have seven C-130 Hercules, 20 C-160D Transall (Fig. 3 [figure not reproduced]), 22 C-47A Skytrain, 3 Viscount, 2 C-47A and 4 Cessna 421 military transport aircraft.

In addition, the Air Force has 15 UH-1H Iroquois and 5 UH-19B helicopters and so on. The Turkish Air Force order of battle is given in the table in more detail.

#### Turkish Air Force Order of Battle

Squadron Tasking Designation	Number of Squadrons (Aircraft in Them)	Including
Fighter-bomber	13 (227)	4 (75 F-4E) 6 (72 F-104G) 2 (40 F-5A and B) 1 (40 F-100)
Fighter	2 (40)	2 (36 F-104 and 4 TF-104)
Reconnaissance	3 (28)	1 (20 RF-5A and B) 1 (8 RF-4E)
Transport	4 (58)	1 (7 C-130E) 1 (20 C-160D) 1 (22 C-47A) 1 (3 Viscount, 2 C-47A, 4 Cessna 421)
Combat training	2 (28)	2 (4 F-104 and 24 F-5)
Special and auxiliary (including training)	285	55 F-100, 82 T-33, 12 T-34, 2 C-47A, 42 T-37, 29 T-38, 15 UH-1H, 5 UH-19B and others
Surface-to-air missile	11 (96)	8 (72 Nike-Hercules) 3 (24 Rapier)

The *Air Training Command* (Izmir) performs general and special training of flight and engineering-technical personnel for Turkish Air Force units and subunits. It includes officer and NCO flight and technical schools and two air training bases (Konya and Cigli).

The Air Force Air School in Istanbul is the main military educational institution for training officer cadres for the Turkish Air Force. General educational, military and technical training of cadets is carried out here for four years under an integrated program. They take basic flight training in T-33, T-37 and T-38 aircraft. On completing school graduates are given the military rank of lieutenant and issued a diploma in the specialty of "aircraft engine design and operation." Then they are sent for further specialization to schools of combat arms and services, and those chosen for flight duty are sent to air training bases.

Personnel who service the aircraft are trained at the technical school in Izmir. Radar operators and technicians, specialists of control and warning centers and posts, communicators, and Air Force airfield service and

logistic support officers train in corresponding educational institutions (officer and NCO schools).

Student flight training is conducted at Konya Air Base in F-100 combat trainers and combat aircraft, at Eskisehir Air Base training center in F-4E multirole tactical fighters, and at Murted and Balikesir air bases in F-104G's. Training programs are designed for one year and provide for mastering the technique for flying a combat aircraft and practicing elements of its tactical employment including practice bombing and missile launches. On completion of the training course students are presented a diploma and a military pilot's badge and sent to combat air units.

According to foreign press data the aircraft inventory of the Air Training Command numbers over 200 aircraft, including 82 T-33's, 12 T-34A's, 42 T-37's, 29 T-38's, 20 T-41's and 17 TF-104's.

**Turkish air defense** is a component part of the NATO allied air defense system in Europe (6th ATAC area of



responsibility). The military-political leadership is notified about an air enemy, and command and control of active personnel and equipment is exercised on the basis of data coming from control and warning centers and radar posts, the majority of which are connected to NATO's allied automated air defense control system known as NADGE.

There are F-104S fighters, Nike-Hercules and Rapier surface-to-air missiles, as well as AAA in Turkey's active air defense forces. Air defense of the greater part of the country's territory is accomplished primarily by fighter aviation and AAA, and the Nike-Hercules surface-to-air missile squadron (72 launchers) chiefly is assigned to cover the Black Sea Strait zone.

In addition, air defense of airfields, ports and so on against low-flying targets is provided by batteries of 40-mm antiaircraft guns and Rapier surface-to-air missiles (24 launchers).

In the opinion of the bloc leadership, the Turkish air defense system presently does not provide reliable cover of installations, especially against strikes by aircraft flying at low and extremely low altitude. Radar posts and warning and control centers are being modernized, Rapier surface-to-air missiles are being purchased and so on in connection with this. In the future it is planned to use some of the F-16 tactical fighters equipped with the latest short and medium range air-to-air guided missiles for this purpose. It is also planned to use the NATO AWACS Command's airborne early warning and control system.

Combat training of the Turkish Air Force is organized and conducted under plans of the national command authority under supervision of the NATO Allied Air Forces Command in the Southern Europe Sector and is aimed at a further increase in their combat readiness. Great emphasis is placed on exercises and competitions during which the personnel's proficiency is improved and the coordination of units and subunits is practiced in a varying situation.

The Turkish Air Force takes an active part in NATO field training exercises and command and staff exercises held in the Southern Europe Sector such as Display Determination, Dawn Patrol and others.

In the process of combat training, Air Force personnel practice executing missions chiefly inherent to a given air arm. In particular, the crews of tactical fighters practice delivering missile and bombing strikes against ground and naval surface targets. Special emphasis is placed on training crews to penetrate strong enemy air defense. In the views of Turkish military specialists, the level of friendly aircraft losses to enemy air defense forces can be reduced by making flights at low and

extremely low altitude, by optimum alignment of combat formations and selection of flight routes, by effective use of EW resources, by destroying targets on the first pass and so on.

Fighter aviation crews learn to intercept airborne targets from an airfield alert status or while patrolling in a zone. Recently, however, the foreign press indicates that the Turkish Air Force also is giving great attention to training fighter pilots to deliver strikes against ground targets.

Transport aviation subunits train to perform such traditional missions as moving troops and cargoes, dropping airborne assault forces, evacuating sick and wounded and so on.

Judging from western press materials, considerable attention in Air Force operational training is being given to practicing coordination between aviation and ground and naval forces both on a national scale and within the framework of the NATO bloc.

**Development.** The country's military-political leadership believes that the Turkish Air Force will not be able to accomplish its assigned missions completely and needs a qualitative replacement of the aircraft inventory, outfitting with modern guided weapons, and improvement of control systems. It is noted that some 30 percent of combat aircraft in the Air Force inventory are made up of very obsolete fighters such as the F-5 (Fig. 4 [figure not reproduced]) and F-100. The F-104 and F-4 also do not quite meet modern requirements. Therefore at the present time a program is being realized for re-equipping a portion of Air Force subunits with new aircraft. In particular, the production of F-16 tactical fighters is being organized for these purposes together with the United States. Under an agreement signed in late 1983 the Turkish aircraft firm of Tusas built two plants together with General Dynamics and General Electric—in Murted (a suburb of Ankara), where aircraft are assembled, and in Eskisehir (for producing the aircraft engines for them). Flight tests of the first F-16 built in Turkey began in October 1987. Initially the aircraft will be assembled from parts and assemblies supplied by the American company of General Dynamics, and then it is planned to organize the production of some machine units at national enterprises. It is planned to have 160 F-16 aircraft in the Turkish Air Force by the mid-1990's.

Other NATO countries also are actively helping Turkey strengthen its Air Force. The western press reports that enterprises for assembling UH-1H Iroquois multipurpose helicopters have been expanded and modernized with the help of the FRG. In addition, the foreign press reports that Turkey will continue outfitting its Air Force with aircraft guided weapons, particularly the Sidewinder, Sparrow, Falcon, Bullpup and other guided missiles.

In the assessment of foreign military specialists, on the whole the Turkish Air Force represents a rather strong

air grouping in the NATO Allied Air Forces in the Southern Europe Sector and it will become the most powerful component of this aggressive bloc's Air Force in the given region as it is re-equipped with new aircraft and weapons.

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### Prospects for Development of Air-to-Surface Guided Weapons

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[Article by Col V. Prokofyev, candidate of technical sciences]

[Text] The Soviet Union's persistent campaign to eliminate nuclear weapons is beginning to bear fruit. Under pressure of progressive world opinion the United States has been forced to take the first steps to reduce its nuclear arsenals. That turn of events, however, clearly does not suit American "hawks," who are urgently attempting to find an equivalent substitute for nuclear weapons. One such "substitute" is considered to be precision guided weapons with conventional filling. The latest achievements of science and technology are being used and the best minds of scientists and engineers are being brought in to develop them. The ultimate objective of these aspirations is to create robotized or, as the western press calls them, "smart" and "intelligent" guided weapon systems.

The history of development of aircraft guided weapons is above all the history of development of their guidance systems. Without belittling the role of all other component parts of such weapons (motors, warheads, aerodynamic devices, fuzes and so on), foreign specialists nevertheless yield the palm to guidance systems, because of which the very term "guided weapon" appeared. This is the most complex, most expensive, most "intelligent" part of the majority of contemporary conventional aircraft guided munitions.

After covering a path of development from simple manual guidance systems to complicated automated complexes, guidance systems have approached the next phase of improvement—the appearance of models with components of artificial intelligence systems.<sup>1</sup> This shows up most significantly in aircraft air-to-surface guided weapon guidance systems. At the present time these systems already have broad capabilities: they can automatically select the munition's optimum flight path, keep track of target maneuvers, avoid obstacles, and guide the munition to the target at the aspect angle for most effective engagement; however, they still cannot recognize targets or select the most vulnerable spots for their destruction. Such a task for now is only within human (the operator's) capability.

Without going into detail in recognition theory, western experts note that completeness of accomplishing the task of target recognition by an operator depends on the number and quality of identifying signs being received and the operator's level of training and quickness of thinking. Recognition of a detected object from its image down to type and status (for example, an M1 tank in motion) is the highest level in accomplishing this task; recognition down to kind (tank) is the middle level; and recognition of an object from one or more signs down to class (an armored equipment object) is the lowest level. As applied to air-to-surface weapons (with the exception of antiradiation missiles), developers are trying to give guidance systems the capability of accomplishing the task of recognition at the highest level. By analogy with a human, for this it is necessary to fulfill three very important conditions at the very least:

- Equip the guidance system with high-resolution sensors so that it can "see" objects well;
- Supply it with a large-power computer—the "brain" for processing data collected by sensors;
- Teach this device to "think" and to make decisions by comparing preliminary data on the object stored in its memory (data bank) with data collected by sensors during execution of the flight in accordance with special algorithms.

The foreign press customarily calls such a "thinking" computer an automatic recognition device.

The sensors are the "eyes" of the guidance system. The higher their resolution, the more sharp-sighted the "eyes" and the more data they collect for the automatic recognition device. Further sensor development is linked with progress in the sphere of technology of fabricating very large-scale integrated circuits and optoelectronic devices with a high packing density. For example, the American firm of Hughes developed an electron-beam technology for fabricating circuits which permits creating interconnection elements on a microchip with a thickness of less than one-tenth the wavelength of light. This makes it possible to sharply increase the packing density of electronic circuits, and above all the large number of passive infrared sensors on one chip. Firm specialists believe that these will hold one of the leading places among other sensors, since they allow obtaining a sharp target image regardless of time of day. At the same time, the firm is resting great hopes on all-weather radars and homing heads in the millimeter waveband in an attempt to achieve sufficiently high resolution within small dimensions. Work here is concentrated on a search for new miniature devices and on methods of signal processing for improving the signal-to-noise ratio and consequently for achieving higher resolution as well as compensating for energy losses in the presence of precipitation.

Western specialists also are showing very lively interest in sensors created on the basis of the CO<sub>2</sub> laser which, almost like a radar, essentially has an all-weather capability. Thanks to unique features of laser emission these sensors make it possible to obtain a three-dimensional image of the object. Moreover, with the help of a recording of the Doppler frequency shift of reflected signals it is possible to obtain such identifying signs as the fact of a ring mount (track, turret) displacement and hull vibration frequency with engine operating.

Successes in the field of sensor microminiaturization open up opportunities for using different sensor combinations, which sharply increases the number of target recognition signs. For example, flying laboratory tests of a multifunction lidar of the American firm of Vought showed that a forward-looking infrared system can be built into this lidar. Firm specialists believe that such a symbiosis can lead to fundamental changes in weapon guidance systems.

Until recently, data collected by sensors was processed by equipment based on analog technology. In particular, spectral signal filtering, boundary correction, a change in image scale, image rotation, adjustment of image contrast and so on were accomplished in processing a target image using such equipment. There was a genuine leap in this area with the transition to digital processing methods, which made it possible to memorize and store object images in digital form and then compare them in different combinations. Conversion of the object image into digital form takes a certain amount of time. The more detailed the image and the more objects there are, the greater the time required for this operation. Merely converting object images into digital form is not enough. In order to recognize them it is also necessary to process the data being received from sensors according to appropriate algorithms and compare the data with that present aboard. Powerful computing equipment and excellent software are necessary for this.

The difficulty in accomplishing the task of recognizing objects in an aircraft air-to-surface weapon also is aggravated by the fact that the guidance system here is functioning not in a static but in an intense dynamic mode and with an acute time shortage. Target images must be processed by the system with continuously changing aspect angles and scales, against different underlying backgrounds, and under conditions of natural and organized jamming.

American military specialists conducting research on air-to-surface weapon guidance systems concluded that in order to recognize target images the amount of data which has to be processed and analyzed aboard the munition exceeds by several orders of magnitude the amount of data which the most up-to-date on-board digital processor is capable of processing and analyzing. Moreover, in order for the guidance system to be able to determine that a detected object such as a tank is

behaving appropriately it is necessary to use artificial intelligence system methods.

Prospective computers with artificial intelligence system elements will differ from present devices by incomparably higher speed. For example, specialists working in the sphere of artificial intelligence system technology set as their immediate objective an increase in device speed by two orders of magnitude, and subsequently by five. It is noted that attainment of such a speed is impossible without integrated circuits of superhigh speed and very large scale. Experts of Honeywell, which is developing a processor based on such circuits that is part of optoelectronic equipment and is optimized for use in recognition systems for work only with one sensor, believe that requisite processor speed is 5-10 billion operations per second. Data processing by artificial intelligence methods and the integration of data collected from several sensors will require an increase in speed by another 3-4 times.

Another very important aspect of prospective computers with artificial intelligence system elements will be the capability of storing and logically processing an enormous amount of data. In accordance with this it is deemed necessary to develop two types of specialized computers: the first for storing and accumulating knowledge (a data bank)—so-called expert devices; the second capable of drawing logical conclusions based on data that are stored and that are being received on line—devices of inductive (logical) conclusion. The use of such devices in aircraft weapon guidance systems imposes rigid conditions on them in weight-dimensional characteristics. Foreign scientists see a solution to these problems in the creation of chip microprocessors. In particular, the U.S. Defense Department Advanced Research Projects Agency is financing development of a microprocessor chip being created on the basis of components 2 microns in size that are capable of replacing several hundred microcircuits.

The western press emphasizes that the effectiveness of employing combat systems depends to a growing extent on the computer programs. Software plays a deciding role for the precision weapon systems in which artificial intelligence system elements are used. U.S. Air Force representatives note that the process of programming presently is very laborious and depends on the human factor. Creation of sophisticated software now is more an art than a science. Therefore work in the sphere of software technology and prospective computer technology is aimed to a considerable extent at increasing programming automation. Judging from foreign press reports, the United States presently is making a prototype software package with certain elements of artificial intelligence for the on-board digital equipment of guided missiles.

The high cost of a guidance system with artificial intelligence elements, especially an automatic recognition device, plays far from the last role in building a structural

scheme of an "intelligent" air-to-surface weapon. Western experts are proposing two versions of such a scheme. The first, intended basically for close-combat weapons, proposes to accommodate the automatic recognition device and principal sensors aboard an aircraft or helicopter. In this case the munition has only simple servosystems permitting its flight to be controlled by commands from aboard the platform. The second version is more suitable for long-range weapons or weapons to be employed in a zone of heavy enemy air defense. Here the guidance system is completely accommodated aboard the munition. After being launched in the direction of the target the munition becomes autonomous and independent of the platform. In the target vicinity it independently performs the target search, acquisition, recognition, homing, and destruction. It is noted that the one-time use of such a weapon is very costly, but it is justified when it operates against especially important enemy targets.

Intensive work to create an "intelligent" aircraft weapon in the first version is being carried out by a number of American firms under contract with the U.S. Air Force within the framework of the Pilot's Associate program, the objective of which is to study the possibility of using artificial intelligence methods to increase the combat effectiveness of crews of combat aircraft, especially single-place fighters. For example, Hughes is conducting experiments on precise target recognition for achieving a high launch frequency of Maverick guided missiles with a television homing head. The system installed aboard the flying laboratory uses six powerful computers for recognizing targets from the shape of their images received by the missile homing head and transmitted to an indicator displaying data against the background of the cockpit windshield. Zones around possible targets are highlighted and their priority is indicated on the display thanks to special devices. This facilitates the pilot's task of rapidly finding targets against the terrain background and making decisions for launching missiles. It is noted that the system's target discrimination capability already is almost the very same as for a pilot. The firm's specialists assert that this system realizes algorithms for recognizing destroyed targets and therefore it is capable of distinguishing destroyed targets from functioning ones. Initially it was planned to ensure the capability of intercepting two targets in one attack, but the firm succeeded in ensuring the intercept of four targets. This opens up the prospect of sharply reducing the time a combat aircraft is present in an air defense engagement envelope by executing a salvo launch of guided missiles with their separation to different targets.

Similar research is being performed by Honeywell under contract with the U.S. Army. The firm is attempting to reduce the length of time a helicopter spends in the danger zone by using an on-board ATR (Automatic Target Recognizer) system. In this system the target search is performed by a thermal imaging or television sensor in accordance with a predetermined search

scheme. Target acquisition and recognition are performed by a processor based on results from processing data coming from sensors and comparing the data with a data bank. The processor ensures recognition of potential targets among detected objects and performs their classification (tank, motor vehicle, air defense equipment and so on). At the processor's command a servodevice generates symbolics showing target priority on the display. At any point in the search process any crew member can take control and make necessary corrections to the system's operation. After recognition of targets the crew makes the decision to open fire against a selected object or to take cover. While a maneuver is being executed the ATR system keeps track of a change in the target's bearing and quickly updates its location after the helicopter makes another attack. This permits the crew to open fire immediately after the helicopter breaks cover and to engage several of the most important targets in one attack.

Boeing is conducting demonstration flight tests of a target recognition radar operating in the millimeter band on the UH-1B helicopter. The system recognizes certain kinds of military equipment—tanks, APC's, trucks—according to radar signs. Data on them is shown on a display in the helicopter cabin. Western specialists assume that guidance systems capable of recognizing such important targets as airfields or bridges can be developed above all for the "intelligent" long-range air-to-surface weapon being created under the second variant of the structural scheme. It was reported in particular that under laboratory conditions Hughes achieved computer recognition of the images of airfields obtained both by optical means and by a radar operating in a synthetic aperture mode. They established that recognizing an airfield requires around a quarter-million cells for one image. The firm planned to flight-test an experimental recognition system in 1987. It is presumed that the combat recognition system will be programmed on the flight line or even in flight prior to missile launch. For this it is planned to use a light beam passing along the image of the target intended for engagement.

Since 1986 the United States has been researching the possibility of creating an autonomous cruise missile known as the AAV (Automatic Air Vehicle), which is to perform an independent search of given targets and engage them with homing cluster munitions. To execute the combat mission the missile processor must be programmed in such a way that after execution of one mission the guidance system can shift to another (with consideration of the situation at hand).

In early 1987 the U.S. Department of the Army issued Lockheed a contract for designing, developing and conducting demonstration tests of a drone capable of acquiring and recognizing targets, classifying them according to importance, making a decision and conducting an attack without operator participation. Hughes is attempting to give guidance systems for long-range antiship missiles a capability not only of recognizing and intercepting the

most important targets after launch, but also selecting the most vulnerable places to hit on ships.

The above indicates that the United States is intensively unfolding work of creating an "intelligent" aircraft air-to-surface weapon. The Pentagon is attempting to consolidate the efforts of many firms performing research in this area by directing the research above all at developing prospective technology of artificial intelligence systems and microelectronics as well as at creating corresponding algorithms for processing data from many sensors. Much attention is being given to studying approaches to artificial intelligence with consideration of neurobiological aspects. At the same time an experimental accumulation (data bank) of the recognition signs of different targets when they are observed in different bands of wavelengths is being accomplished. In the opinion of foreign specialists, the first models of an "intelligent" air-to-surface weapon will appear as early as the first half of the 1990's. It is presumed that these will be systems with limited capabilities, capable of recognizing and engaging only specific kinds of targets such as only tanks, airfields or ships. The combat capabilities of such a weapon will increase as the speed of on-board computers increases, as software develops and as the data bank is filled.

#### Footnotes

1. Foreign specialists understand artificial intelligence systems to be systems capable of making decisions independently, without human involvement, under conditions of uncertainty. It is believed that an operator's referral to an artificial intelligence system will permit him to have data similar to that which he could receive from a specialist in the given field of knowledge.

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#### Propfan Engines

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[Article by Col Yu. Alekseyev, candidate of technical sciences]

[Text] Until recently it was believed that the only substantial way to increase the economy of aircraft engines for subsonic flight speeds was to increase their bypass ratio. Studies performed abroad in aerodynamics, structural materials and other fields, however, permitted revising these views and led to the idea of creating propfan engines,<sup>1</sup> work on which has unfolded in practically all leading NATO countries. In the United States for example the National Aeronautics and Space Administration (NASA) is fulfilling an extensive research program to develop and evaluate propfan engines. Such very

large American engine building firms as General Electric, Pratt and Whitney, and Allison are participating. A series of flight tests of propfan engines of several design configurations was conducted in 1987.

A propfan engine with a single forward propfan (Fig. 1 [figure not reproduced]) was tested on a Gulfstream II jet aircraft (empty weight 15,400 kg). An engine nacelle was mounted on the left outboard wing panel. The propfan engine used an Allison 501-M78 gas generator with a power output of 6,000 hp, a propfan 2.75 m in diameter and a reduction gear from the T56-A-14 turboshaft engine (installed on P-3 Orion aircraft), in which output shaft rotational speed is increased from 1,020 to 1,690 rpm. The tests (150 total flying hours) were conducted at altitudes of 1,500-12,000 m and at speeds up to Mach 0.85. A speed of Mach 0.89 was reached in one of the flights in a flat dive mode at an altitude of 8,400 m. The basic purpose of the tests was to evaluate strength characteristics of the propfan blades and noise levels created by the propfan engine. The engine nacelle was mounted at different angles (from 3 degrees upward to 5 degrees downward), which permitted assessing the effect of the incident flow angle on the magnitude of stresses in propfan blades. A measurement of propfan engine operating parameters was performed using more than 600 sensors, including 100 microphones.

To compensate for the static asymmetric load from mounting the nacelle with the propfan engine on the left outboard wing panel, a balancing rod (weighing 950 kg) was accommodated on the right outboard wing panel, and a rod weighing 135 kg was accommodated on the outboard wing panel to compensate for dynamic loads. Protection was provided to the crew and fuselage (only in the initial stage of testing) in case the blades broke by a steel plate 9.5 mm thick weighing 320 kg. Special tests of the aircraft for evaluating cockpit noise levels were planned for the first quarter of 1988.

The foreign press notes that flight tests of the propfan engine on the Gulfstream II aircraft are assessed positively by American specialists. In particular, compared with turbojet bypass engines of equivalent thrust class, specific fuel consumption of the propfan engine was 17 percent less, which corresponds to an absolute fuel economy of 20-25 percent on the flight route of the Gulfstream II aircraft. It is believed that absolute fuel economy can be up to 50 percent on DC-9 and Boeing 727 aircraft.

The firms of Allison and Pratt and Whitney created a more powerful 578-DX demonstrator propfan engine with two rear six-blade, counterrotation propfan engines. Output of the engine is 10,400 hp, output of the planetary reduction gear is 13,000 hp, and the diameter of the propfans is 3.54 m. The propfans are driven by a modified gas generator from the T701 turboshaft engine. It is assumed that this gas generator is suitable for creating a 9,000-16,000 hp propfan engine. The 578-DX engine control system is full authority digital, providing

in particular for control of fuel flow, angle of incidence of compressor stator blades, and pitch of propfan blades. The MD-80 aircraft (take-off weight 63,500 kg; power plant consists of two JT8D-209 turbojet bypass engines each with a static thrust of 8,400 kg mounted on the sides of the fuselage tail section) was chosen for flight tests. It was planned to complete them in the first half of 1988. The program envisages 70 flying hours.

The 578-DX demonstrator engine is designed for maximum flight speeds of Mach 0.8-0.82 and peripheral velocities of the propfan bladetips of up to 230 m/sec. Inasmuch as the blades experience the effect of engine exhaust gases, they are designed for a working temperature of up to 260 degrees Centigrade. For this they are fabricated from composite material with a foam filler in inner cavities. The blade spar is made of aluminum alloy. Blade leading edges have metal overlays for protection against erosion. The series-produced version of the engine will be created based on the design of the experimental model of the 578-DX with six-blade propfans. It is believed that this approach will accelerate engine development.

Tests of another American experimental propfan engine, the General Electric GE36, were conducted by NASA on the Boeing 727-100 (Fig. 2 [figure not reproduced]) and MD-80 aircraft. Twenty-five flights were made on the Boeing 727-100 with a total engine operating time in the air of 42 hours; in addition, its operating time on the ground was 58 hours. During tests of the engine, which has a bench thrust of 11,300 kg-f, a top flight speed of Mach 0.84 and altitude of 11,000 m were achieved. At an altitude of 10,500 m at Mach 0.72 fuel consumption was reduced 47 percent in comparison with the aircraft's standard JT8D-17R engine.

A feature of the GE36 is considered to be the absence of a reduction gear and the presence of protection against overspeeding, thanks to which an automatic increase in blade pitch is ensured in case of a loss of engine control. The propfan blades (2x8) are made of carbon-fiber-reinforced composite material and their leading edges are made of nickel alloy. No blade breaks were noted during collision tests with foreign objects (four birds weighing 0.68 kg each, two weighing 1.81 kg each, and a tire fragment).

After completion of tests on the Boeing 727-100 aircraft the GE36 engine was removed and further testing took place on the MD-80 aircraft at Edwards Air Force Base in California. The firm made certain changes to the engine design; in particular, a new gas generator was used. The principal objectives of the tests were to evaluate the fatigue strength of propfans under acoustic loads, thrust characteristics, specific fuel consumption, the automatic starter for starting the engine in the air after shutting down and feathering the propfans, and thrust reversal (on the ground).

In the first series of flight tests 20 flights were made with a total of around 40 flying hours. Then a new ten-blade propfan was installed in the engine and a second series of tests conducted. A total of 35 flights were made in both series with a total of 70 flying hours. During the tests it was noted that the ten-blade propfan provided a 3 db reduction in the engine noise level.

Judging from foreign press reports, General Electric has decided to develop a series-produced propfan engine in the 9,500-11,300 kg-f thrust class with a gas generator of lesser size (compared with the experimental model of the GE36 engine) and new propfans (a possible version consists of 12 and 10 blades).

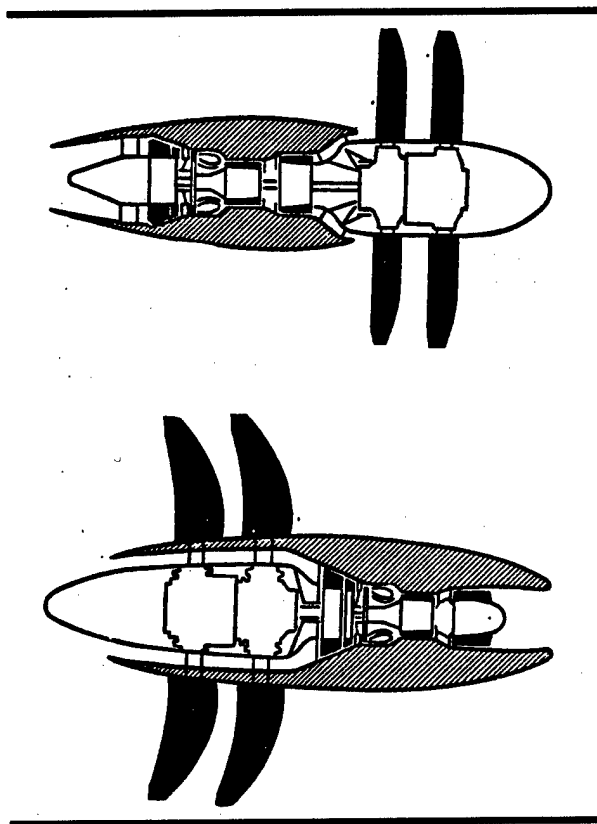
Practical development of propfan engines has begun in Great Britain. In particular, Rolls Royce is carrying out a demonstrator technological program envisaging creation of a propfan engine by the mid-1990's. The designs of two engines with counterrotation propfans are being developed: RB.509-11 and RB.509-14 with rear and forward placement of the propfans respectively (Fig. 3). Both engines are geared. British experts believe that the use of a propfan engine with a thrust of 6,800-11,300 kg-f on the aircraft is economically justified. Like the United States, Great Britain is using the technology of military aircraft engines in creating a propfan engine. For example, use of the gas generator of the XG-40 engine is possible in the RB.509, and an engine is being developed for the prospective European EFA fighter based on the XG-40.

The boom in the area of creating propfan engines urged on developers of turbojet bypass engines. Statements appeared in the western press that it was possible to create more economic turbojet bypass engines (compared with the propfan engines) by a sharp increase in the bypass ratio of up to 35-40 (in modern turbojet bypass engines it is 6-8).

A polarization of developers' views on questions of the possible areas of use is seen right in the initial stage of creating propfan engines. For example, despite joint development of the 578-DX engine, the American firms of Pratt and Whitney and Allison have different end objectives: the former is oriented toward the civilian area of using propfan engines and the latter toward the military area. The United States is considering aircraft of different types, from a prospective land-based patrol aircraft to heavy transport aircraft, as possible areas of military use of propfan engines. At the present time the possibility of using propfan engines as power plants for cruise missiles also is being studied. Foreign specialists assume that propfan engines will be able to provide a substantial reduction in specific fuel consumption and consequently an increase in the range of fire of such missiles.

Initiative research in this area is being performed in particular by the American firms of McDonnell Douglas and Boeing. The former rested its choice on the Allison

**Fig. 3. Design configurations of the Rolls Royce RB.509-11 (top) and RB.509-14 propfan engines**



propfan engine with two geared-drive counterrotation propfans with folding blades. The engine itself will be accommodated in the missile tail section. It is believed that Allison will be able to develop a propfan engine for cruise missiles in the first half of the 1990's.

#### Footnotes

1. For more detail about the initial stage of work on propfan engines see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 4, 1986, pp 40-44—Ed.

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**The Northeast Atlantic in NATO Plans**  
18010303k Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 49-53

[Article by Capt 1st Rank Yu. Galkin]

[Text] Today's world situation as well as the nature of measures being taken to strengthen the NATO Allied Armed Forces clearly demonstrate the desire of the bloc military-political leadership to achieve military superiority over the USSR and the Warsaw Pact Organization.

An important place in these aggressive plans is set aside for naval forces, with the "forward positions" concept the basis of their tactical employment. This concept envisages deploying in advance (or preemptively deploying) and concentrating major naval force groupings of the United States and its allies in forward ocean areas, preventing the Soviet Union's Navy from deploying, and seizing and holding the initiative from the very beginning of combat operations in areas immediately adjoining the USSR's borders.

The foreign press notes that in the initial period of a war a major role will be played by the Northeast Atlantic, in which NATO specialists include the northeastern part of the Atlantic Ocean proper as well as the Norwegian and Greenland seas, the northern part of the North Sea and the western part of the Barents Sea. It is believed that not winning supremacy in the Northeast Atlantic will hamper combat operations in the Central Europe Sector and will threaten NATO's northern flank and lines of communication [LOC] between the North American continent and Western Europe, over which reserves will be moved from overseas.

Foreign experts believe that the **military-strategic importance of the Northeast Atlantic** is determined by the fact that its waters are the gates for Atlantic deployment of enemy warships, which will create a serious threat to transatlantic routes between the North American continent and Europe; this can considerably affect the course and outcome of combat operations in the European theater of war. Combat patrol areas of U.S., UK and French SSBN's are situated in the Northeast Atlantic. From here it is planned to deliver strikes against important targets of military and economic potential of the Soviet Union and other countries of the socialist community by deck-based aircraft and sea-launched cruise missiles.

In recent years this area acquired great importance because of the presence of considerable oil and natural gas reserves in the North and Norwegian seas, which is of substantial importance for the military-industrial potential of bloc member countries. According to experts' evaluations, identified oil reserves were over 2.8 trillion tons as of the end of 1987. Therefore the problem of protecting oil and gas development arises in case a crisis situation emerges.

In peacetime the presence of naval forces of NATO countries in the Northeast Atlantic is ensured by constant patrols by SSBN's of the United States, Great Britain and France as well as by the presence of multi-purpose nuclear-powered and diesel submarines in this area. Orion (United States and Norway), Nimrod (UK) and Atlantic (FRG and France) land-based patrol aircraft make regular flights around this water area. In addition, ships of the permanent NATO naval force in the Atlantic practice combat training missions in the Norwegian and North seas. The SOSUS long-range sonar surveillance system which functions here monitors most of the Norwegian Sea. It includes shore sonars and



hydrophones placed on the ocean floor and seabeds. Data from this system are used for vectoring land-based patrol aircraft, submarines and surface combatants to detected enemy submarines. Patrolling by special STALWART-Class sonar surveillance ships equipped with the SURTASS towed long-range sonar acquisition system is organized to increase the likelihood of detecting submarines in zones of low SOSUS system effectiveness. Judging from foreign press materials, these ships are capable of performing direction-finding against noise-emitting underwater objects at distances of around 550 km and classifying submarines at a distance up to 140 km.

The question is being considered of deploying a task force of NATO ships in waters of the Northeast Atlantic on the Greenland-Iceland-British Isles line on a permanent basis with the mission of preventing Soviet submarines from crossing the line with the onset of combat operations. The need for establishing such a force in peacetime is substantiated by the fact that with the emergence of a crisis situation the U.S. Navy combatant ships which will be the basis of the force will be able to arrive in this part of the Northeast Atlantic only after several days.

The foreign press notes that in a threat period it is planned to deploy a powerful naval force in the Northeast Atlantic which includes around 150 combatant ships and up to 400 combat aircraft and helicopters from naval forces of the United States, Denmark, Great Britain, the FRG, Norway and the Netherlands (see figure [figure not reproduced]), and in some cases France as well. It is planned to form a NATO striking fleet from them: up to three carrier striking forces, at least two carrier hunter-killer forces, and a missile striking force. They will be supported by 4-5 ship hunter-killer forces, land-based patrol aircraft, as well as continental air defense personnel and equipment.

The NATO command believes that in wartime naval forces deployed in this area must accomplish the following primary missions: winning sea supremacy and air superiority; giving close air and ship fire support to ground forces in the Northern Europe Sector; conducting amphibious landing operations in North and Central Norway; and protecting sea and ocean LOC with the objective of carrying out uninterrupted movement of reinforcements, arms, and other military and economic cargoes. Lately great importance has been attached to protecting oil and gas complexes in the North and Norwegian seas; organization of this protection is a component element of general plans for combat employment of bloc allied naval forces to win supremacy in the Northeast Atlantic.

NATO specialists believe that the primary mission of allied naval forces in the initial period of a war will be *winning supremacy* in the Northeast Atlantic by destroying enemy naval forces and above all submarines, and preventing the deployment of his combatant ships from naval bases and basing facilities. This mission will be

accomplished by integrated employment of deck-based aircraft, ship striking forces, land-based aviation and other forces, and by the delivery of massed missile and bombing strikes by aviation and ships of NATO's striking fleet against ship forces, bases, command and control and communications system facilities, depots, arsenals and other targets.

*Antisubmarine warfare* is considered one of the most important kinds of operations (combat operations) in this part of the Atlantic. It includes hunting and destroying submarines at exits from bases, on deployment routes (on the sea transit), and in combat patrol areas.

Western specialists believe antisubmarine operations will unfold basically on antisubmarine barriers in the Barents and Norwegian seas: North Cape-Bear Island; Greenland-Iceland-Faeroes and Shetland Islands-Norwegian coast. The NATO command plans to deploy a powerful grouping of antisubmarine forces on the barriers. Laying minefields also is envisaged here. Submarines, surface combatants and land-based patrol aircraft can be used for this purpose, and in recent years American strategic B-52 bombers practiced minelaying during NATO allied naval force exercises. The Mk 60 Captor is the most modern American antisubmarine mine. It can be used at depths to 800 m and its payload is a small Mk 46 Mod 4 torpedo. It is planned to lay minefields 1-3 days before the beginning of combat operations to disrupt the deployment of submarines into the Atlantic.

To improve the effectiveness of antisubmarine warfare, antisubmarine ships of navies of the United States, Great Britain and France are equipped with sonar with long towed arrays. A trend has been seen in recent years to form mixed ship hunter-killer forces (one or two ships with keel-mounted sonar and one or two equipped with sonar with long towed arrays). Up to four ships with sonar with long towed arrays can be included in a carrier hunter-killer force.

In the assessment of foreign specialists, the principal role in *warfare against surface combatant forces* of the probable enemy in accomplishing the mission of winning sea supremacy will be played by a carrier striking force included in the NATO striking fleet in the Atlantic. The carrier striking force can include up to four American multipurpose and one or two British antisubmarine carriers, over 40 escort ships, and 360-380 combat aircraft, including around 160 nuclear weapon platforms. In addition, an amphibious landing force and support forces as well as other forces will be formed in the striking fleet for accomplishing specific missions. The water area of the Norwegian and North seas represents the principal maneuver areas of the striking fleet's main forces. The striking fleet will conduct combat operations together with land-based patrol aircraft, land-based tactical aircraft, NATO allied naval ship forces, as well as E-3 early warning and control aircraft of the NATO AWACS Command.



Deck-based attack aircraft are an important means of conducting naval combat operations. As a rule up to 70 percent of sorties are used for engaging mixed enemy forces, of which 50 percent are for delivering strikes against ships at sea and 20 percent for supporting basic defense of the carrier force. In delivering strikes against surface combatants deck-based aircraft operate at a distance of 500-600 km from the carriers. It is planned to deliver strikes against lone ships (surface targets) by groups of deck-based A-7E Corsair, A-6E Intruder and F/A-18 Hornet deck-based attack aircraft (3-4 aircraft in a group) under cover of 2-3 fighter aircraft. E-3, E-2C Hawkeye and Shackleton early warning and control aircraft are used for vectoring the attack forces. The latter number increases when delivering strikes against group naval surface targets. This is dictated by capabilities of enemy air defense and is around 20 aircraft, of which half are attack aircraft. Strikes are delivered from one or more directions using antiship missiles, aerial bombs and machinegun-cannon armament. In order to disorganize the air defense of ship forces and divert its active resources into dummy sectors it is a wide practice to use decoy groups (3-6 attack aircraft) as well as the penetration and neutralization of air defense weapons (up to eight aircraft), which substantially increases the likelihood that the primary groups will penetrate to the strike targets and destroy them. In exercises deck-based aircraft operate basically in hours of daylight, flying an average of two sorties daily.

The ship striking force is the basic combat formation for winning supremacy in a limited sea area. It is made up of around six ships armed with antiship missiles with a range capability of up to 130 km. The striking force can include a guided missile cruiser, 2-3 guided missile destroyers and frigates (see insert [color insert not reproduced]), and several destroyers and frigates. It advances to threatened sectors at a distance of up to 200-250 nm from the carrier. The ship striking force can be vectored and target designations given in firing antiship missiles not only from its own acquisition resources, but also from data of external sources.

Lately the delivery of strikes against enemy striking forces in the Norwegian Sea has been widely practiced by tactical and strategic aircraft armed with antiship missiles. Strike forces of 4-8 aircraft were formed during exercises for destroying enemy surface combatants or a convoy, and a group of two aircraft was formed for delivering a strike against a lone target.

One mission of the NATO allied naval force deployed in the Northeast Atlantic is to give *close air and ship fire support* to the grouping of ground forces operating in Central and Northern Norway. The NATO command plans to accomplish it only after winning supremacy in that sea area. Both surface combatants which are part of task forces and forces with various missions as well as submarines with cruise missiles, naval aviation, and marine forces are employed for this purpose. The role of

combatant ships has grown especially of late in connection with their being armed with Tomahawk cruise missiles. For example, a number of NATO allied naval force exercises practice problems of employing new ship formations—missile striking forces—in the Norwegian and North seas. Each such force can include up to five combatant ships: an IOWA-Class battleship armed with Tomahawk cruise missiles, one or two guided missile cruisers, and several destroyers and frigates, including guided missile ships. Foreign specialists note that the missile striking force will be capable of providing effective support to ground forces in coastal sectors not only by delivering precision missile strikes against important shore targets, but also by employing ship guns.

Judging from foreign press materials, it is possible that up to two missile striking forces will be deployed in the Northeast Atlantic, with their operating areas being the Norwegian and North seas. Deck-based aircraft of carrier striking forces deployed in the North and Norwegian seas are an effective means of support to ground forces in the Northern Europe Sector. In accomplishing this mission carriers usually maneuver at a distance of up to 150 nm offshore, launching deck-based aircraft in groups of 4-12. In order to increase the depth of action of carrier-based aircraft against shore targets, the combat employment areas of carriers will be brought closer to the coastlines at a distance of 50-100 nm, if the situation is favorable. In some cases aerial refueling of the aircraft is planned, particularly for delivering strikes against second echelons and advancing reserves of enemy troops; this will permit increasing the tactical operating radius of deck-based aircraft by 1.5-2 times.

Attack aircraft are used in individual groups (an aircraft detail for one day is 4-6 attack aircraft) in giving support with conventional weapons. The store of conventional weapons aboard a carrier supports up to ten sorties for each organic aircraft without replenishment. Deck-based attack aircraft deliver strikes chiefly in hours of daylight. The take-off of aircraft essentially ceases with a wind force of 8-9 and sea state of 7. Depending on the situation and assigned mission, carrier-based aircraft can operate in groups of 4-22 from each carrier. Large groups (25-40 aircraft) are employed rarely and only for delivering strikes against the most important targets.

*Amphibious landing operations* are possible in the interests of supporting ground troops in the Northern Europe Sector. It is planned to use an American and an Anglo-Dutch Marine brigade in them. Movement of a U.S. Marine expeditionary brigade from the 2d Expeditionary Division is planned aboard landing ships of the striking fleet's amphibious landing force. Weapons and combat equipment are stockpiled in advance on that country's territory to shorten movement time from the United States to Northern Norway.

Up to 12 landing ships and vessels including 2-3 amphibious assault ships and helicopter assault carriers can be activated to deliver a U.S. Marine expeditionary brigade

to Northern Norway. The air group of the Marine expeditionary brigade (up to 150 aircraft and helicopters) will fly to air bases of Northern and Central Norway independently. From these airfields they can give support to Marine forces during a landing both in Northern Norway and in the Baltic Strait zone. The Royal Marines (two battalions and reinforcing units from the 3d Marine Brigade) and the Dutch Marines (1st Amphibious Combat Group) can be moved to the combat mission area aboard 5-6 British landing ships.

The primary role of Marine forces on NATO's northern flank is to reinforce the bloc ground force grouping, capture and defend important areas and sectors, and provide antilanding defense of a seacoast. In addition, Marine subunits can be employed in a favorable situation for exploiting success of offensive operations by ground forces.

The success of combat operations in the European theater of war will depend largely on the timely movement of reinforcements from the United States and Canada. It is planned to use a carrier hunter-killer force, submarines, as well as tactical and land-based patrol aircraft for *defense of ocean and sea LOC*. A defended zone of sea LOC<sup>1</sup> will be the most likely method of protecting LOC in the Northeast Atlantic. The escorting of convoys in the North and Norwegian seas is organized on a regional principle where responsibility for safety of shipping rests with zonal commands of the NATO allied naval forces. Antisubmarine and antiaircraft defense of convoys is accomplished by close escort ships, land-based patrol aircraft, as well as coastal air defense resources.

In addition to conventional convoy escort methods, the "overflow" method, which reduces the effectiveness of enemy air action against vessels and permits freeing up a portion of close escort forces for accomplishing other missions, also is considered effective in the Norwegian Sea with its numerous fjords.

Mine countermeasures support of convoys includes sweeping the water area of ports, anchorages and convoy assembly areas as well as providing immediate escort by minesweeping groups (2-5 minesweepers) behind sweeps in dangerous areas. Minesweepers in the groups ordinarily operate in a quarter line of bearing at a distance of 0.1 nm from each other. Distance between groups is around 3 nm. Sweeping is accomplished at a speed up to 6 knots.

In realizing requirements of the "forward positions" concept, the NATO command reinforced attention to practical use of allied naval forces in the Northeast Atlantic; it considers the winning of supremacy in the initial period of a war in this area to be the deciding condition for attaining strategic objectives in the Atlantic Ocean theater and European theater of war. It is planned to concentrate basic efforts on bottling up and defeating the enemy in the Norwegian Sea, ensuring

combat stability of friendly SSBN's, and ensuring uninterrupted functioning of ocean and sea LOC in the Atlantic.

#### Footnotes

1. For more details on convoy protection in the Atlantic see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 11, 1985, pp 57-64—Ed.

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#### Ship Data Multiplex Links

180103031 Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 54-61

[Article by Capt 2d Rank B. Poyarkov]

[Text] The command authorities of naval forces of the United States and other NATO countries are devoting much attention to developing fundamentally new approaches to the organization of data exchange aboard ships. This is objectively determined by the trend toward integrating electronics and ship technical equipment. In the opinion of foreign specialists, the greatest gain is achieved here by integrating all ship resources (sensors) for collecting (radars, sonars and so on) and processing data in an integrated on-board automated combat control system (ASBU) based on a local computer network. Missile and other weapons are consolidated in a ship system for weapon control and missile storage and launch.

The Aegis multifunction weapon system being installed aboard "Ticonderoga"-Class guided missile cruisers and "Arleigh Burke"-Class guided missile destroyers can serve as an example of the integration of all of a ship's technical resources. In it all ship equipment and weapons are consolidated not only organizationally, as on the majority of preceding ship classes, but also with the help of special technical resources providing any subsystem (component or user) of the system with a fundamental capability of access to all necessary data of the ship's internal data flow. Such technical resources include ship data multiplex links.

Ship data links are various special cables over which only "their own" signals, which are specific for the interworking devices, are transmitted from one device to another. The structure of connections of existing internal ship communication links is organized according to a "point-to-point" arrangement. It has a number of serious inherent deficiencies, the chief ones being the great length and weight of cable lines as well as their relatively low survivability. In particular, following modernization of the nuclear-powered guided missile cruiser "Bainbridge," the overall length and weight of cable lines reached 600 km and 300 tons respectively (including all necessary auxiliary equipment such as cross-connectors

and interface connectors, distribution boxes, fasteners and so on) and 70-75 percent of the cables are data cable routes, which increases the cost of building modern ships. In the assessment of foreign specialists, expenses for running one running meter of cable on a ship are continuously increasing; at the present time they have reached approximately \$120 counting the cost of design, documentation, and installation work, and checking and adjustment work. In addition, the use of unproductive manual labor in running cable routes increases the time periods for building a ship.

The low survivability of ship subsystems linked by cable lines is explained by the fact that cables run (Fig. 1 [figure not reproduced]) through a considerable part of the space inside the hull. This predetermines the high likelihood of mechanical damage to cable routes from accidents and in combat. It is very difficult to locate and restore damaged cable sections, especially under combat conditions, inasmuch as they usually run in places in the ship difficult of access and pass through those compartments and spaces which might be flooded, heavily smoke-filled, or to which access is entirely lacking. In addition, it is noted that cable lines are backed up on a very limited basis so as not to increase the overall length and weight of cables. The need for multiple passage through watertight bulkheads in running cable routes also noticeably reduces a ship's survivability.

The foreign press attests that organizing a ship's internal data exchange on a "point-to-point" links arrangement extremely complicates standardization and unification of on-board equipment, makes it practically impossible to realize the concept of building electronics from functionally independent modules, and becomes a serious obstacle in the path toward ever greater integration of ship weapons and technical resources into a unified multifunctional system.

One of the first shipboard data multiplex links in the U.S. Navy in which basic deficiencies of traditional cables were successfully overcome is the SDMS (Shipboard Data Multiplex System) link. Its creation began in 1974, and by 1984 a pre-series model, the AN/USQ-82(V), was developed and recently underwent testing.

The SDMS link functions together with various ship subsystems and devices, including the multifunctional automated combat control system operator consoles, recording sensors, radars and sonars, launchers and so on. The modular nature of its construction permits varying the make-up of subsystems in satisfying various requirements placed on the principal types of surface combatants (from frigate to carrier).

The link (Fig. 2) can include from two to five buses made of coaxial cable which back up each other and run in various places of the ship's hull. The buses can be armored for their entire length to increase survivability. Data input/output [I/O] points can be accommodated in

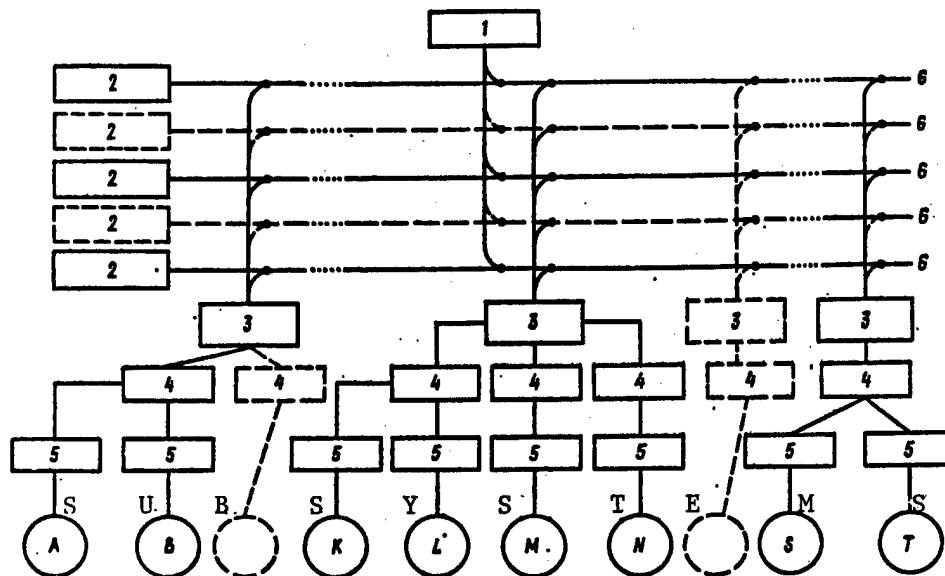
various sectors of the bus. Therefore the buses are run in accordance with a predetermined scheme before ship subsystems are installed.

In addition to buses, the SDMS link includes a diagnostics unit (Fig. 3 [figure not reproduced]), message commutators or exchange control devices (UUO), area multiplexing equipment (RAU, Fig. 4 [figure not reproduced]) units, peripheral multiplexing equipment (PAU, Fig. 5 [figure not reproduced]) units, as well as I/O devices (UVV) containing a set of interface modules (MI) for receiving and transmitting signals of varying kinds from user equipment.

In transmitting data from devices of subsystem N to subsystem S initially there is an exchange of service messages about readiness for data exchange. Various data go from the source through the I/O device interface modules (Fig. 6) to the peripheral multiplexing equipment for time multiplexing of signals, with their conversion into the standard digital form of the SDMS link. Then the signals are relayed from the peripheral multiplexing equipment to the area multiplexing equipment for the purpose of frequency multiplexing, after which they are transmitted over one of the bus channels in the 40-80 MHz band. Switching of the area multiplexing equipment to one of four frequency channels (there is also a fifth—service—channel) is done with the help of the exchange control device. As a result of the conversions, data (signals) from subsystem N in the form of coded messages with a destination address reach the equipment on the receiving end over the bus, where they are decoded before going to subsystem S.

In the general case there are two basic methods of data exchange control (UOD) in multiplex links: centralized and decentralized. The so-called "partially decentralized method of data exchange control" is realized in the SDMS link with retention of a central data exchange control device for determining a free channel in the bus and presenting it to a subscriber. In the first method the entire collection of exchange rules and procedures is concentrated in one central control device; in the second method the rules and procedures are distributed among various equipment of the shipboard data multiplex links. Such equipment in the SDMS link consists of the exchange control device and peripheral multiplexing equipment. The latter is executed on microprocessors and has a programmable ROM, where the set of rules and procedures for exchange among subscribers is contained in coded form: addresses of data sources and receivers, their priorities, data on time delays necessary for matching signal rates in subsystems and in the bus, message sizes and so on. To select or change a bus communication channel between two SDMS link subscribers (subsystems), it is sufficient to input (particularly from the control console) necessary data to the appropriate programmable ROM file. This achieves great flexibility in using shipboard data multiplex links.

Fig. 2. Variant of structuring SDMS link elements and subsystems interworking with the link

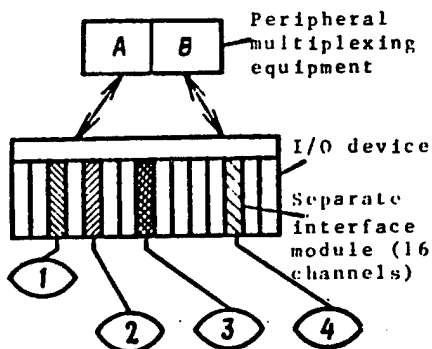


Key:

- 1. Diagnostics unit
- 2. Exchange control devices
- 3. Area multiplexing equipment

- 4. Peripheral multiplexing equipment
- 5. Input/output devices with interface modules
- 6. Buses

Fig. 6. General diagram of the passage of SDMS link subsystem signals to peripheral multiplexing equipment through the I/O device with interface modules



Key:

- 1. Discrete signals
- 2. Analog signals
- 3. Synchronous signals
- 4. Digital signals

The SDMS link is asynchronous and, as the foreign press notes, this meets requirements of a data exchange aboard ship. Asynchronism lies in the fact that transmission of service instructions and information data is accomplished independently over separate channels. In addition, asynchronous time-division switching is used in which, after one subscriber completes a data exchange session, the freed-up bus channel is transferred to the use of another subscriber for the full time of the exchange

session. The process of control over bus channel switching is realized on the basis of a survey of subscribers as to their priority (the so-called "roll call" arrangement). A decentralized data exchange control in data multiplex links permits quickly building up the make-up of subscribers (subsystems) of the shipboard data multiplex link without its fundamental restructuring during modernizations and provides high survivability of the shipboard automated combat control system inasmuch as a malfunction of one link element does not disrupt functioning of the system as a whole.

The SDMS link also can perform the functions of various distribution panels and control consoles, including controlling the distribution of electrical power among users, protecting against overload, monitoring electrical parameters, functional switching, accomplishing logic delays, and converting angular values (for example, relative bearing, the ship's rolling and pitching angles) into standard digital form. The following indicator panels are used as SDMS link subsystems for these purposes: power distribution control; user disconnect and overload protection; status monitoring of electrical parameters and the position of switches; functional and digital switching and so on.

As an example let us examine the user disconnect and overload protection indicator panel. It can be mounted in a special box (structurally combined with the I/O device) which also accommodates logic delay circuits on solid-state components for switchings involving power

distribution, as well as small dc sources. The panel itself has up to five detachable sections with rotary selector switches, two-position switches and indicator lights. Using a two-position switch, the operator can connect a circuit of the appropriate line of fuses for a test; fuse serviceability is tested by successively placing the rotary selector switch in the necessary positions. An indicator light goes on if a fuse has blown, and the operator replaces the necessary fuse.

Distribution panels and control consoles are traditional components of the equipment of conventional cable routes. They provide for restructuring (reconfiguring) communication links between subsystems in case of a change in work modes, cable damage, a transfer of devices into testing and simulation or operator training modes, and joint use of peripheral instruments. For example, an analysis of switchings performed during combat work aboard a "Spruance"-Class destroyer showed that 79 of 161 panels with switches on the control console (6.3x1.8x0.9 m in size) accomplished the switching of data communication links. A total of hundreds of switchings for changing the signal routing are performed for realizing just one functional switching connected with a change in the nature of combat work of the subsystem being served. This requires up to ten 50-position switches capable of switching 450 communication links. A similar result also can be achieved with the help of miniature unidirectional multiposition switches (Fig. 7 [figure not reproduced]) being used in the SDMS link. Such switches are located on the functional and digital switching indicator panel mounted on the outside of a special I/O device for changing the switching of signals. Foreign specialists note that use of an SDMS link with such miniature switches aboard a "Spruance"-Class destroyer will permit reducing the number of data switching panels by more than threefold (from 79 to 24).

One of the main objectives in adopting shipboard data multiplex links and automating shipboard systems is considered to be a reduction in the number of personnel for servicing various equipment. For example, automating the power plant control station leads to the need to install a considerable number of testing and measuring instruments (KIP) and cable communication links on it to provide necessary data to the power plant and control station (PEZh). Within the framework of the traditional approach, a cable is run for each testing and measuring instrument, over which data go to the power plant and control station. In the majority of cases signals are transmitted over them only when there is a deviation from normal functioning conditions. Consequently these cables are not used for the greater part of the time and together with auxiliary equipment contribute to an unjustified increase in the ship's displacement. U.S. Navy specialists note that the number of testing and measuring instrument cables was cut in half and the number of power distribution control cables was cut by 25 percent thanks to the use of the SDMS link aboard "Spruance"-Class destroyers.

Use of the SDMS link will allow a considerable expansion in the capabilities of ship subsystems, including continuously and automatically measuring and displaying noise and vibration levels of various machinery and devices, data on pressures, temperatures and water level in boilers, and the position of various valves; distributing data for monitoring continuity of service; supporting the interworking of control and display consoles, and consoles for accounting for and using spare tools and instruments; simplifying functional switchings for reconfiguring the structure of ship subsystems; carrying out remote functioning checks of equipment; troubleshooting, localizing troubles, and issuing recommendations for remedying them; automatically checking the combat readiness of subsystems; and conducting training exercises on combat equipment with the simulation of actual combat work conditions.

A pair of special buses, one of which is a microprocessor, has been mounted in the I/O device for receiving, processing and displaying data on machinery noise levels. It performs the functions of a frequency spectrum analyzer. Each pair of noise interface modules (MISh) of such an I/O device is capable of receiving up to 32 signals from various sensors (accelerometers or hydrophones). Accelerometers can be positioned on the hull and on machinery most subject to vibrations, and signals from them will go to the nearest I/O device from the noise interface module and further to any display or recording device of various subsystems served by the SDMS link.

Elaboration of the idea of multiplexing signals and transmitting them in a serial digital code over an integrated shipboard bus appeared in the development of the SDB SHINPADS data link by the American firm of Sperry Univac on order from the Canadian Navy. It has a transmission rate in the bus of 10 megabits per second, in accordance with requirements of the new NATO military standard MIL-STD-1397, and the SDMS multiplex link was developed with a transmission rate of 1-3 megabits per second according to the STANAG-4156 standard. In the developers' opinion, the higher rate (speed) of the SDB SHINPADS link will permit supporting a data exchange among computers of the ship computer network (KVS) in real time. The number of mini-computers, microcomputers and microprocessors in the shipboard computer system can be 100 units or more with the help of the shipboard data multiplex links. Initial results of simulating a distributed ship computer network for a type frigate showed that the average load in transmitting data in the bus (the bus of the SDB SHINPADS link also has a special channel for exchange control) does not exceed 2.2 megabits per second. This indicates that link speed is more than four times the average load of a data exchange in a type frigate's automated combat control system, which may permit solving the problem of transmitting data in real time. With such an excess the likelihood of the appearance of queuing from one message in the link as a result of the bus being busy is close to zero. During further simulation the load values in a distributed ship computer network

varied from 3.5 to 4.7 megabits per second, but the necessary data processing modes were supported even under these conditions.

Despite the widespread opinion abroad that the most promising method of data transmission in a shipboard automated combat control system with distributed processing in the future will be multiplexing with the help of a global bus and its varieties, some American specialists believe that a high-speed shipboard link also can be created on the basis of other engineering solutions. From the standpoint of ensuring maximum data transmission effectiveness, a global bus collectively used by many has greater advantages in comparison with other methods. But along with the merits, shipboard data multiplex links have a number of deficiencies, above all organizational difficulties in the course of development and creation. First of all, their wide use in the automated combat control system depends on effectiveness of measures being taken to standardize data processing equipment in the military sphere. This requires adoption of a standard computer unified at the NATO bloc level, peripherals and multifunctional panels of the same type, standard interface modules for aligning user equipment with the bus, and also the use of unified military standards defining data exchange control protocols in the bus and its basic characteristics. Secondly, it is necessary to develop fundamentally new software for the computer network of shipboard automated combat control systems inasmuch as each of the computers must have its own operating subsystem for processing and accomplishing not only tasks "organic" to it, but also tasks in the interests of the entire ship computer network. In view of the fact that manual labor basically is used in developing software, the use of a bus organization of interconnection in shipboard automated combat control systems involves great additional inputs and an increase in the time periods for their creation and adoption.

Meanwhile, in the opinion of some foreign computer equipment experts, there is also another sufficiently effective method of organizing interconnection in prospective automated combat control systems on the basis of the SITACS switching network (KS). The network consists of a set of transceiver switching elements (KE) executed on the basis of microprocessors and exclusive paths. Exclusive paths are communication links providing a "user-switching element" and "switching element-switching element" type paired connection. Collective paths (such as a global bus) are characterized by the connection of all users served by them. Switching networks perform an immediate physical connection between data sources and receivers aboard ship according to the principle of channel switching. There are switching elements of two types in the network. The first are intended for connecting users to the network. Each of them is capable of supporting the passage of data from 16 different subscribers to switching elements of the second type. The second ones serve for relaying data and for switching exclusive paths within the network and also have 16 inputs and outputs. The overall maximum

number of switching elements in a switching network is limited to 64 and is determined only by the word size of the address part of service messages (SS), but that number of switching elements is capable of supporting interworking among a sufficiently large number of subscribers.

In the waiting mode there is a continuous exchange of brief service messages among data sources and receivers in the network. They indicate the readiness of a receiver or source to receive or transmit data and the serviceability of network equipment. If a need should arise to transmit data, a source sends a service message into the network with an instruction to form a communication channel with the appropriate receiver. Indirect addressing of the receiver occurs here, i.e., only the data file where the source's true (direct) address can be found is indicated. This usually is done to preclude error in forming a communication channel; for example, so that data from a radar do not go to a power plant control circuit. Operations to translate an indirect address into a direct address preclude such errors. After translating the indirect address, the first switching element connected with the user begins to search for an alternative route for transmitting the service message in the direction of the source with the help of a specially developed logic. The search begins with a check of the shortest path—the path consisting of the least number of switching elements. If the nearest switching element of this path is busy, the possibility of transmitting the service message over other routes is considered, i.e., a dynamic reconfiguration (restructuring) of the network structure is carried out. After the transmission channel has been formed, i.e., a route has been found consisting of free (serviceable) switching elements and exclusive paths linking them, the service message reaches the data receiver. In response the receiver issues a message about its readiness for receiving, and a data transmission session begins. After receiving all data the receiver again issues a message about its readiness (for the next reception), the channel is broken up, and freed-up elements shift to a waiting mode.

The described mechanism of data transmission in a switching network best supports realization of interworking of subscribers in the automated combat control system according to the "from one to one" scheme. Another frequently required scheme of interworking, "from one to all" or "from all to one," is realized in the switching network with considerable difficulties. Foreign specialists assume that an optimum combination of these schemes is achievable by combining the merits of the global bus and switching network. The principal advantages of the SITACS network over multiplex links based on a global bus reduce to the following: capability for broader use of existing software in creating computer systems of prospective automated combat control systems, which contributes to an evolutionary transition to the ship computer network with distributed data processing; and the use of simpler interfaces because of an absence of the need for intermediate data storage before

a communication session. Such storage is mandatory in multiplex links with a global bus.

On the whole, use of the new shipboard communication links will permit consolidating all electronic equipment and other on-board subsystems into a shipboard automated combat control system with fundamentally new qualities: real-time parallel processing of large data flows; full automation of weapon control processes in typical tactical situations; automatic restructuring of the make-up of shipboard subsystems depending on changes in the situation and in missions being accomplished by the ship, and on damage received during combat; provision of data to control stations and battle stations to the requisite level of refinement. In addition, the ship's continuity of service increases and the time periods and cost of building her are reduced.

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#### **Trinity Antiaircraft Gun System**

*18010303m Moscow ZARUBEZHNOYE  
VOYENNOYE OBOZRENIYE in Russian  
No 10, Oct 88 (signed to press 10 Oct 88) pp 61-62*

[Article by Capt 1st Rank V. Nikolayev]

[Text] The Trinity short-range all-weather shipboard antiaircraft gun system developed by the Swedish firm of Bofors<sup>1</sup> is a self-contained gun mounting with an automated control and guidance system. It is intended for engaging modern air attack weapons, and above all low-flying and diving antiship missiles, which are regarded abroad as the chief threat to surface combatants. Development of the gun mounting and ammunition as well as the fire control system was accomplished simultaneously and in coordination by all developers in the process of creating the antiaircraft gun system to obtain optimum performance characteristics of the system as a whole. Special attention was given to attaining the desired fire accuracy. The foreign press notes that in firing against a low-flying attack aircraft (using radar to track the target), the angular dispersion of projectiles is 3 millirads at a distance of 6 km and 1.7 millirads at 2 km, and when firing against an antiship missile using electro-optical tracking equipment it is 1.3 millirads at a distance of 1 km and 1.5 millirads at 2.5 km.

The single-barrel deck-mounted 40-mm gun mounting of the Trinity antiaircraft gun system has a maximum rate of fire of 330 rounds per minute, a range of fire of 12.5 km and a vertical range of 8,700 m. It is compact and of light construction (see figure [figure not reproduced]). Thanks to the wide use of aluminum alloys, its weight does not exceed 3.7 tons. The automatic magazine accommodated on the gun mounting platform holds 100 projectiles, stowed separately in 11 vertical sections. Foreign specialists believe that this unit of fire is sufficient for intercepting 6-12 airborne targets without refilling the magazine, which is done manually. Cabins for the

operator with a combination sight, the tracking radar, and a gyroscopic stabilization unit also are accommodated on the platform. The fire control system computer and power panel are set up in an underdeck space.

The combination sight includes an optical sight and system of electro-optical sensors connected with infrared television gear as well as with a laser rangefinder. The optical sight is stabilized from a gyroscope and equipped with a servocontrolled input/output mirror and brightness amplifier allowing the target to be observed under low-light conditions. A design feature of the combination sight is the presence of one line of sight common to all the sensors mentioned and coinciding with the axis of the optical sight's main light channel. A light flux entering the combination sight window is directed to the brightness amplifier as well as to the TV and IR cameras with the help of two beam splitters mounted in the main light channel. Laser rangefinder pulses emitted and reflected from the target also pass through the beam splitters. The automatic target tracking unit also operates together with the electro-optical sensors.

There is a button panel and CRT monitor with crosshairs in the center of the screen on the antiaircraft gun system control console. Above it are the optical sight eyepieces. Data from the fire control system computer are sent to the console. There can be a system remote control console in the ship's combat information center.

For firing against airborne targets Bofors developed a new projectile (weighing 1 kg) with programmable proximity fuze and preformed fragments designated 3P (Programmed, Proximity-Fuzed, Prefragmented). The weight of its burster charge is 25 percent more than for standard 40-mm fragmentation-HE projectiles and the muzzle velocity is 1,025 m/sec. More than 3,000 fragments, including 1,000 3-mm tungsten balls, form when it bursts. The most damaging effect in firing on an aircraft is noted in case the projectile detonates at a distance of 2.5 m from the target, and in firing against an antiship missile when it detonates at a distance up to 2 m. With the fuze set for percussion action a projectile can penetrate untempered steel plate up to 25 mm thick. This also makes it possible to employ it for engaging small naval surface targets.

The maximum effective range of fire of the Trinity antiaircraft gun system with the 3P projectile, defined as the distance to which the kill probability is 50 percent with a two-second burst, is 3 km against low-flying antiship missiles and 5 km against aircraft. The minimum range of fire is 200 m. The principal combat operating mode of the Trinity antiaircraft gun system is automatic with direct or remote control. Manual control using a lever on the console in the operator cabin is a back-up.

#### **Footnotes**

1. In addition to the firm of Bofors, the firms of Philips and Ericsson as well as the West German LITEF took



part in creating the system. Development expenses are evaluated at 300 million Swedish kronor—Ed.

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**American SLBM Tests at the Eastern Test Range**  
*18010303n Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 63-68*

[Article by Capt 1st Rank V. Cherenkov]

[Text] The constant improvement of submarine-launched ballistic missiles [SLBM's] is evidence of the unceasing build-up in combat potential of American sea-based strategic nuclear forces. Over the almost 30-year period that nuclear-powered strategic missile submarines [SSBN's] have existed in the U.S. Navy their missile armament has undergone substantial quality changes.

The latest phase in this continuous process involves the adoption of a new generation of ballistic missiles, the Trident II (D-5). According to western press data, this three-stage missile will have a MIRV multiple re-entry vehicle (seven 600-KT or fourteen 150-KT warheads). The design range of fire of the Trident II SLBM is over 11,000 km and the circular error probable is around 100 m. In its characteristics, and chiefly its combat effectiveness, the new missile concedes nothing to modern land-based ICBM's.

The importance of improving SSBN missile armament and keeping it in a combat-ready status dictates the need for rigid monitoring of missile status. The most comprehensive form for checking them consists of missile firings during which missiles are launched with warheads having inert filling. In accordance with the set objectives, these launches can be for test, demonstration and shakedown, and operational training. They are conducted from ground launchers and from SSBN's at ranges, where the appropriate logistic and technical support facilities have been created and the organization for conducting and supporting missile firings has been worked out. Test launches of SLBM's from SSBN's pursue the objective of testing the missile and submarine missile system. Demonstration and shakedown launches of missiles from SSBN's—DASO (Demonstration and Shakedown Operations)—mean the testing of a missile system after completion of submarine construction, after major overhaul or after refitting with a new type of missile. Operational training launches—OT (Operational Tests)—are conducted from combat-ready SSBN's for an integrated check of their level of readiness to employ nuclear missile weapons.

In the United States SLBM launches are carried out at two missile ranges: the Western in the Pacific and the Eastern in the Atlantic. They belong to the American Air Force and are used for testing various missile weapons as

well as for launching space objects in the interests of all branches of the Armed Forces and civilian departments.

The Eastern Test Range (sometimes called the John Kennedy Space Center, Fig. 1 [figure not reproduced]) is the most versatile from the standpoint of supporting SLBM launches. All kinds of launches of any SLBM's are made here, above all test launches from ground launchers during SLBM design-flight tests (Fig. 2 [figure not reproduced]), while the Western Test Range presently supports DASO and OT launches only of Trident I missiles from "Ohio"-Class SSBN's based at the Bangor Naval Base.

Construction of the Eastern Test Range at Cape Canaveral (Florida Peninsula) concluded in 1956. The range's principal facilities take up almost 400 km<sup>2</sup> and the missile test course extending for around 20,000 km passes over the Atlantic and Indian oceans. There are over 25 fixed tracking stations along the course. Attendant range personnel number over 20,000.

According to foreign press reports, the first launch of a Polaris A-1 SLBM took place on the Eastern Test Range in 1958. Since then there were 42 Polaris A-1, 28 Polaris A-2, 55 Polaris A-3, 25 Poseidon C-3 and 25 Trident I SLBM launches conducted here under the SLBM design-flight test program. Missiles also were launched here from Royal Navy SSBN's.

It is planned to accomplish all 30 Trident II SLBM test launches envisaged by the design-flight test program at this range, including 20 from a ground launcher and 10 from SSBN 734 "Tennessee," the ninth "Ohio"-Class SSBN. Range modernization was completed in late 1986 to prepare it for design-flight tests of the Trident II SLBM. Trident II test launches have been conducted from a ground launcher since January 1987. It is planned to complete them and make the missile operational in 1989.

The basic components of the Eastern Test Range which serve to support SLBM launches are ground facilities on Cape Canaveral and on the east coast of the Florida Peninsula, missile flight tracking equipment (shore stations, ships and aircraft), as well as equipment along the range courses for determining the precise location of splashdown of individual components or fragments of the missile. A special naval detachment has been created at the range, the FBM OTSU-2 (Fleet Ballistic Missile Operations Test Support Unit), which engages in preparation and conduct of SLBM launches. Representatives of Lockheed (the main company for SLBM production) as well as specialists in control and guidance systems from General Electric and the Massachusetts Institute of Technology take a direct part in accomplishing this work and processing data collected during the tests.

The principal facilities on the east coast of the Florida Peninsula (south of Cape Canaveral) are consolidated in a specialized complex which includes a data processing center, missile assembly and checkout area, and Launch Complex No 46.



Various characteristics read out in all missile test stages—during the ground check, during launch, in flight and at the moment of splashdown—go to the data processing center for analysis. For safety reasons it is located 7 km from the launch complex. The missile assembly and checkout area is for preparing SLBM's for launch. Two missiles can be assembled and one checked out simultaneously in this area's two special technical buildings.

Launch Complex No 46 was especially created for launching Trident II SLBM's (Fig. 3 [figure not reproduced]). It is located in the immediate vicinity of the Polaris A-3, Poseidon C-3 and Trident I missile launchers. The launch complex includes a launcher, a 20 m mobile service tower for access to the missile on the launch pad in order to check out its assemblies, a hoisting crane, and underground spaces with gear and auxiliary equipment. All launch complex facilities are connected with each other and with the missile assembly and checkout area by railroad tracks.

The FTSS-2 (Flight Test Support System) serves to read telemetry about operation of Trident II missile assemblies during flight tests. It is deployed 150 km south of the Trident II SLBM launch complex in the vicinity of Jonathan Dickinson National Park. Data on missile flight coordinates are issued with the help of the NAVSTAR satellite navigation system. This system also will be used for supporting subsequent OT and DASO launches of the Trident II SLBM. Launches of Trident I missiles were supported by the FTSS-1 system having a similar purpose, with its control center on Grand Bahama Island. It processed data on the status of missile systems and mechanisms in flight which were received from five ground stations located on the U.S. east coast and in the Bermuda, Bahama, and Greater and Lesser Antilles islands.

Missile flights are tracked with the help of technical equipment and if necessary also by visual monitoring from surface vessels and from aircraft assigned to the Eastern Test Range. During launch preparations they are in the missile launch area and at locations of the presumed impact of its individual components. Missile launches at the range are supported by two missile range instrumentation ships, the "Range Sentinel" (T-AGM-22) and "Redstone" (T-AGM-20), which have special equipment for receiving data from telemetric and optical equipment (Fig. 4 [figure not reproduced]). Both vessels are part of the U.S. Navy Military Sealift Command and are based at Everglades, Florida. Their characteristics are given in the table.

In addition to the vessels, ballistic missile flights are observed from eight EC-135 ARIA (Advanced Range Instrumentation Aircraft) based at Patrick Air Force Base, Florida. According to foreign press data a new aircraft, the EC-18B ARIA, was developed in the United States based on the civilian Boeing 707-320 for missions of tracking various ballistic missile launches (Fig. 5 [figure not reproduced]). Special antennas are accommodated in its nose and wings and there is an on-board

**Principal Characteristics of Missile Range Instrumentation Ships**

Characteristics	"Range Sentinel"	"Redstone"
Year built/refitted	1944/1969	1944/1966
Full displacement, tons	12,170	24,710
Principal dimensions, m:		
—Length	138.7	181.4
—Beam	18.9	22.9
—Draft	7.9	7.6
Speed, knots	17.7	14.0
Crew	81	165

computer for processing data collected during the tests. It is also planned to install gear to accurately determine the location of splashdown of fragments and individual components of a missile using the SMILS (Sonobuoy Missile Impact Location System) sonobuoys. There is the capability of refueling the EC-18B ARIA aircraft in the air, which permits increasing its flight endurance. It is also planned to use the new aircraft for tracking unmanned spacecraft and the Shuttle manned spaceships. The first EC-18B ARIA aircraft began operating in the interests of the missile range in 1986, and in 1988 it is planned to replace four obsolete EC-135 ARIA's with them.

After planned missile launches from the ground launcher, the design-flight tests conclude with a series of missile firings from SSBN's. Subsequently, after the missiles have become operational, their reliability is checked out during periodic DASO and OT launches from missile submarines.

The submarine designated for conducting the launches is on the Eastern Test Range at the Port Canaveral temporary basing facility during the entire period of testing. Special berths have been prepared here for "Ohio"-Class and "Lafayette"-Class SSBN's.

Missile launches from SSBN's are directed from the range control center, and coordination of interworking of support facilities and the missile submarine is organized through the tracking vessel using special radio nets. The vessel also is assigned tasks of controlling the SSBN, monitoring her precise position at the moment of launch and ensuring navigation safety. On receiving data during a missile's flight about its deviation from the calculated trajectory and system malfunctions, a decision is made on destroying the SLBM by detonation. To conduct a missile launch the submarine arrives in an area 30-50 nm east of Cape Canaveral, accompanied by the tracking vessel. On taking up the desired position, the missile submarine submerges to the prescribed depth and launches the missiles on command from the range control center (Fig. 6 [figure not reproduced]). One missile is launched during each SSBN sortie during design-flight tests.

The preparedness of missile teams and SSBN crews as a whole for missile firings also is checked in the process of

preparing and conducting the DASO launches. They may be conducted twice from one submarine (separately by each SSBN crew—"Blue" and "Gold") or once with the involvement of missile teams of both crews.

A missile submarine arrives at Port Canaveral for preparation for DASO firings. The actions of missile teams are checked and their teamwork in conducting missile launches is practiced during preliminary drills and local drills. SLBM launches are made from an area east of Cape Canaveral, as they are for missile design-flight tests. Range support facilities are activated in the usual manner. Throughout the year American SSBN's conduct 7-10 DASO missile launches.

The American press reports that an SSBN is assigned from the alert forces for OT launches. On command, the missile submarine departs the combat patrol area and arrives at the Port Canaveral temporary basing facility, where she replaces 2-4 missiles having nuclear warheads with missiles having warheads with an inert filling and fitted with telemetry equipment. With these missiles aboard, the SSBN puts to sea and after taking up the assigned range area she conducts missile firings on command. All range facilities are deployed to support them, as with test and DASO launches. During the year an average of 5-6 SSBN's conduct OT launches, with approximately 15 missiles expended.

Judging from statements by U.S. Navy command representatives, missile launches from combat-ready SSBN's are performed by operational alert teams under conditions of a situation that approximates combat to the maximum. The real performance characteristics of missiles and data collected here on reliability of functioning of the missile complex and the entire missile system as a whole are used by the U.S. Armed Forces Joint Chiefs of Staff and by the Joint Strategic Target Planning Staff at Offutt Air Base in Nebraska for developing options for engaging targets in accordance with the SIOP, the integrated operations plan for conducting nuclear war.<sup>1</sup>

A constant improvement in sea-based strategic missiles, in which the Eastern Test Range plays a significant role in their testing and in developing operational standards of combat employment, is clear evidence of the unceasing arms race on the part of U.S. militarist circles.

#### Footnotes

1. For more details on this see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 2, 1987, pp 7-14—Ed.

#### FRG Armor Industry Maintenance Facility 18010303o Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 69-73

[Article by Maj N. Voyevodin]

[Text] The FRG Army command authority believes that measures for maintenance, repair and modernization of weapons and military equipment have a significant influence on high troop combat readiness.

The amount of military equipment in the country's Army grows from year to year. According to assessments by West German specialists, in 1970 the Army alone had around 250,000 items of various models of materiel, and at the present time they already have over 400,000 items. The overall cost of Army weapons and munitions approaches 35 billion Marks (in 1982 prices). For the upkeep and repair of this equipment the Bundeswehr requires more and more financial resources and spare parts, a considerable number of monitoring and testing systems (their cost is growing), and skilled cadres.

Tank units and subunits make up the basis of the Bundeswehr Army; therefore the bulk of financial resources for maintaining and repairing Army military equipment is allocated to the FRG Ministry of Defense under the item "Upkeep and Repair of Wheeled and Armored Equipment." For example, in 1987 1.5 billion West German Marks were spent under this military budget item, and in 1988 it is planned to spend 1,560,000 Marks for these purposes (not counting funds allocated for repairing engineer equipment). Each year over 200 million Marks are spent just for motor pool and plant repair of tracked armored equipment.

The command authority of the FRG Army believes that these financial resources clearly have been insufficient from the moment repair work began on such modern weapon systems as the Leopard 2 tank, Gepard self-propelled AAA mount and Roland surface-to-air missile system.

An increase in the amount of electronic components, an increase in time periods to become operational, a growth in operating expenses, the desire by the Bundeswehr command to lengthen the service life of armored equipment with the troops, and so on changed the expense ratio by phases of the life cycle of weapon systems. For example, previously the ratio was 1:3:6 among expenses for R&D, procurement, and operation and repair, but this ratio presently is 1:5:10. A service life extension for armored equipment led to the appearance in the FRG Army of models with an operating life of over 20 years. While previously one major overhaul was required as a rule for 20 years of military equipment operation, now a second additional one is needed according to data of the country's Ministry of Defense.

Along with the above reasons, the need to load the capacities of the country's armor industry with new orders for the next seven years is forcing the Army command to make maintenance, repair and modernization of armored equipment one of the central tasks. A number of specialized enterprises have been established for rapid, quality performance of complex repair, overhaul and rebuilding work within the framework of the FRG armor industry, and there are plants which are used periodically to perform repair work. At the present time 11 enterprises in the country are engaged in repairing armored equipment, including six state and five private enterprises. Some of the state enterprises are under the purview of the FRG Army Logistic Support Directorate and others are leased to U.S. Army units stationed on FRG territory or to private firms.

The principal state repair, overhaul and rebuilding plants are:

- Army Repair, Overhaul and Rebuilding Plant No 850 (Darmstadt), No 860 (Sankt Wendel) and No 800 (Juelich, leased to the U.S. Armed Forces)—these enterprises are under the purview of the FRG Army Logistic Support Directorate;
- Fahrzeugwerke Ichendorf (Bergheim, west of Koeln)—managed by private businessmen;
- Flensburger Fahrzeugbau (Flensburg) and Industriewerke Saar (Freisen).

Major overhaul of armored equipment also is presently being accomplished in some of the capacities of enterprises of the following private firms:

- Krauss-Maffei (Munich, repair of the Gepard self-propelled AAA mount was begun here in 1988 at a rate of five units a month);
- Krupp-MaK Maschinenbau (Kiel, it is the main plant for repairing Leopard 2 tanks in the late 1980's);
- Keller und Knappich (Augsburg, it will repair and modernize 1,400 Marder infantry fighting vehicles up to the end of the 1990's);

—Wegmann und K° (Kassel, repair and modernization of Leopard 1A5 and M48 tanks);

—Mainz Industries Panzerwerk (Mainz, leased by the United States for major overhaul on armored equipment of the United States and other NATO bloc allies).

A diagram of the location of the main FRG armor industry repair enterprises is shown in Fig. 1.

When a threat of war or of the outbreak of war appears, the leadership of the FRG Armed Forces plans to considerably expand the network of repair, overhaul and rebuilding plants and enterprises of subsuppliers. The Bundeswehr's Administrative Management Directorate concluded contracts with 2,500 private firms for the repair, overhaul and rebuilding of wheeled and tracked armored and unarmored equipment in case of war. In addition the FRG has agreements with other North Atlantic Alliance countries providing for the use, in a "crisis situation," of central NATO bases and depots of spare parts and machine units in Western Europe for supplying West German enterprises and for repairing, overhauling and rebuilding Bundeswehr military (particularly armored) equipment.

The FRG Armed Forces leadership places great emphasis on the planning, organization and management of repair, overhaul and rebuilding work. The repair of armored equipment in the country is concentrated in four areas with the objective of optimizing management: Land Schleswig-Holstein, "North"—zone of responsibility of I Army Corps, and "Center" and "South"—zones of responsibility of III and II army corps commands respectively. In the opinion of the West German military command authority, such a territorial division ensures optimum distance of maintenance facilities from a possible front line and shortens the distance of transport shipments.

Organizationally the repair of armored equipment in the FRG is divided into three categories (according to where accomplished) and five levels (according to the nature and scope of work to be done, see table).

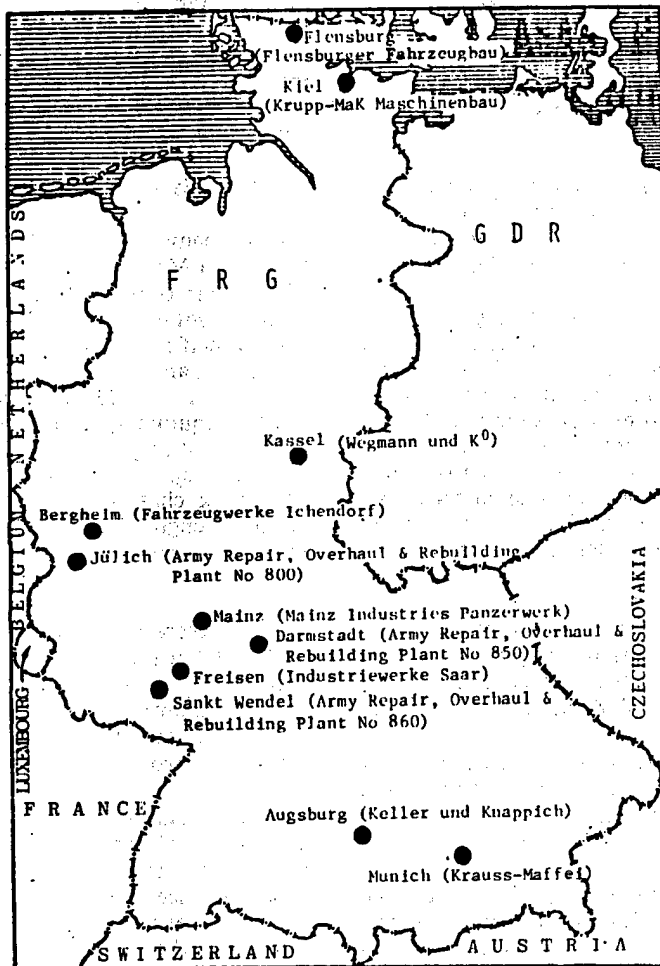
#### Organization of Armored Equipment Repair in the FRG

Repair Category	Repair Levels	Tasks	Responsible for Performing Tasks
I Organizational maintenance	1a	Routine care, including cleaning, lubricating, adjusting, replacing small parts	Crew
	1b	Maintenance, including replacing and repairing small parts	Maintenance groups of repair subunits of ground and territorial troops, traveling plant teams
	2	Organizational maintenance and repair, including repair work lasting up to one day	Specialized repair subunits (battalions), traveling plant teams, enterprises of small industrial firms

**Organization of Armored Equipment Repair in the FRG**

Repair Category	Repair Levels	Tasks	Responsible for Performing Tasks
II Field maintenance	3	Medium repair as well as replacement of armored equipment assemblies and machine units	Specialized repair subunits, enterprises of small industrial firms
III Motor pool and plant repair	4	Major overhaul of armored equipment, fabrication of major machine units and modules, repair of machine units with their complete dismantling	Specialized repair plants and other industrial enterprises

**Fig. 1. Location of the main FRG armor industry repair enterprises**



It is apparent from the table that the West German armor industry provides services and performs repair work beginning essentially with category I. The principal task of the sector, however, is the major overhaul of armored equipment (80 percent of armored vehicles are repaired at enterprises and 20 percent under motor pool conditions).

The Fifth Department of the Army Main Staff Rear and Second Department of the FRG Ministry of Defense Armament Directorate together are responsible for drawing up and approving armored equipment repair plans. The FRG Army Logistic Support Directorate and Federal Department of Military Equipment and Procurements handle (within the scope of their zones of responsibility) the conclusion of contracts with industrial enterprises for the repair of armored vehicles.

Two types of contracts are distinguished depending on the location of repair work: for repair of equipment at an enterprise and for repair of equipment by a traveling plant team at the equipment location.

The circumstance that a greater number of requests for armored equipment repair come in in the winter period is taken into account in the planning and concluding of contracts in the FRG Ministry of Defense. The country's Armed Forces command distributes orders on a competitive basis. To this end a contract for repairing each type of armored vehicle is concluded with two or three firms. These firms are supplied with models of these armored vehicles in advance (4-5 years ahead) for a trial major overhaul to be accomplished over 8-12 months. Results are compared and taken into account by the Ministry of Defense in placing the prime order with one chosen firm. Capabilities of subcontracting firms—suppliers of off-the-shelf armored equipment machine units to repair enterprises—are considered in planning and concluding contracts.

On the whole, subcontracting plants take part in filling an order usually to the extent of 20 percent of their capacities, since these enterprises are engaged in producing other products for the civilian and military market.

Delivery of new or previously repaired spare parts and machine units—modules ready for installation—to repair enterprises is the principal method of industrial repair of armored equipment in the FRG.

In concluding contracts with industry, deliveries of spare parts and off-the-shelf modules with a lengthy fabrication cycle are coordinated 2-3 years before basic work is done at repair plants.

Over the last ten years a consolidated system of repair and deliveries of spare parts for the family of Leopard armored vehicles (tanks and engineer vehicles) was organized through FRG efforts among Australia, Belgium, Denmark, Italy, Canada, the Netherlands, Norway, Greece and Turkey. Each year agreements concluded

with these states for delivery of spare parts and machine units to them provide the FRG with military budget revenues amounting to 90 million West German Marks (in 1988 prices).

At the present time the nucleus of the FRG armor industry's maintenance facility consists of five specialized enterprises with considerable repair, overhaul and rebuilding capabilities.

**Repair, Overhaul and Rebuilding Plant No 860 (Sankt Wendel)** is a state enterprise under the purview of the FRG Army Logistic Support Directorate. It has over 1,000 employees. It has specialized armored equipment repair lines. At the present time M109A3G 155-mm self-propelled howitzers are being modernized and maintained at the plant.

**Fahrzeugwerke Ichendorf Repair, Overhaul and Rebuilding Plant (Bergheim, Fig. 2 [figure not reproduced])** is a state enterprise leased and managed by a branch company of the private firms of Krupp-MaK Maschinenbau (51 percent of stock) and Industrierwerke Karlsruhe-Augsburg (49 percent).

The company has 950 workers and an annual turnover of 60 million Marks. Overall area of enterprise grounds is 170,000 m<sup>2</sup>, of which 50,000 are built up. The plant has a state depot where some 25,000 various spare parts and off-the-shelf modules of tracked armored and engineer equipment are constantly present. Following World War II the plant engaged in repairing British and Belgian military equipment. Since 1961 the enterprise has been carrying out major overhaul of BREM [armored recovery vehicles], armored vehicle launched bridges on the M48 tank chassis, and M88 combat engineer tanks. Armored engineer equipment of the Leopard family as well as Leopard 1 tanks have been repaired in recent years.

On the average, the annual volume of repair work performed at the enterprise is 780,000 man-hours. The length of major overhaul of tracked armored equipment is three months, and for individual assemblies and machine units (power plant, power transmission, armament) it is two months.

**Industrierwerke Saar Plant (Freisen)** is a state enterprise with over 1,000 employees. The area of plant buildings is 40,000 m<sup>2</sup>. The enterprise began specializing in the repair of wheeled equipment in 1963 and fully mastered the major overhaul of tracked armored equipment in 1965. At the present time armored vehicles being repaired are disassembled and assembled on specially equipped lines.

The following have been included in the enterprise's work program: repair of APC's (1965-1972), wheeled armored vehicles and trucks on the Unimog vehicle chassis (up to the present time), engineer vehicles and DK-60 prime movers (1973-1981), Kanonenjagdpanzer

90-mm self-propelled antitank guns (beginning in 1973), Marder IFV (Fig. 3 [figure not reproduced]), since 1975), M113A1 APC (since 1979), and Luchs combat reconnaissance vehicle (since 1982).

A total of over 100,000 engines, 75,000 gearboxes, over 20,000 pieces of Bundeswehr wheeled equipment and around 3,000 tracked armored and engineer combat vehicles have undergone major overhaul at the plant. A portion of the enterprise's capacities is engaged in the civilian sector of the economy for repairing agricultural equipment, refrigerating plants for the atomic industry, and various plant equipment.

**Flensburger Fahrzeugbau Repair, Overhaul and Rebuilding Plant** (Flensburg) is a state enterprise (a branch company of the state firm of Flensburger Schiffbau). In recent years the personnel strength rose from 270 to 350, and the shop area for repairing armored vehicles is 15,000 m<sup>2</sup>. The plant has depots of spare parts and off-the-shelf modules of armored equipment with an overall area of around 5,000 m<sup>2</sup>.

The plant began functioning as a shipyard in 1872. In 1963 it was converted into the FRG Army's main maintenance facility for logistic property and wheeled equipment, and in 1965 it began performing major overhaul on tracked armored equipment. At the present time the plant performs major overhaul of armored equipment of the Schleswig-Holstein territorial command and the Bundeswehr's 6th Mechanized Division.

Beginning in 1965 the plant took up the repair of M41 tanks, M42 self-propelled AAA mounts (around 300 units were repaired), Hotchkiss (over 700) and MTW13 APC's (over 1,000), M48 and Leopard 1 tanks, the Marder IFV, as well as engines and transmissions.

**Mainz Industries Panzerwerke Repair, Overhaul and Rebuilding Plant** (Mainz). It has been functioning since 1956 as a branch of the private firm of Luether-Werke und K<sup>o</sup>. After a financial failure the plant was leased to the United States for repairing American armored equipment. It has 2,800 employees, including 270 who work in a separate plant production unit in Ober-Ramstadt (specializing in the replacement of tank wheel rubber tires and track link linings).

The enterprise's annual turnover (counting 130 million Marks for the pay of production personnel) is 300 million Marks and the value of fixed capital is one million Marks.

The plant performs major overhaul of M1 Abrams tanks and M113 APC's and the modernization of M60A1 tanks and M109A1 self-propelled artillery mounts. Armored equipment of Austria, Belgium, Canada, Portugal, the Netherlands, Switzerland and Great Britain also is repaired. In addition, from the late 1950's to the present time the enterprise has repaired over 8,000

engines and gearboxes and replaced rubber tires on 45,000 tank wheels and rubber linings on 170,000 tank track links.

On the average, the time for major overhaul of armored equipment at the plant is from 35 to 52 days, including up to 45 days for tanks. It takes approximately 60 days (under normal working conditions) to overhaul and rebuild damaged armored equipment.

After completion of plant renovation in 1988 it became possible to increase its capacities and work volume. For example, while three million man-hours per year were spent on capital repair of 1,670 armored vehicles in 1983, since 1988 the plant has been capable of repairing 2,300 pieces of armored equipment while spending up to five million man-hours. Equipment for repairing multiple rocket launchers also was installed during enterprise renovation.

And so even in peacetime the FRG's armor industry has a rather large repair, overhaul and rebuilding facility capable of repairing the armored equipment both of national Armed Forces and of allies in the NATO bloc. In case war is unleashed the country's military-political leadership envisages a considerable expansion in the network of repair, overhaul and rebuilding enterprises.

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#### **Stepped-Up Activity of Canadian Armed Forces in Northern Areas**

18010303p Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 73-74

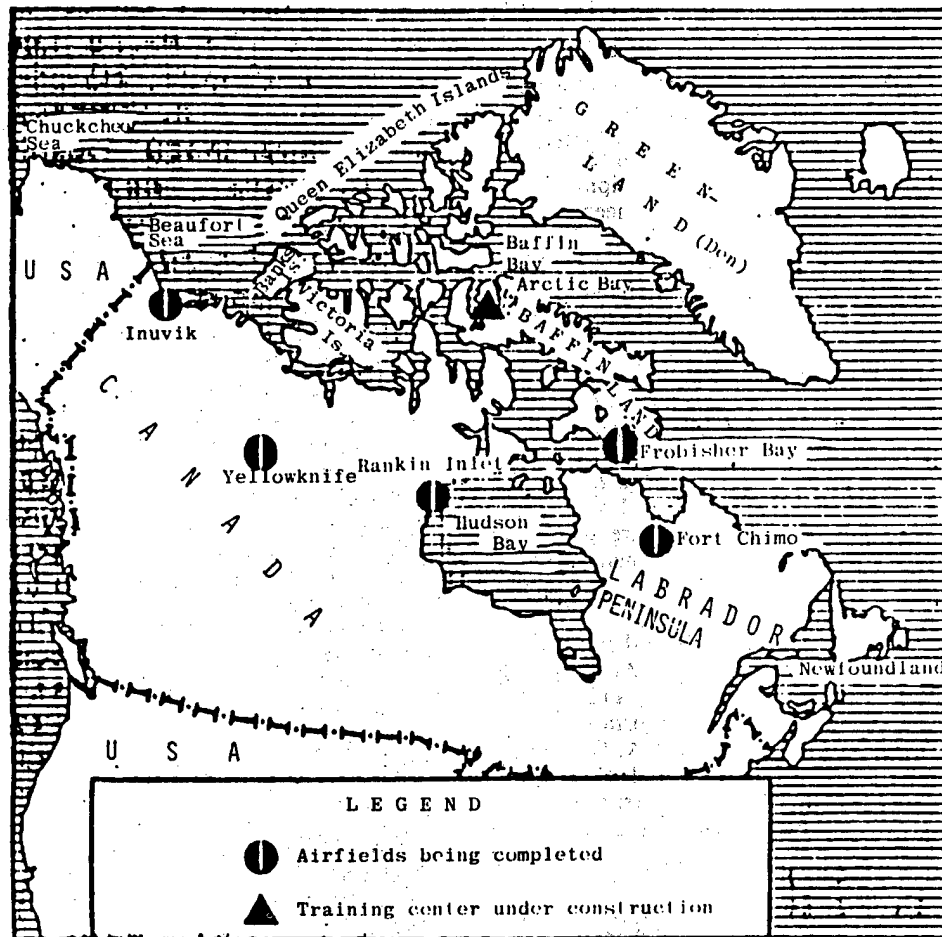
[Article by Col V. Cheremushkin]

[Text] In accordance with the country's military-political course, determined by close comprehensive cooperation with the United States and by membership in NATO, the Armed Forces command lately has been fixing its attention more and more on the Arctic. Having rejected Soviet proposals for creating a zone of peace and for sharply reducing military activity in this region, Canadian militarist circles are building up efforts to construct various installations of a military nature here.

The foreign press reports plans to build a permanently operating military base in the town of Nanisivik (near the city of Arctic Bay) in the northern part of Baffin Island (largest island of the Canadian Arctic Archipelago; the sea route between the Atlantic and Arctic oceans passes through its seas and straits, see figure).

Located in a zone of lead and zinc deposits, Nanisivik presently has a deep-water port (official sources inform that for now it is not planned to be used for basing submarines with nuclear power plants which possibly will replace obsolete diesel submarines). An airfield with

Location of completed airfields and a training center under construction



a dirt runway has been constructed there as well. Its length (1,800 m) and firmness permit receiving C-130 military transports.

One of the base components will be a center for training servicemen in actions under Arctic conditions. Around 100 military specialists will work at the base in Nanisivik and will be replaced every two years. It is planned to make all facilities operational by 1993.

In the northern part of Canada it is planned to complete airfields near the cities of Inuvik, Yellowknife, Rankin Inlet, Frobisher Bay and Fort Chimo by 1992 in order to use them as forward bases for U.S. and Canadian air defense fighter-interceptors. As a result of work done at these airfields it is planned to have runways at least 1,600 m long and to build hardened shelters for aircraft, field POL depots and ground maintenance equipment depots. Aviation will not be based permanently there.

Canada and the United States plan to spend 150 million American dollars just for equipment to refuel combat aircraft at the five Arctic airfields.

One further example indicating intensification of militarist activity in the Arctic is the planned increase in strength of Canadian Rangers to 1,000. These are volunteer militarized formations created chiefly in northern areas and on the coast. Local residents (Eskimos and Indians) who have a good knowledge of the terrain and are adapted to life under the severe natural climatic conditions are their basis. They are organized by place of residence into small subunits and can be employed for performing patrol duty on individual islands and as guides and instructors for subunits of regular forces. It is planned to issue the Rangers military uniforms and modern small arms. It is proposed to bring the number of Ranger subunits to 50, which will permit them to perform surveillance over the bulk of Northern Canadian territory.

The Armed Forces command also plans to perform widescale work of mapping the country's Arctic areas.

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### **NATO Mobile Forces Exercise**

*18010303q Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) p 75*

[Article by Lt Col M. Kosykh]

[Text] A planned exercise by the NATO Mobile Forces codenamed Arrowhead Express-88 was conducted on the territory of Norway in the period from 2 through 24 March 1988. Its objective was to rehearse plans for the movement and combat employment of this bloc "fire brigade" in Northern Norway.

The NATO Mobile Forces are a special multinational troop formation immediately subordinate to the NATO Supreme Commander of Allied Forces in Europe. They are intended for movement to "threatened" areas in case of a sharp aggravation of the situation both for reinforcing NATO force groupings and for showing "solidarity" and "cohesiveness" of bloc countries, and in case an armed conflict breaks out, to give it a coalition character from the very beginning.

Command and control elements and contingents of mobile forces totaling some 4,800 persons, two Norwegian brigades, and tactical air subunits of the air forces of the United States, Great Britain, the Netherlands and Norway (a total of 14,800 persons) were used for participation in these maneuvers.

The exercise was held in accordance with a standard antisoviet scenario according to which the "Orange" (that is what NATO war games customarily call the enemy, and above all the Warsaw Pact countries) sharply steps up military activity in Northern Europe and exerts political pressure on Norway. This "forces" the country's authorities to request the supreme leadership entities of the "Blue" (NATO) bloc to send bloc mobile forces onto Norwegian territory.

Problems of moving mobile forces to Northern Norway by air, sea and land were practiced in the first exercise phase. Some 200 transport aviation flights actually were made.

There was a landing by amphibious assault forces in the second and primary phase. In accordance with the background established in the exercise, NATO Mobile Forces together with Norwegian troops repelled "Orange" attempts to take the Bardufoss area.

The return movement of troops to their permanent locations was accomplished in the third phase.

The Arrowhead Express exercises are typical NATO Allied Armed Forces training activities held in Norway once every two years. It is common knowledge that Bundeswehr combat subunits never have been included in these or similar maneuvers held on the territory of Norway and Denmark, where they are considered a

worthy continuer of traditions of Hitler's Wehrmacht. Recently, however, changes have been seen in this matter. The first exception in the postwar period was made last fall by Danish authorities during a similar exercise, Accord Express-87. Officially, as before, only supporting Bundeswehr subunits took part in Arrowhead Express-88, but the Norwegian side already has expressed readiness to allow West German airborne personnel onto the country's territory for participation in the very same maneuvers in 1990. According to an assessment by foreign specialists, a gradual normalization of relations between the FRG and its Scandinavian allies in NATO is occurring in the channel of an openly antisoviet, militarist policy.

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### **Italian B-1 Centauro Armored Fighting Vehicle**

*18010303r Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 75-76*

[Article by Col Ye. Viktorov]

[Text] In the first half of the 1980's the Italian firm of Fiat began developing a wheeled (8x8) armored fighting vehicle, which subsequently was designated the B-1 Centauro (see color insert [color insert not reproduced]). Having relatively powerful main armament, it can not only provide infantry fire support, but also engage tanks.

The first vehicle prototype appeared in 1987 and three of its prototypes were supplied to the ground forces for testing at the end of that year.

The vehicle's configuration is executed with a forward engine and transmission compartment. The hull is welded of steel armor plate. Its frontal part protects against 20-mm projectiles and the sides protect against bullets and fragments of artillery and mortar rounds. It has an air filtration and ventilation unit.

All wheels are driving wheels and it has an independent suspension. The 520 hp V-6 diesel engine provides high mobility on broken terrain. Maximum highway speed reaches 108 km/hr and the range is 800 km.

A three-place armored turret created by the firm of OTO Melara is installed on the B-1 Centauro. The main armament is a 105-mm low-impulse gun of Italian development, with which a 7.62-mm machinegun is coaxial. A second machinegun is mounted above the commander's hatch. Four-tube smoke grenade launchers are mounted along the sides of the turret.

The commander, gunner and loader are accommodated in the turret. A modern fire control system includes a laser rangefinder, electronic ballistic computer, as well as gunner's and commander's sights with a stabilized line of



aim and a thermal-imaging channel. The drives for laying the gun and turning the turret are electrohydraulic.

The principal characteristics of the B-1 Centauro armored fighting vehicle are a combat weight of 22 tons, a length of 7.4 m, width of 2.95 m, height of 2.69 m, and crew of 4.

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**Tornado Aircraft in the Royal Air Force**  
*18010303s Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) p 76*

[Article by Col V. Utkin]

[Text] According to foreign press data, 220 Tornado-GR.1 tactical fighters and 165 Tornado-F.3 fighter-interceptors have been ordered for the Royal Air Force. At the present time nine tactical fighter squadrons are equipped with the Tornado-GR.1, seven of which are part of the order of battle of the Royal Air Force command in the FRG and are stationed on the territory of West Germany (9th, 14th, 17th and 31st tactical air squadrons at Brueggen Air Base and 15th, 16th and 20th tactical air squadrons at Laarbruch). Two squadrons are in Great Britain (27th and 617th tactical air squadrons) at Mareham Air Base. In addition, the 45th Training Squadron of the Combat Applications Center (Honington) and one squadron of the Joint Tornado Crew Training Center at Cottesmore (this center sometimes is called a retraining center by the western press) are equipped with Tornado-GR.1 aircraft.

Having made the bulk of attack subunits operational, the Royal Air Force command began rearming fighter aviation (air defense) with new Tornado-F.3 aircraft (see color insert [color insert not reproduced]). The foreign press states that the 229th Training Squadron and 29th Fighter Squadron (both at Coningsby Air Base) in the 11th Fighter Group of the Royal Air Force command in Great Britain were equipped with these aircraft by the beginning of 1988. Over the next three years it is planned to outfit another six squadrons with Tornado aircraft, of which five are fighter squadrons and one is a reconnaissance squadron.

In accordance with these plans, crews of the 11th Fighter Squadron (equipped with Lightning-F.6 fighter-interceptors stationed at Binbrook Air Base) began retraining in the Tornado-F.3 in April 1988. In 1989 the 43d and 111th fighter squadrons (Phantom-FG.1, Leuchars) will begin to be equipped with Tornado-F.3 aircraft. After this it is planned to deploy another two fighter squadrons equipped with such aircraft at Leeming Air Base.

Somewhat later (in late 1989 and early 1990) it is planned to activate the aforementioned reconnaissance

squadron. For this it is planned to modernize at least 12 Tornado-GR.1 tactical fighters in the inventory of other subunits as reconnaissance aircraft, after which they will be designated Tornado-PR.

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**New American Drone**  
*18010303t Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) pp 76-77*

[Article by Col I. Karenin]

[Text] The United States has begun flight tests of a new drone developed on an initiative basis by the American firm of Teledyne Ryan as a high-altitude multipurpose reconnaissance resource with great endurance. The drone's design (its firm designation is Mod 410) is executed in a double-beam configuration with high-set wing, twin-fin stabilizer and tricycle landing gear with retractable nose gear and fixed main gear (see figure [figure not reproduced]). The drone airframe is made of composite materials. The power plant consists of a Lycoming 160 hp four-cylinder piston engine with three-blade pusher propeller 1.6 m in diameter. The drone's maximum take-off weight is 725 kg, the wingspan is 9.45 m, and its range of flight speeds is 160-260 km/hr.

The following are distinguishing features of the new drone which, as firm specialists believe, will permit a maximum reduction in its operating costs:

—Capability of making a take-off and landing from ordinary runways or sections of freeways (the drone's take-off distance is around 230 m). This precludes the need for creating relatively complex and costly ground devices (including expendable launching boosters) for launching the drone, as well as landing support systems after returning from a combat assignment.

—Considerable flight range and endurance (up to 48 hours), enabling the drone to take off from rear airfields and be in the air over the desired reconnaissance area for a lengthy time independent of weather conditions.

—Large capacity (around 0.7 m<sup>3</sup>) for accommodating special equipment, which facilitates the use of various large, series-produced equipment. In particular, it is planned to install either reconnaissance equipment (forward-looking infrared and a panoramic aerial camera) weighing 45 kg or electronic warfare equipment weighing over 130 kg in the drone.

Judging from foreign press reports, firm specialists subsequently consider the possibility of working on a certain modernization of the Mod 410 drone to increase maximum take-off weight to 1,100 kg and wingspan by 1.8 m. As a result of this the drone will be able to carry an

increased payload and an increased fuel reserve (168 kg) and have greater endurance (up to 72 hours) and flight range.

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**American Mk 2 Torpedo Decoy**

18010303u Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 10, Oct 88 (signed to press 10 Oct 88) p 77

[Article by Capt 1st Rank A. Prostakov]

[Text] To divert antisubmarine torpedoes by neutralizing their active-passive acoustic homing heads, the U.S. Navy uses a special Mk 2 Mod 0 decoy device. It can be dispensed by a submarine being attacked by torpedoes using a device designed for firing ordinary bathythermographs. In an operating state the torpedo decoy assumes a vertical position and automatically remains at a given depth. This device emits false noises resembling those of the submarine it is screening to neutralize the passive homing channel; re-emission of signals is used in the form of response jamming to divert torpedoes having active homing heads in homing systems.

The Mk 2 torpedo decoy (see figure [figure not reproduced]) has a light weight and small size (case diameter is 80 mm). Its nose section contains a group of electroacoustic transducers forming an acoustic antenna, and a matching device. The upper part of the device case contains electronic units which produce and amplify the emitted acoustic noises and interference. Next to them are storage batteries activated by sea water and supplying electrical power to the electronic units and device motor. The lower part of the decoy case contains an electric motor, which is controlled by a hydrostat and rotates a propeller shaft. The hydrostatic device is used to regulate the speed and direction of rotation of the motor with propeller, which is necessary for keeping the device at a given depth.

Judging from foreign press reports, 2,700 such decoys were produced on order of the U.S. Navy. The manufacturing firm of Emerson also plans to begin selling them to the fleets of a number of western countries.

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**Articles Not Translated from ZARUBEZHNOYE VOYENNOYE OBOZRENIYE No 10, October 1988**

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Foreign Military Chronicle (Unattributed) .....pp 79-80

Journal Editors with Leningrad Military District Personnel (Unattributed) .....p 80

Color Inserts: British Tornado-F.3 Fighter-Interceptor; Italian B-1 Centauro Wheeled (8x8) Armored Vehicle; West German Luchs Combat Reconnaissance Vehicle; Royal Navy "Broadsword"-Class Guided Missile Frigate F 99 "Cornwall" (Unattributed) ....inserted between pp 48-49

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