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SCIENTIFIC TECHNICAL REVIEW
is dedicated to 60 years – anniversary of the
Military Technical Institute
in Belgrade, SERBIA

МИНИСТАРСТВО НАРОДНЕ ОДБРАНЕ

ГЕНЕРАЛШТАБ

Југословенске армије

3. Novembar 1948

Po ukazanoj potrebi,

N A R E D J U J E M :

Da se formira Vojno-tehnički institut Jugoslovenske armije po sledećem:

1/ U sastav Vojno-tehničkog instituta ulaze postojeći tehnički instituti rodova vojske, kao i Institut Komande J.R.vazduhoplovstva.

2/ Osnovni delokrug rada Vojno-tehničkog instituta je sledeći:

- proučavanje našeg postojećeg i stranog naoružanja i opreme; radi na pronalaženju novog naoružanja i opreme koristeći u tome smislu postignuća drugih zemalja i razvijajući vlastitu delatnost, kao i proučavajući patente interesantne za vojne potrebe; radi na usavršavanju našeg naoružanja i opreme, daje sugestije za unifikaciju i tipiziranje;

- izradjuje tehničku dokumentaciju za izradu naoružanja i opreme u vojnoj i civilnoj industriji, kontroliše sa tehničke strane izradjene prototipove i produkte uz saradnju zainteresovanih komandi rodova;

- utiče na civilni sektor u pogledu izrade tipiziranih potreba za armiju /kola, samari i sl./;

- stvara i usavršava stručne tehničke i naučne kadrove;

- održava vezu s civilnim srodnim ustanovama i iskorišćava njihove mogućnosti u stručnim kadrovima i materijalnim sredstvima za vojne potrebe;

- daje stručna mišljenja iz naučno-tehničke oblasti.

3/ Vojno-tehnički institut neposredno je potčinjen Načelniku Generalštaba J.A.

4/ Formiranje Vojno-tehničkog instituta izvršiće načelnik Instituta najdalje do 1. decembra.

Načelnik Vojno-tehničkog instituta će proučiti i do 1o novembra predložiti Generalštabu detaljnju organizaciju i nadležnost Instituta, kao i smeštaj istoga.

Načelnik Instituta takodje će predložiti Generalštabu do 1o.XI. potrebe u oficirima, podoficirima, vojnim službenicima i stalnim gradjanskim licima da bi Institut mogao otpočeti sa radom, uzevši u obzir postojeće ljudstvo u institutima rodova i vazduhoplovstva. Za početni period se neće izdavati posebna formacija instituta.

Institut se treba orjentisati pored vojnih lica i stalnih gradjanskih lica i na korišćenje pogodnih gradjanskih stručnjaka pored redovne njihove dužnosti angažujući ih za rad uz honor /profesori univerziteta, inžinjeri i ostali/.

Smrt fašizmu – Sloboda narodu!

POM. MINISTRA NARODNE OBRANE I
NAČELNIK GENERALŠTABA J.A.
general-pukovnik,

/Koča Popović/

Order of Koča Popović

UDK: 355.014:623.4
COSATI: 15-05, 19-06, 01-03

Six Decades of Military Technical Institute

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WHEN in 19th century after two uprisings (1804 and 1815), Serbia finally got rid of almost 5 centuries of Turkish occupation and tyranny, it started the creation of its regular army, based on the most sophisticated European military doctrine of organizing and equipping in that time. Planned equipping of the Serbian army with weapons and military equipment of domestic production (NVO) started right after the conference in the former Serbian capital of Kragujevac in 1837, when an initiative from Miloš Obrenović was adopted to build a foundry in that city. The main reasons for this were: equipping the Serbian army independently from politically infuenced foreign countries, reducing expenses for equipment and employing its own population.

Forming of a foundry in 1851 in the city of Kragujevac can be considered as a conception of modern military industry, not only in Serbia but on the territories of the entire Balkans, even in the middle Europe. The first cannons with seals in the shape of the Serbian coat-of-arms were developed in the foundry in 1853.

Figure 1. VTI was located in the center of Belgrade at Katanićeva Street 15 for almost five decades

Even in the Kingdom of Yugoslavia (1921 – 1941), Serbia was considered to be a leader of military industry development. In this period IK-3 was designed as one of the best combat airplanes that in 1941 very successfully defended the skies over Belgrade against far overpowering Hitler's aviation. Also in this period, the world was surprised with the development of a Belgrade's project of an electromagnetic gun.

The question of equipping army with NVO from domestic production in Serbia, as an imperative of political and military independence of the country, was always asked as a question of priority, and soon after the end of WWII, the Military Technical Institute (VTI) was founded on November 3rd 1948, in the former FNR Yugoslavia where Serbia presented an integral part, by an order of the former chief of headquarters for the Yugoslav army and the defense minister assistant – lieutenant colonel general Koča Popović.

Figure 2. Current VTI management building in Žarkovo

VTI was and still is a leader of development and production of modern NVO on these territories, and judging by the projects realized so far, it can be stated that it still is one of the most influential scientific institutions of its kind in the world. Its life started in 1948 at Katanićeva Street 15, and it continued with its relocation to Žarkovo in 1992, where only the aeronautical part of the institute had been originally placed.

Ever since the beginning of VTI, over 1000 NVO articles have been introduced into service in the Serbian Army and armies of many different countries on different continents. Most significant achievements were developments in areas of military aeronautics, classic and rocket artillery, combat and non-combat vehicles, infantry armament, mine-explosive equipment, infantry and artillery ammunition, protection equipment, telecommunication devices, etc.

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Classic armament

For these six decades of VTI's existence, 12 types of small arms of different caliber were developed. Right after WWII, the development of small arms - rifle 7.9 mm M48, automatic gun 7.62 mm M49 and M56, pistol 7.62 mm M57, machinegun 7.9 mm M53- was based on the fact that after the war huge amount of ammunition for the above mentioned caliber remained in the country and could be used, and on the fact that production of individual models for this ammunition, 7.9 mm above all, had been already conquered during the war.

Figure 3. Machinegun M72 with passive night sight

By the end of 1950s in cooperation with the firm ZASTAVA from Kragujevac, development of 7.62 caliber small arms began, first with semi-automatic rifle M59/56, then with automatic weapon based on the principle of bolting mechanism such as kalashnikov (automatic rifle M70A and machinegun M72). At the beginning of the 80s, a generation of light small arms of small caliber (5.56 mm and 5.45 mm) but with great stopping power was developed.

Figure 4. Infantry trooper with automatic rifle M21 with under barrel grenade launcher and optical sight

During the last ten years, the development of 5.56 mm M97 automatic gun, intended for special operations units, and automatic rifle 5.56 mm M21 with under barrel 40 mm grenade launcher has been successfully completed and introduced into the operational use in the Serbian Army. Production of compatible ammunition and a wide range of infantry and antitank fragmentation mines for both weapons, as well as ammunition for under barrel grenade launcher, was developed and conquered.

Development of classic artillery for fire support represents one of the most significant and most fruitful expert areas that VTI dealt with for its entire working existence. For these 60 years of existence of VTI, three generations of artillery weapons were developed and introduced into the operational use in the Serbian army and many other foreign armies.

The first generation of weapons for fire support includes: mountain gun 76 mm M48, mortar 120 mm M52 and towing howitzers 105 mm M56 and 155 mm M65. The second generation includes: mortar 82 mm M69, light mortars 120 mm M74 and M75, towing howitzer 122 mm D30J and towing gun-howitzer 152 mm NORA-A. The third generation includes: converted gun 152/155 mm M46/86 on the gun-carriage for the towed gun 130 mm M46, self-propelled gun-howitzer 152 mm NORA-C and self-propelled gun-howitzer 152/155 mm NORA-B on the chassis of an 8x8 terrain vehicle.

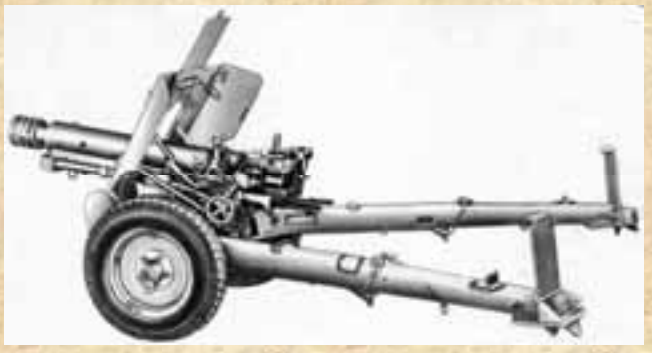

Figure 5. 76 mm mountain gun M48

Development of the first artillery weapon, the mountain gun 76.2 mm M48, started in 1947, in the moment when the entire country was under immediate danger of war from the countries belonging to the Warsaw Pact. This gun, with a maximum range of 8600 m, with its tactical-technical characteristics, reliability and simplicity for maneuvering, was considered for a long time to be one of the most successful solutions in its class in the world and as such, was introduced into operational use in many foreign armies. In 1950s, this gun was the first exporting deal of the former Yugoslav military industry.

Immediately after the end of the first phase of the development of the mountain gun M48, the development of the howitzer 105 mm M56 started with a goal to design a weapon of 14 km in range. In a relatively short period, by the end of 1957, the development was completed and the decision to introduce it into the operational use was made. With the newest modernization, a 33 caliber barrel is installed. This howitzer is the most exported model of the Yugoslav military industry from the category of artillery weapons and weapons that are still operational in several foreign armies.

Through programs of modernization and increase of artillery firepower, based on American howitzer 155 mm M1 and Soviet howitzer 122 D30 mm, domestic versions of these howitzers were developed. Realizing new demands of modern artillery, besides working on development of new weapons, the Institute worked on the conversion of the gun 130 mm M46 into the converted gun M46/86. Mounting of 152 mm and 155 mm barrels onto the gun carriage of the towed gun M46 resulted in a very reliable and robust modern artillery system with respectable ballistic performances and significantly higher efficiency.

Figure 6. 105 mm howitzer M56

In the middle of 70s, VTI started developing the towed gun-howitzer 152 mm M84, with an increased range, which was introduced into operational use under the name NORA in 1984. In the category of 39 caliber artillery weapons, NORA represented a weapon with respectable fire support that can achieve the maximum range of about 24 km under a starting speed of V_0= 810 m/s.

Figure 7. Towed 152 mm gun-howitzer NORA-A (M84)

The story of NORA does not end here. The self-propelled version of 152 mm NORA-B on the chassis of a modified, serial, terrain vehicle FAP 2832 with carrying capabilities of 9 tons was the first to be developed, and then the chassis on the vehicle KAMAZ was developed in cooperation with the company JUGOIMPORT-SDPR, on demand of a foreign purchaser. This weapon currently represents the main exporting item of the Serbian military industry.

The self-propelled 155 mm gun-howitzer NORA-B52 and 52 caliber barrel was intended for general fire support of units with indirect and point-blank shooting up to 41 km of range. This weapon was realized on the principle of open installation of weaponry (without turret) and was placed onto the chassis of an 8x8 vehicle with 4x4 drive. A gas break of high efficiency and a breech with horizontal-sphenoid shutter were mounted on the barrel. The system for automated sealing of the gun powder chamber was installed in the barrel and shutter system so that caseless ammunition can be used. This weapon with a mass of 31000 kg in marching position has a maximum speed of 70 km/h and an operational autonomy of 500 km.

The 120 mm mortar M52 was tactically very useful for application and transport owing to the use of a recoilless device, shooting from wheels and because of simple disassembling for transport on towing animals. This mortar was one of better technical solutions in 1950s, and that is why it has been kept as a device of fire support in Yugoslav as well as many foreign armies for two decades.

Figure 9. 120 mm mortar M95

In the middle of 70s, modernization of mortars of this caliber was carried out, and light mortars M74 and M75 were developed and introduced into service. They became the basic fire support for infantry battalions. The towed mortar 120 mm M95 with a large range is currently in the final stages of development.

Figure 8. Self-propelled 155 mm gun-howitzer NORA-B52

Development of classic weapons for antitank combat started with the development of bazookas RB M49 and RB M57 and the towed recoilless gun 82 mm M60 with compatible projectiles. With installation of two recoilless guns onto armored transporter OT M60, a self-propelled variant for antitank protection of mechanized units was developed. The mobile recoilless gun 82 mm M79 with new optical sight was developed in the 70s.

Figure 10. 82 mm recoilless gun M79

In the middle of 80s, in a unique way at that time, the antitank gun 100 mm M87 TOPAZ was developed, with great firepower, higher accuracy and high firing speed. The ballistic solution of the gun was unified with the solution for the gun 100 mm T-12 The tripod gun-carriage obtained by the modification of the gun-carriage for the howitzer 122 mm D30J allows for circular field of effect by direction and field of -5° to 18° by elevation. A special day-night system of fire control achieves higher probability of hitting moving targets with 70% first-hit probability. With a starting projectile speed of V_0= 1575 m/s, the effective range of TOPAZ with moving targets 2 m high is 1880 m, and for targets 3 m high it is 2230 m. The maximum range for gun in fire support is 8200 m.

Figure 11. 100 mm antitank gun M87 TOPAZ

The coastal gun 100 mm TON was developed and introduced into service in coastal defense, in stationary and towed variants with semiautomatic ammo reload. Also, VTI has developed and modernized the entire range of anti-aircraft guns with calibers 20, 30 and 40 mm in towed and self-propelled versions that showed to be very efficient in close anti-aircraft defense. This proved particularly successful in defense of Serbia from NATO aggression in 1999, when dozens of TOMAHAWK missiles and UAVs were shot down.

There is a long tradition of producing small arms and artillery ammunition in Serbia. Even during the WWII in Western Serbia, in Užice, in autumn of 1941, there was only one free territory in the occupied Europe where regular ammunition was produced. Continuing this tradition, VTI developed and offered expertise help to military industry with development and conquering production of different calibers of ammunition intended for classic armament.

Figure 12. 125 mm projectile for the M-84tank

New propellant charges and modern HE and cluster projectiles with gas generators were developed for artillery weapons. In the area of antitank combat, shaped charges, anti armour and sub caliber projectiles with calibers 100 mm and 125 mm were developed. The introduction of ERA brought development of sub caliber projectiles with hardcore penetrators and projectiles with tandem shaped charge warheads. For all these projectiles, entire families of special fuses were developed.

Rocket armament

In 1955, VTI started with research and development in the area of rocket technology, with a 57 mm unguided air-surface rocket. In the area of missiles, the first projects were two-stage surface-air missile VULKAN with a range of 30 km and an antitank missile SKAKAVAC with a range of 1600 m.

Figure 13. Firing of a PLAMEN rocket

The first experiences in the design of multi-tube rocket launchers are connected to the towed rocket system M63 PLAMEN, a weapon with 32 launching tubes from which 128 mm projectiles were fired at 8.6 km. With the modernization of this system, a self-propelled version of a multi-tube rocket launcher with a range of 12.6 km was developed under the label M94 PLAMEN-C and introduced into service in the Serbian army.

The next step in development of this kind of weapon was a self-propelled multi-tube rocket system M77 OGANJ

with a range of 20 km. This powerful fire support system is mounted on a 6x6 vehicle FAP, with a 32 tube-launcher and a charger that enables firing of two 128 mm rockets subsequently. A single-tube, self-propelled rocket launching system of a long range, suitable for partisan warfare, has been developed from the same system.

Figure 14. Self-propelled rocket system M77 OGANJ during firing

Last in development series of this kind of weapon is a long-range self-propelled multi-tube rocket system – M87 ORKAN. Development of this completely automated rocket system with great maneuvering capabilities and with a range of 50 km enlisted our country in a group of few countries in the world that used to develop and produce similar systems; therefore it is no wonder that since 1988 it has been included into armament of some foreign countries. Owing to its TV corrector, the ORKAN system has a 262 mm rocket of a particularly high precision which can follow four different ballistic trajectories for the same range of activating aerodynamic breaks. The rocket is highly efficient at a target owing to a cluster bomb with bomblets and antipersonnel obstacle mines.

Figure 15. Self-propelled 262 mm multi-tube rocket launcher M87 ORKAN

With the modification of the original version of the ORKAN system mounted on an 8x8 vehicle from the Serbian manufacturer of special terrain vehicles FAP, a four-cylinder system M96 LUNA was obtained and mounted on a Russian 8x8 terrain vehicle MAZ, with similar ballistic characteristics.

In the beginning of the 70s, VTI started development of antitank unguided rocket systems intended for close antitank combat. Manual rocket launchers OSA and OLJA were introduced into service by the end of 70s. With OSA launchers, application of composite materials and aluminum alloys resulted in higher performances and reduced mass with a possibility of firing up to 1000 rounds from the same tube. The 90 mm rocket with shaped charge warhead penetrates up to 400 mm into homogeneous armored steel and has an efficient range of 350 m. The 64 mm rocket launcher M80 ZOLJA is considered to be in a class of single-use antitank rocket launchers with a rocket with a shaped charge warhead and penetrability of over 300 mm and an efficient range of 200 m. In 1990, the further development of this manual rocket launcher intended for antitank combat at small distances, the development of a 120 mm model M91 with 800 mm penetrability and 250 m efficient range was finished.

Figure 16. 90 mm rocket launcher M79 OSA

By the end of 60s, in the area of antitank guided rockets, the Institute was the leader in conquering production of MALJUTKA rockets, built according to licensed documentation. During the production and exploitation, the system was perfected with the development of semiautomatic guidance system and increase of penetrability. With a shaped charge tandem warhead, the rocket penetrability is 800 mm into homogeneous armor. Besides the basic mobile variant, the system is used as a helicopter weapon (XH-42M) and on combat vehicles (POLO-M83) intended for antitank combat up to 3000 m. Also, the system is mounted on a turret of the infantry combat vehicle BVP M80A1.

Figure 17. Antitank launching kit MALJUTKA-2T with the tandem warhead

The antitank rocket system BUMBAR is currently in the final stages of research. It is a light mobile antitank model intended for combats within a range up to 600 m (1000 m with modification) that is capable for zone of point-blank antitank defense of infantry. BUMBAR is primarily an antitank model, but its capabilities allow executing combat assignments of much broader range.

Figure 18. Antitank guided rocket system BUMBAR

The multifunctional use of the BUMBAR system is achieved by applying alternative warheads for destruction of bunkers and other fortified objects. The minimum efficient range of 60 m and its use from a closed space make this system very practical for urban combats and antiterrorist actions. The basis of the system is a 136 mm rocket with 250 m/s speed and a tandem warhead with a penetrability power of 1000 mm into homogeneous armor.

Based on licensed documentation in the period between 1970 and 1990, VTI started conquering the production of a light mobile system for anti-aircraft defense STRELA-2m and self-propelled system STRELA-10M2. At the beginning of the 80s, a rocket reconstruction of STRELA-2M was performed in order to increase efficiency of warheads with miniaturization of electronic head for self-guidance by introducing digital signal processing. Miniaturization was achieved by developing special integrated circuits. The warhead target efficiency was increased for 30%, which led to adopting this rocket system into service in 1984. This mobile antitank rocket system proved to be very effective in the defense of Serbia against NATO aggression.

Figure 19. Self-propelled rocket system for anti-aircraft defense STRELA-10M2J

The self-propelled rocket system for anti-aircraft defense STRELA-10M2J was created as a modification of the basic version. The complete combat system is installed on an amphibian tracking vehicle. The installed subsystems for target acquisition and identification allow manual and automatic fire-and-forget rocket launching in infrared and photo channel. The combat kit consists of 10 rockets, which represents an increase of 20% versus the licensed solution.

VTI also worked on the development of HE air-to-surface missiles MUNJA and GROM. Also, rockets for special purposes were developed within the Institute, such as: flare rockets SVITAC and KOMETA and a rocket target ISKRA.

An especially important place in the development of aircraft equipment is saved for rocket motors for ejection seats equipping ORAO and G-4 SUPER GALEB aircraft since 1997. By conquering production of these rocket motors, VTI has lined among scientific institutions in the world that successfully solved problem of catapulting pilots in case of danger.

Figure 20. Missile system RL-4M

During the warfare conditions in 1999, when 19 NATO members headed by the USA attacked Serbia, without an UN decision and declaration of war, with their actions over civilian (maternity hospitals, hospitals, refugee lines, passenger trains, buses, densely populated areas, TV stations, etc.) and military objects primarily involving actions of outnumbering aviation, the experts from VTI with the help of the "Moma Stanojlović" Repair Factory conducted modifications on IC self-guidance air-to-air missiles and adjusted them for launching from the ground. In only 40 days from the beginning of the aggression, two such systems (RL-4 and RL-2) were introduced into service proving to be very efficient and confusing for the enemy (air-to-air missiles with no aircraft to launch them).

Both of these systems were realized on the vehicle PRAGA from which 30 mm guns (30/2) had been previously removed. The system RL-2M is based on the missile RL-60MK, and the system RL-4M on the missile R-73. In order for missiles from these systems to have a sufficient range, since they lacked the starting aircraft speed, relevant booster engines were added. Many countries today follow this procedure designing ground anti-aircraft missile systems based on air-to-air missiles.

Combat and non-combat vehicles

In the area of combat vehicles, VTI was engaged in developing tanks, armored transporters, infantry combat vehicles and their modifications. The Institute started with tank development in 1954, when the decision to develop a domestic middle tank was made at the highest level.

Based on the Institute's own design and the design of the best tank from WWII, T-34, two different prototypes, M-628 and M-636, were produced. All further activities concerned the model M-636. Participation in these projects brought extremely valuable expert knowledge to the researchers who applied it much later into the development of a top-quality tank M-84.

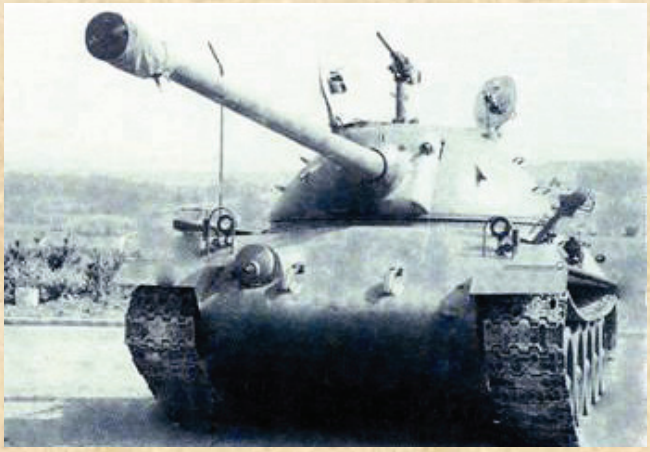

Figure 21. Tank M-636

In the beginning of the 80s, as a result of extensive research that led to significant modifications of the licensed tank T-72, the tank T-84 was developed. Over 20 new types of materials were conquered, new system for fire control, ballistic protection of frontal parts for the armored body and the turret, new tracks with disassembling rubber footboards for driving on public roads were developed as well as a new cooling system, a two-way air purifier, a protection device against fuel explosion and fire and many other systems and subsystems. With an extremely low silhouette, a power-to-weight ratio of 18 kW/t, great maneuverability enabled by a power group of 735 kW and modern transmission, and a 125 mm smooth barrel gun with automatic reload, this tank was listed among the best tanks of its generation and it should not come as a surprise that some foreign armies were also equipped with it.

Figure 22. Tank M-84

By modifying the tank M-84 in 1994, a command tank M-84K was realized, differing from the basic model in the level of communication systems equipment and depending on the version (battalion or brigade one).

The beginning of this millennium saw the beginning of its modification and a new tank has now improved firepower, maneuverability and ballistic protection. The tank M-2001 (M-84AB1) matches the tank T-90S which can be more than successfully compared with tanks Abrams, Leklerk and Leopard. This tank, in comparison with M-84, has an easily exchangeable 125 mm gun barrel (without taking off the turret) from which, besides standard projectiles, laser-guided missiles can be fired, thus increasing its efficiency range on moving targets from 2500 m to 5000 m.

The tank M-2001 possesses a new system of dynamic protection based on a special procedure of armor embedding, a system of optical-electronic neutralization of Štora guided missiles and a 1200 HP power group. Many new systems and devices will make this tank very up-to-date in the years to come.

Figure 23. Tank M-2001

The first combat vehicle that was developed in VTI and introduced into service in 1961 was the armoured personnel carrier OT M-60. The carrier had a power-to-weight ratio of 9.6 kW/t; a maximum speed of 43 km/h and it served as a means of transportation for a combat group of ten. During its serial production, vehicle modifications were conducted and an improved variant, OT M-60P, with reconstructed commands and a new planetary gear, appeared in 1971.

The demand of a foreign purchaser to increase firepower resulted in mounting two 82 mm recoilless guns on the turret. These carriers, OT M-60PB, had a significantly improved cooling system for an operational use under desert conditions.

Figure 24. Armoured personnel carrier OT M-60PB

When the infantry fighting vehicle BVP M-80 was introduced into service in 1979, it was among the best in its own generation because of its general conception, constructional solutions of circuits, aggregates, subsystems and entire vehicle, technical-technological level of solutions, maneuverability and tactical-technical characteristics. Formation armament (20 mm gun, 7.62 mm machinegun and two launchers of antitank missiles), modern solutions for sighting and surveillance, its day-night action, communication devices, NBC protection

device, etc., allow the BVP M-80, its crew and six-member fighting group to wage classic and nuclear warfare under different climactic and weather conditions.

Figure 25. Infantry fighting vehicle BVP M-80A

In 1980, the first modification of this vehicle was carried out resulting in a new model BVP M-80A. The main modification concerned the installation of a more powerful power group with a maximum speed of 65 km/h and increase of a power-to-weight ratio from 13.6 kW/t to 17 kW/t. This vehicle with its amphibian properties was listed as one of the best among world's fighting vehicles of its generation.

In 1991, on the basis of BVP M-80A, the development of commanding combat vehicles on the level of company, battalion, brigade and division was completed. A developed sanitary vehicle BVP M80-A SN was also based on this vehicle, with the purpose of rescuing and medically caring for 4-8 injured soldiers. The basic variant of this vehicle was also used for production of tank-hunters equipped with six MALJUTKA antitank rocket launchers, self-propelled mine depositing vehicle and a light anti-aircraft weapon.

The last modification of this IFV, named BVP M-80A1, included installation of a 30 mm gun-mounted turret stabilized in both vertical and horizontal axis.

Figure 26. Universal engineering vehicle MUNJA

While working on conversion of existing resources, VTI developed a universal engineering vehicle MUNJA based on the T-55 tank. Besides the blade, this vehicle is equipped with other necessary engineering kits placed in containers outside or inside the vehicle, for different engineering tasks such as negotiating natural and man-made obstacles, blocking, road repairs, demining, etc. The important part of equipment is a computer system with a GPS-integrated software, digital compass, laser range finder and digital camera. It is also equipped with a 30 mm automatic grenade launcher and a 7.62 mm machinegun which proved to be an ideal combination in counter-terrorist actions for neutralizing spot targets while engineers conduct prescheduled tasks.

In the area of non-combat vehicles, the VTI's experts have dealt with research, development, modification and realization of cross-country, towed and trailing vehicles for different purposes.

Figure 27. Sanitary vehicle TAM 110 T7 BV

The Institute was also a leader of the development and realization of other significant results in this field such is a family of vehicles TAM 110 T7 - its basic 4x4 version of 1.5 t capacity was the foundation for developing an entire family of special terrain vehicles, including: ambulance, NBC laboratory, communication vehicle and terrain minibus. The basic variant of the 6x6 terrain vehicle TAM 150 T11, with a capacity of 3 t, gave the following special purpose vehicles: water auto-tank, decontamination auto-tank, mobile technical workshop for light repairs and command and communication vehicle.

Based on the terrain vehicle from a Serbian manufacturer in Priboj, FAP 2026 BC/AV with a 6x6 configuration and a capacity of 6 t, a family of special terrain vehicles was developed, the most important among them being: vehicle for the installation of the 128 mm multi-tube rocket system OGANJ as its mounting platform, logistic vehicle for rocket systems OGANJ and ORKAN, fuel auto-tank, fire extinguisher, vehicle with a surveillance-acquisition radar, vehicle with a water purifying device, vehicle with a drill for mine-wells and vehicle equipped for the production of physiological solutions.

Figure 28. Towed vehicle FAP 3232 with a low-carrying semi-trailer with a capacity of 45 t

The all-terrain vehicle FAP 2832 BS/AB with a 6x6 configuration and a capacity of 9 t that entered in service in 1988, served as a mounting platform for the 262 mm multi-tube rocket system ORKAN and for the 152 mm self-propelled gun-howitzer NORA. Also, owing to the cooperation of the Institute and the manufacturer, this terrain vehicle was adjusted for towing low-carrying semi-trailers with a capacity of 45 t.

Figure 29. Command vehicle VK-0,75 TARA

The all-terrain vehicle TARA with a 4x4 configuration and a capacity of 0.75 t was developed at the beginning of the 90s, together with a whole family of these vehicles, from military to civilian purpose types. The most interesting and the most complex one is the command vehicle VK-0.75, equipped with various systems, communication ones in particular, and intended for operation at the commanding level of battalions, brigades and corpuses in all combat conditions.

Figure 30. Terrain vehicle FAP 1118

In cooperation with the manufacturer, the VTI's experts are currently working on the final phase of the conversion of a non-combat 4x4 vehicle FAP 1118, of 5 t capacity, into its military purpose version. This all-terrain truck is able to negotiate gradients of 60%, and owing to its low balance point with no risk of turning over, it negotiates lateral slopes up to 35%. With the autonomy of 700 km, FAP 1118 is designed to operate efficiently in the temperature range from –30 to +50° and to ford depths to 80 cm.

Aircraft and aeronautic systems

The tradition of producing military aircraft in Serbia has dated since March 1924, when the factory IKARUS developed its first training military airplane ŠB-1. Between two world wars, Serbia, as a part of the Kingdom of Yugoslavia, produced many different models of airplanes, from fighters to bombers. Continuing this tradition, immediately after WWII, a newly formed Aeronautics-technical Institute (10 August 1946), which later became an integral part of the VTI, began to develop new military airplanes and other air vehicles.

In the period of 1951-1957, the Institute, in cooperation with different constructor groups in the country, designed and tested many different airplane models, among which the S-49C fighter-bomber stood out with its characteristics. In the same period the first wind tunnels were constructed on the basis of national constructors' solutions.

Figure 31. Trainer-fighter G-2 GALEB

Starting from 1957, research, design and tests in the field of air defence were conducted within the Institute, and as a result the year 1961 saw the first national jet aircraft G-2 GALEB of original construction. This trainer-fighter tandem-seat aircraft was intended primarily for initial and combat training of military pilots. The G-2 is designed as a modern low-winged aircraft with a small telescopic landing gear, engine in the fuselage, good overview and excellent fuselage shape. Its completely metal, aluminium-based light alloy structure makes it lightweight, tough and resistant, easily maintainable and long-lasting (almost 40-year long lifetime).

The adopted structural concept of the two-seater G-2 enabled a quick development of the single-seat attack aircraft J-21 JASTREB that flew for the first time in 1963. A reconnaissance (IJ-21) and a two-seat training (NJ-21) version of this aircraft were later developed.

Figure 32. Fighter J-21 JASTREB

As very successful projects, GALEB and JASTREB aircraft drew attention and received important recognition at international air shows in Great Britain and France as impressive technical achievements in their categories. Consequently, many foreign countries introduced these aircraft into their military use.

Soon after the G-2, the Institute designed and developed the light fighting piston-propeller aircraft J-20 KRAGUJ that flew in the summer of 1962. The airplane was intended

as a fire support to ground units and for combat against helicopter landing troops. This light airplane armed with two 12.7 mm machineguns and two 57 mm rocket launchers with 12 rockets, could even take off from meadows.

Figure 33. Aircraft J-20 KRAGUJ

By the end of the 60s and the beginning of the 70s, in cooperation with Romania, the development of the jetfighter-bomber ORAO started and the first prototype had a successful flight in 1974. It was the first national airplane that could fly faster than sound. This two-engine, high-winger with the classic construction in order to shorten the landing track, is equipped with a braking parachute. It can carry a wide range of weaponry including: two 23 mm two-barrel guns, guided and unguided rockets, and air bombs of different size and purpose.

The ORAO airplane has 25 years of lifecycle. There are four versions of this airplane: J-22 single-seat attack-jetfighter, IJ-22 single-seat reconnaissance, NJ-22 tandem-seat training airplane and INJ-22 tandem-seat reconnaissance.

Figure 34. Fighting pair of J-22 airplanes ORAO

The first prototype of the trainer-fighter G-4 SUPER GALEB took off on 17 June 1978. Although it kept the name GALEB, the G-4 represented a completely new airplane, unlike the G-2 version. With remarkable maneuvering capabilities, excellent behavior with high attack angles and spins, with arrow-like wings, favorably shaped fuselage, hydraulic commands for wings and tail and with good ergonomics, SUPER GALEB is adapted to high sub-sound and mild supersonic speed in a broad range of heights, which allows the pilot training in similar fighting conditions.

Figure 35. G-4 Trainer-fighter SUPER GALEB

The robust landing gear enables taking off from grassy landing tracks, and starting rockets and braking parachutes secure, when needed, short-distance take-off and landing. With solid rocket and gun weaponry, the G-4 proved good as a fire support and in fighting against helicopters.

Modern design solutions made SUPER GALEB very suitable for further development and in the beginning of the 90s the G-4M version was designed. The modernization mainly includes equipping the airplane with new digital avionics with modern navigational-attacking, identification and communication equipment.

Since 1985, when it first appeared first at Air Show LE BURGEE in France and at any world air show afterwards, the SUPER GALEB caught remarkable attention and received compliments. Good behavior of the airplane at low speed and at spins was mainly accentuated, as well as remarkable maneuvering capabilities, and it is of no surprise that this airplane is still among the best in its category. A certain number of these planes were exported and unjust brutal sanctions against Yugoslavia, i.e. Serbia, stopped already spoken for export deals.

Figure 36. Airplane LASTA

In order to reduce expenses of initial pilot training, the Institute launched the development of a piston-propeller airplane for the initial and basic pilot training. The first prototype of this airplane, known as LASTA 1, took off in 1985. By the end of the 80s, the version LASTA 2 was designed, with a smaller fuselage, new landing gear and redesigned equipment. Because of the sanctions, further development of this airplane was temporarily canceled and in the second part of the 90s a new version LASTA 95 appeared with even better flight capabilities. During the aggression in 1999, all models were destroyed in the factory. At this moment the latest version of LASTA is under development and it will be armed upon the request of a foreign purchaser.

Figure 37. Mini UAV

Besides the airplanes, the Institute worked on design and development of other types of air vehicles. The glider KORUND is considered to be a very successful solution. At the moment, a project of a mini UAV is very prosperous and it is intended for protection and reconnaissance of major infrastructure objects such as pipelines, power lines, important traffic roads, etc. Its basic military use is for close range reconnaissance.

At the same time with development of aircraft models, the Institute was also developing elements of aeronautical

equipment and weaponry. Special attention was dedicated to communication, navigation and control systems, systems of counter-electronic protection, systems for processing radar, speech and TV signals, parts of pilot equipment and weaponry systems.

Figure 38. LVB-230F laser guided bomb

In order to realize all these projects in the area of aeronautics, i.e. aerodynamics, it is necessary to carry out appropriate wind tunnel tests. Over the last 60 years, the Institute developed, mostly independently, a powerful wind-tunnel complex, usually found only in industrially and technologically most advanced countries, which includes the following: T-32 small subsonic wind tunnel, T-33 water-cavitation wind tunnel, T-34 hypersonic wind tunnel (in cooperation with the Faculty of Mechanical Engineering, Belgrade, Serbia), T-35 large subsonic wind tunnel, T-36 transonic-supersonic wind tunnel and T-38 tri-sonic wind tunnel (in cooperation with the Canadian company DSMA).

Figure 39. LASTA airplane model in the T-35 wind tunnel

The wind tunnel complex and an expert team from the Institute often help foreign companies in their projects which require this type of testing. Besides testing for military purposes, these wind tunnels are used for tests in the areas of civil engineering, transportation, etc.

Telecommunication, radar, computer and optic-electronic devices

Scientific research in the area of telecommunications was conducted at the same time with development of new resources and communication systems, including many scientific and technical areas, such as: methods, techniques and transfer systems (wiring and optical cables, radio relays, VF and VVF systems of radio transfer, analogue and digital multi-channel systems,etc.), commutation and commutation systems (telephone, telegraph and digitally integrated ones), methods and techniques of synchronization and signalization in digital telecommunications, analogue and digital signal processing, coding and compression, etc.

The first beginnings of VTI in the area of telephony were connected to the modifications of trophy devices, from which more complex devices followed, including the induction telephone central unit MP-10 and the telephone set PTI-49. In order to increase capacity and automation of telephone and telegraph communications, as well as to integrate telephon mobile and combat radio-network, the following devices were developed and introduced into service: automated telephone central units ATC-1 and ATC-2. With further development of this area in the 60s, a radio-relay device for transferring 4-frequency distributed telephone channels HVT-1 was developed, followed by the next generation of RRU-9 intended for communication with supreme command – army – division. In the 90s the model RRU-D was realized (30 digital channels) with integrated functions of surveillance and control. The most recently developed model was the RRU-1.

Figure 40. Radio-relay device RRU-1

Development in the area of devices and systems of radio-contact included research and development of radio devices with signal transmission in extended spectrum. Independently or in cooperation with the industry, over 30 types of radio devices and a large number of antennas and antenna devices were developed and introduced into service. A special achievement was accomplished in the area of developing VHF radio devices with frequency hopping and integrated crypto-protection of speech and data, RU-5 and RU-50.

By the end of 90s, the DISC system was developed (Digitally Integrated System of Communication) with a purpose to create modern digital telecommunication system that meets military requirements regarding high-quality and fast verbal and nonverbal communication of stationary and mobile users, with tactical and technical flexibility and high

level of protection and data transfer resistant to electronic warfare. The DISC is designed as a system of modular structure, and organized into three levels: magistral, accessing and user.

Activities on electronic protection systems resulted in a solution for a PC-based integrated system of technical protection. A developed microprocessor alarm central unit is intended for complete protection of stationary objects. It uses different types of sensors, including fire protection sensors. The mobile system for movement identification PRESEK was also developed, allowing identification and classification of violations in protected spaces (pedestrian, group of pedestrians, vehicle, animals), as well as determination of movement trajectory, direction and speed.

Figure 41. Radio-direction finder RG-2/3

The VTI started research in the areas of electronic warfare in telecommunications a few decades ago, and at the very beginning the system for analysis of telegraph signals ATC-1 and the automated radio-reconaissance system ARIS were developed. By solving problems of automated search processes and signal analysis, receiving, tracking, direction finding, data acquisition and processing, many types of radio-jammers and direction finders were developed.

By the end of 90s, prior to the aggression of the NATO on Serbia, the work on application of microprocessor technology and software control resulted in the radio-direction finder RG-1 for a VHF/UHF band range of 50-500 Mhz, which proved to be very efficient in war conditions. The direction finder RG-1 and its successor RG-2/3 determine a direction of a radio-transmitter based on a modern MUSIC method that allows direction finding of multiple simultaneous, active emissions in the same channel, which is not possible with classic methods.

Development in the area of radar technique started immediately after the founding of the Institute in 1948. From the very first days, emphasis on three radar areas of research was established: primary radars, radar jammers and secondary radars (identificators). The development of the first national surveillance radar was completed in 1955. It had 220 MHz frequency, impulse power of 100 kW and a range of 150 km. At the beginning of the 60s, in cooperation with the industry, the mobile surveillance-acquisition radar FRUŠKA GORA was realized and its serial production lasted until 1973. In the 80s, on the basis of licensed documentation, the VTI started the realization of a modified 40 mm AA artillery system which also included a modification of a self-propelled variant of the surveillance and sighting radar- this led to a YU variant of a well-known radar GIRAFFE.

Research and development in the area of computer technique started in 1952 with development of an analogue computer. By the mid-60s, developed computer systems have found their use mostly in fire control systems of AA guns.

Figure 42. Control board of the surveillance-acquisition radar P-15 in the SONIC system

With the conquest of microprocessor and multi-microprocessor technology by the end of 70s, the system for detection of low-flying targets SONIC was developed. The technical solution for this system is based on a VTI's design of an integrated system with distributed data processing. The operative system SONIC, intended for anti-aircraft defense regiments and divisions, detects targets and integrates target surveillance, selection, tracking and monitoring. It also informs units and performs the weapons system acquisition. By the beginning of the 90s the horizontal, digital panoramic display for automated display of primary and secondary radar image processing and target tracking entered service while the radar P-15 was adapted.

During the 80s, for the M-84 tank fire control system, a computer subsystem with an original software for real-time performance was developed. Together with the other fire control subsystems, the computer provides the first-hit probability higher than 50% at a distance of 2000m. Based on these experiences in design and system development in real-time, computer fire control subsystems in 40 mm and 30/2 mm AA guns were developed.

Figure 43. M-84 tank fire control system components

During the development of the M-84 tank fire control system, the VTI developed adequate optical and optical-electronic equipment which was a vital part of the day-night sight with an integrated laser rangefinder. This knowledge was applied in the development of the fire control systems of the TON coastal gun, TOPAZ antitank gun, OGANJ and ORKAN rocket systems and T-55 modernized tank.

In the area of electric power sources, the VTI had also significant success over the last 60 years. Many electric power sources, power generators and electro-chemical power sources were developed. This period witnessed also to a large number of training aids such as training devices for tank drivers, training devices for radiotelegraph and teleprinter operators, mini training shooting ranges, etc.

Devices of nuclear-biological-chemical protection

In the area of nuclear-biological-chemical (NBC) protection, the VTI carried out research into effects of NBC weapons, together with development of detection and measurement methods, equipment and devices as well as individual and collective protection against NBC weapons.

Figure 44. Radioactive contamination measurement device M87

The research regarding nuclear protection included war dosimetry and radiometry and technical nuclear protection. In war dosimetry and radiometry, the following methods and devices for detecting and measuring nuclear radiation were developed: general purpose detector of radioactive radiation DRZON and radioactive contamination measurement device M87. These devices, based on the gamma method, were used during the NATO aggression on Serbia when some of its regions were hit by depleted uranium ammunition.

Figure 45. Phonic protection mask with the drinking water kit

Within the protection against effects of nerve gases, the VTI has dealt with detection, devices of individual and collective protection and decontamination. The research results enabled the development of many generations of devices for protection of body and respiratory organs, of filtration, insulation and ventilation type. The phonic mask with a drinking water kit was developed as an efficient device for individual protection of respiratory organs, eyes and face against NBC contamination in the form of raindrops, gases, vapours of solid and liquid aerosols and contaminated dust particles.

Development in the area of detection of nerve gases resulted in designing devices and kits for detection that operate on the electro-chemical principle. An automated chemical detector is an efficient device for continual monitoring of the surrounding atmosphere with the goal to detect nerve gases (sarin, soman, VX), chaking gas (phosgene) and nerve blood gases (hydrogen cyanide). The personal decontamination kit M3 was developed for a single use and quick decontamination of exposed body parts, personal weaponry and items of clothes and equipment as well as the group decontaminator AGD-1 that can efficiently decontaminate 4-5 m2 of a contaminated surface by dispersion with a single charge of decontamination liquid TD-1.

Figure 46. Protection overalls, protection filtrating suit and protective cloak

A filtrating protection suit, protection overalls M5, protective cloak M3, boots, gloves and socks were developed and introduced into service as individual NBC protection equipment.

Engineering equipment

In the area of negotiating water and dry obstacles, the VTI achieved significant results in the theory of calculus of bridge constructions. The VTI created its own calculation methods for systems of suspending bridges with the span of up to 117 m and pontoon bridges as well as theoretical solutions for problems in prefabricated systems of BAILEY bridges, thus

increasing their span 2-3 times, and carriage capacity up to 10 times. The knowledge gained in designing BAILEY bridges with large span and carriage capacity was used for rebuilding bridges destroyed in NATO aggression that had primarily targeted civilian infrastructure objects. The several hundred-meter-long railway-road bridge MD-88 near Novi Sad was erected over the Danube river in only 100 days.

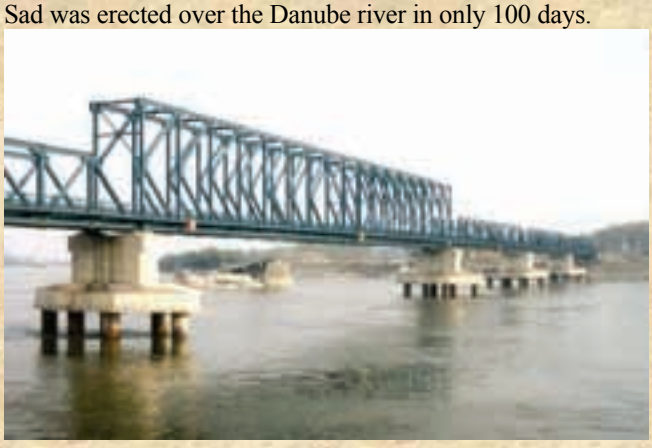

Figure 47. МД-88 Bridge over the Danube near Novi Sad

Methods for laboratory and field testing of soil, stone aggregates, concrete and asphalt mixtures were conquered as well as methods for testing carriage capacity, roughness and damage of driveway constructions in the domain of building military roads and airports. A large number of engineering toolkits and devices of different purposes was developed together with methods and equipment for quick repair of airport runways. VTI experts have successfully implemented acquired knowledge of repairing airport runways in military and civilian airports of the former Yugoslavia and foreign countries.

Figure 48. M70 drilling kit for mine wells

Different methods and techniques of demolishing various objects were mastered for the purpose of road and area blocking. One of the important realized designs was the development of a mine well drilling kit mounted on the vehicle FAP 2026 BS/AV-KBMB. For area blocking with antitank mines, a self-propelled armored mine layer was developed on the chassis of the fighting tracked vehicle M-80. This vehicle carries 288 mines which can be either dug in or spread on the ground.

Many models of equipment for the manual and mechanized de-mining were developed. A mechanized minesweeper intended for opening passageways and de-mining antipersonnel and antitank minefields were developed for T-55 and M-84 tanks as its carriers.

The VTI gave remarkable contribution in designing, developing and equipping special protective constructions for buildings such as military and civilian shelters, revetments, special purpose structures (commanding posts, communication centers, etc.). Within this domain, problems of projectile direct impact or explosion blast waves were treated. It was proved that reinforced bars in concrete constructions were not essential for concrete resistance, that they do not react with concrete in the impact area and that too many reinforced bars in direction of projectile penetration can have opposite effects. Remarkable results in designing special protection equipment for this type of objects were achieved, such as filtrating-ventilation devices as well as an entire family of antishock valves for shutting exterior hatches in shelters.

Figure 49. Water station for complex water purification

The VTI dealt with water supply systems from its founding. Several different types of water tanks, families of manual filters for simple and complex water purification, water stations of different capacities and well drilling kits were introduced into civilian and military service. The Institute successfully applied this knowledge, in cooperation with other relevant national partners, throughout the country as well as abroad, eg. in the sub-Saharan part of Africa.

In the initial period of the VTI, from 1948 to 1960, the experiences from WWII were used in conquering camouflage equipment for the protection of important military and economic facilities. For the last 30 years in the area of camouflage, intensive research was conducted with significant results in testing and determining spectral qualities of the characteristic types of terrain in the country, camouflage characteristics of different natural and manmade materials and the possibility of their application in camouflage. Methods and procedures for camouflaging people, objects and weapons and military equipment were studied in ultraviolet, visible and close IC spectrum, as well as methods for deceiving.

Figure 50. Camouflaging the ship with the camouflage net

Many types of camouflage equipment were developed such as camouflage uniforms for all weather conditions, cloaks, tent wings, camouflaging nets, camouflaging paints in three different systems (alcide, acrylic and dispersive), etc. In the area of deceiving equipment, remarkable results were achieved and demonstrated during the war in 1999.

Naval systems

Military shipbuilding in the VTI continues a long and rich tradition of the former Naval Institute that was left in the separated republic after the Yugoslavia breakdown. Since 1992, the Institute has primarily been dealing with the River Naval Army requirements. The Institute was mainly engaged in modernization and re-armament of mine hunters, tank carriers and landing boats that Serbian river fleet used.

Besides participating in modernization of the existing river naval fleet of Serbia, the VTI actively participated in equipping the latest river mine hunter NOVI SAD that entered the Serbian River Navy service during the war in 1999. This is the latest and the most sophisticated river naval ship in the Danube basin, probably in the entire Europe, which showed its fighting prowess and vitality during 78 days of the NATO aggression. It is no wonder that some countries, some even from the NATO alliance, show interest in purchasing it, especially when its previous version NEŠTIN had already been introduced into river flotillas of several countries.

Figure 51. River mine hunter 341 NOVI SAD

The NOVI SAD represents a very powerful and efficient fighting system owing to its low draft, reduced physical fields (thus allowing safe passage over minefields), ability to dock to natural river banks, transport of 100 soldiers with their weapons and equipment, diverse weaponry and ability to camouflage near the bank, etc. This ship with displacement 57.31/79.60 т is armed with two 20 mm 4-barreled artillery systems M75 and the launcher with 4 STRELA-2M rockets.

Information support and information technologies

The primary task of the information support in the VTI is the support of research and development projects in the areas of armament and military equipment. The heterogeneity of these projects dictates a very complex information support.

In order to keep up with the scientific development in the world and to satisfy the information needs of the VTI researchers, a Military Automated Scientific Technical Information System or VANTIS was designed in 1978 for processing VTI's own and foreign bibliographic and information data basis.

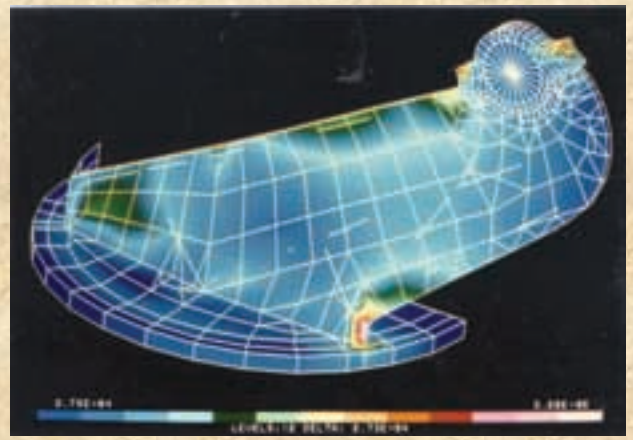

Figure 52. Calculation of static tilt for the howitzer carriage with the Final Element Method

Well-organized librarian-information-publishing activities of the Institute have accompanied all VTI's projects. The library of the Institute has over 200.000 monographs, nearly 30.000 special documents, over 2000 magazine titles, etc. The following serial publications have been published: SCIENTIFIC TECHNICAL REVIEW (since 1950), SCIENTIFIC TECHNICAL INFORMATION (since 1963) and WEAPON DATA (since 1977).

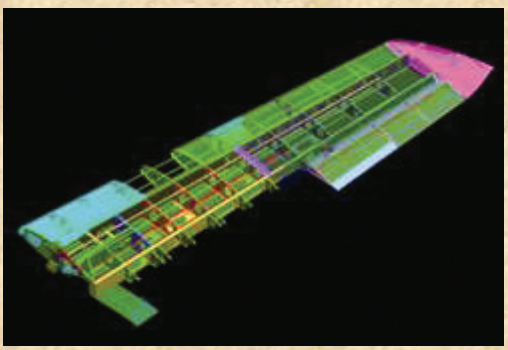

Figure 53. CAD model of the aircraft wing

The Institute possesses the most technologically advanced computer systems for design, structural analysis and production (CAD/CAM/CAE). The application of these computer systems and relevant computer tools has allowed design of individual assemblies and elements for most advanced models of weaponry and military equipment. Modern numerical methods, mostly based on the method of final elements, are used for different calculations and analyses.

Conclusion

All these projects would not have been realized if there had not been preliminary tests and verifications in 28 specialized laboratories within the VTI. Some of the presented laboratories are of international importance, some are unique in the West Balkan region, and most of the Military Technical Institute's laboratories exceed military importance and can be regarded as a national resource of the Republic of Serbia.

The laboratory potentials of the Military Technical Institute have been created for six decades and it is a never-ending process. These laboratories fulfill the quality system requirements regulated by SRPS ISO/IES 17025 and SRPS ISO 9001 standards. These are the Institute's laboratories:

- for Experimental Aerodynamics,
- for Experimental Modal Analysis, Signal Analysis and Balancing,

- for Experimental Strength,
- for Special Armament Measurements,
- for Solid Propellant Rocket Engine Testing,
- Explosive Materials Testing Laboratory,
- Hardware In The Loop (HIL) and Telemetry Measurements Laboratory,
- for Inertial Sensors,
- for NBC protection,
- for Nuclear Radiometry and Dosimetry,
- for Analysis of Toxic and Hazardous Chemicals,
- Electromagnetic Compatibility (EMC) Laboratory,
- For Optics and Optoelectronics,
- TV Guidance Laboratory,
- For Fuels and Lubricants testing,
- Vehicle Subsystems Laboratory,
- Metrological Laboratory,
- For Applied Spectrophotometry,
- For Polymeric and Corrosion Protective Materials,
- For Metal Materials,
- For Hydro-acoustics,
- For Physical-technical Measurements,
- For Devices in Environmental Conditions Testing,
- For Telecommunication Networks,
- For Digital Signal Processing,
- For Radio Equipment and Radio Systems,
- Antenna Laboratory,
- Prototype laboratory.

Figure 54. Tank VIHOR

On the occasion of the sixtieth anniversary of the VTI, this editorial presents the most important realized projects so far. We think that the Institute has a reason to be content about and that all the researchers and other employees that worked and still work in the VTI should be proud of their creativity.

Figure 55. Aircraft N/A

In the end, we cannot avoid to mention that the international community directly and indirectly influenced the development of new modern and advanced models of weapons and military equipment by its decision to break the multinational Yugoslavia and by introducing unjust and unjustified sanctions to Serbia which used to be the driving force of its development. We will mention only three most important projects that were put to halt due to the breakdown of Yugoslavia by the end of the twentieth century. These projects are the VIHOR tank, the multipurpose supersonic fighter N/A and the project EDA concerning an electromagnetic gun.

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6 decenija Vojnotehničkog instituta

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Шесть десятилетий Военнотехнического института

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Six décennies de l' Institut technique militaire