

### *Successful Policy*

The history of this welding technology exemplifies the ingredients of a successful military, energy and industrial development policy. In the 1940s the Soviets were faced with the problem of devising a welding technology that could maintain the rail system in Siberia's intense cold.

One of the Soviet Union's foremost physicists, Mikhail Lavrent'ev, and his students began studies in heat transfer, shock wave propagation, and nonlinear hydrodynamics. As a result of their theoretical work in highly nonlinear effects, and some fortuitous experimental work, the Soviets found that a mixture of flux (cleaning agents used in welding) and explosives allowed for a rapid welding of large surfaces of metal and resulted in welds of extraordinary strength.

Contrary to common sense, the explosion of the flux does not push the metal surfaces apart — it bonds them together with greater strength than the metal itself!

Lavrent'ev continues to lead a large group in Novosibirsk which is studying the problems of materials and welding. It is this expertise which has allowed the Soviets to progress at an extraordinary rate in the fabrication of very large vacuum vessels in fusion research and to build the "impossible" reaction chamber for a military application.

Energy research and industrial development are key in every one of the technologies necessary for building the beam weapon that Keegan warns about.

In an editorial, *Aviation Week* blamed the "suppression of evidence of a massive Soviet research, development, and industrial push aimed at the goal of an anti-ICBM directed-energy weapon" on "smugness and intellectual arrogance." This is silliness. The blame belongs squarely on the shoulders of those who propose a halt to fusion and fission research, a halt to industrial growth, and destruction of creative science.

—Dr. Steven Bardwell

## Aviation Week Magazine:

# Soviets Push For Beam Weapon

*The following are major portions of the article by Clarence Robinson, Jr. which appeared in the May 2 issue of Aviation Week, revealing the imminent Soviet deployment of a charged-particle "beam weapon system" which was developed as a spin off of Soviet research into fusion power applications. The sub-head of the article reads: "USSR developing charged-particle device aimed at missile defense, exploring high-energy lasers as satellite killer."*

Washington — Soviet Union is developing a charged-particle beam device designed to destroy U.S. intercontinental and submarine-launched ballistic missile nuclear warheads. Development tests are being conducted at a facility in Soviet Central Asia.

The Soviets also are exploring another facet of beam weapons technology and preparing to test a spaceborne hydrogen fluoride high-energy laser designed for a satellite killer role. U.S. officials have coined the term directed-energy weapons in referring to both beam weapons and high-energy lasers.

A charged-particle beam weapon focuses and projects atomic particles at the speed of light which could be directed from ground-based sites into space to intercept and neutralize reentry vehicles, according to U.S. officials. Both the USSR and the U.S. also are investigating the concept of placing charged-particle beam devices on spacecraft to intercept missile warheads in space. This method would avoid problems with propagating the beam through the earth's atmosphere.

Because of a controversy within the U.S. intelligence community, the details of Soviet directed-energy weapons have not been made available to the President or to the National Security Council.

Recent events have persuaded a number of U.S. analysts that directed-energy weapons are nearing prototype testing in the Soviet Union. They include:

- \* Detection of large amounts of gaseous hydrogen with traces of tritium in the upper atmosphere. The USAF-TRW Block 647 defense support system early warning satellite with scanning radiation detectors and infrared sensors has been used to determine that on seven occasions since November, 1975, tests that may be related to development of a charged-particle beam device have been carried out in a facility at Semipalatinsk.

- \* Ground testing of a small hydrogen fluoride high-energy laser and detection of preparations to launch the device on board a spacecraft. Some U.S. officials believe the test of the antisatellite laser may be related to recent Soviet activities on a manned Salyut space station.

- \* Test of a new, far more powerful fusion-pulsed magnetohydrodynamic generator to provide power for a charged-particle beam system at Azgir in Kazakhstan near the Caspian Sea. The experiment took place late last year in an underground chamber in an area of natural salt dome formations in the desert near Azgir and was monitored by the TRW early warning satellite stationed over the Indian Ocean.

- \* New test site at Azgir under the direct control of the Soviet national air defense force (PVO Strany), commanded by Marshal of the Soviet Army General P.F. Batitskiy. Since the PVO Strany would be responsible for deploying a beam weapon to counter U.S. ICBM warheads, Marshal Batitskiy's role indicates a near-term weapons application for these experiments, U.S. officials believe.

- \* Point-by-point verification by a team of U.S. physicists and engineers working under USAF sponsorship

that the Soviets had achieved a level of success in each of seven areas of high-energy physics necessary to develop a beam weapon.

\* Recent revelations by Soviet physicist Leonid I. Rudakov during a tour last summer of U.S. fusion laboratories that the USSR can convert electron beam energy to compress fusible material to release maximum fusion energy. Much of the data outlined by Rudakov during his visit to the Lawrence Livermore Laboratory has since been labeled top secret by the Defense Dept. and the Energy Research and Development Administration, but it gave a clue to U.S. scientists that the USSR is far ahead of the U.S. in controlled fusion by inertial confinement (compression of small pellets of thermal nuclear fuel) and weapons based on that technology.

\* Pattern of activity in the USSR, including deployment of large over-the-horizon radars in northern Russia to detect and track U.S. ICBM reentry vehicles, development and deployment of precision mechanical-phased-array anti-ballistic missile radars and massive efforts aimed at civil defense.

There is little doubt within the U.S. scientific or intelligence communities that the Soviets are involved in developing high-energy technology components that could be used to produce a charged-particle beam weapon, but there is a great difference of opinion among officials over whether such a device is now being constructed or tested in the USSR.

In increasing numbers, U.S. officials are coming to the conclusion that a decisive turn in the balance of strategic power is in the making, which could tip that balance heavily in the Soviets' favor through charged-particle beam development, and the development of energetic strategic laser weapons.

Most of the controversy centers on what tests are being conducted in an unusual research facility about 35 mi. south of the city of Semipalatinsk.

In the face of mounting evidence of Soviet efforts aimed at developing a charged-particle beam weapon for anti-ballistic missile defense, the Air Force's Scientific Technical Intelligence Committee (STIC) has scheduled a fall meeting to review new data.

The Semipalatinsk facility where beam weapons tests are taking place has been under observation by the U.S. for about 10 years. The central building at the facility is believed by some officials to contain a collective accelerator, electron injectors and power stores.

The building is 200 ft. wide and 700 ft. long, with walls of reinforced concrete 10 ft. thick. The entire facility, with its associated support equipment, is estimated to have cost \$500 million.

The test site is at the southern edge of the Semipalatinsk nuclear test area, and it is separated from other test facilities. It is surrounded by a series of security fences.

The total amount invested by the USSR in the test project for the 10 years' work there is estimated at \$3 billion by U.S. analysts.

The U.S. used high-resolution photographic reconnaissance satellites to watch as the Soviet technicians had four holes dug through solid granite formations not far from the main large building at the facility. Mine heads were constructed over each opening, and frames were built over the holes. As tons of rock were removed, a

large underground chamber was built deep inside the rock formation.

In a nearby building, huge, extremely thick steel gores were manufactured. The building has since been removed. These steel segments were parts of a large sphere estimated to be about 18 meters (57.8 ft.) in diameter. Enough gores for two complete spheres were constructed. U.S. officials believe the spheres are needed to capture and store energy from nuclear-driven explosives or pulse-power generators. The steel gores are believed by some officials to be among the earliest clues as to what might be taking place at the facility.

The components were moved to the nearby mine heads and lowered into the chamber.

Some other U.S. physicists believe the steel gores are designed for underground storage of unused nuclear fuel for a magnetohydrodynamic or closed cycle gas core fission process needed to power beam weapons or for storing waste products from the fission process.

One of the major problems in gaining acceptance of the concept within the U.S. scientific community was to convince high-energy physics experts that the Russians might be using nuclear explosive generators as a power source to drive accelerators capable of producing high intensity proton beams of killing potential.

Initially, some U.S. physicists believed there was no method the Soviets could use to weld together the steel gores of the spheres to provide a vessel strong enough to withstand pressures likely to occur in the nuclear explosive fission process, particularly when the steel to be welded was extremely thick. U.S. officials later discovered that the Russians invented a process called flux welding and had been using it for years in producing pressure spheres. The flux welding process, according to some U.S. officials, makes the bonded material weld as strong as, or stronger than, the steel walls.

U.S. officials, scientists and engineers queried said that the technologies that can be applied to produce a beam weapon include:

\* Explosive or pulsed power generation through either fission or fusion to achieve peak pulses of power.

\* Giant capacitors capable of storing extremely high levels of power for fractions of a second.

\* Electron injectors capable of generating high-energy pulse streams of electrons at high velocities. This is critical to producing some types of beam weapons.

\* Collective accelerator to generate electron pulse streams or hot gas plasma necessary to accelerate other subatomic particles at high velocities.

\* Flux compression to convert energy from explosive generators to energy to produce the electron beam.

\* Switching necessary to store the energy from the generators in large capacitors.

\* Development of pressurized line needed to transfer the pulses from the generators to power stores. The lines must be cryogenically cooled because of the extreme power levels involved.

For several years, Air Force Maj. Gen. George J. Keegan, who until his recent retirement headed USAF's intelligence activities, has been trying to convince the Central Intelligence Agency and a number of top U.S. high-energy physicists that the Soviets are developing a charged-particle beam weapon for use in an antiballistic missile role.

Evidence was gathered by Air Force intelligence from a variety of sources, including early warning and high-resolution reconnaissance satellites, published USSR papers on high-energy physics and visits between Soviet and Free World physicists. In contacts with scientists deeply involved in developing components necessary for beam weapon application in both the USSR and the U.S., data was gleaned that clearly showed the Russians to be years ahead of the U.S. in most areas of technology, one U.S. physicist said. He added that it became increasingly clear that the Soviets were making a concerted effort to develop the technology in each area so that, if it was pulled together, a beam weapon and possibly related laser weapons could result.

All of the evidence that Gen. Keegan and his small team gathered about Soviet designs on charged-particle beams was presented to the CIA and its Nuclear Intelligence Board, which has so far rejected their conclusion that beam weapons development is evident.

Most of the evidence has been gathered over a four-year period and involved the entire spectrum of facilities for test and experimentation, research laboratories, power generation, electron injection, collective acceleration and beam propagation — all areas where the Soviet Union has outpaced the U.S., according to a U.S. official.

Some scientists and engineers refused to accept information that the installation at Semipalatinsk had anything to do with beam-generation tests or that levels of energy required for these experiments could be attained. And even if somehow the energy could be generated, it could not be harnessed for beam application, they said....

In recent public pronouncements, Gen. Keegan has taken the CIA to task for having rejected Air Force intelligence information about Soviet beam weapon development. He also has spoken bitterly about a number of top U.S. physicists who refused to accept even the possibility that the Soviets are involved in beam weapon development. Most of the physicists who would not accept the data were older members of the scientific community who had been involved in research and development from the early days of a project called Seesaw.

The U.S. attempted unsuccessfully to develop a charged-particle beam device under the project code named Seesaw. It was funded by the Defense Dept.'s Advanced Research Projects Agency but abandoned after several years.

A number of influential U.S. physicists sought to discredit Gen. Keegan's evidence about Soviet beam development. The general attitude within the scientific community was that, if the U.S. could not successfully produce the technology to have a beam weapon, the Russians certainly could not. "It was the original not-invented-here attitude," one U.S. physicist said. . . .

"One of the problems is that some U.S. intelligence officials and scientists have difficulty in understanding the concepts involved. The technology is simply beyond their comprehension," an official said. The facility at Semipalatinsk is an example, the official continued. It depends on how it is visualized. "This is a case where the experimental hardware is identical to the equipment necessary to destroy an ICBM. If they can generate the

charged-particle beam to test the device, and large amounts of hydrogen being burned there indicate they are, then they can generate for weapons use." . . .

"After 10 years of work at the site and after developmental testing of the beam for over a year, the only thing required is to scale the device for weapons application," he said. That could be accomplished by as early as 1978 with a prototype beam weapon, and it could be in an operational form by 1980, some officials believe. . . .

"The one thing that George (Gen. Keegan) finds so pernicious about this whole thing is that CIA and other top U.S. officials scoff at the idea that the backward Russians can develop technology that we have been unable to develop in the U.S.," one official said. "He (Keegan) admits that he could be wrong, but he is not wrong about the Soviets' will to produce such a weapon and about the national assets they are devoting to it."

"From all of this evidence we have a good idea of where the Soviets are in development and where they are headed with beam weapons and high-energy lasers. Not much has been done in this country since Seesaw," a U.S. physicist said. "But there is certainly a lot of new interest now within the scientific community. . . ."

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## U.S. Scientists: 'We May Not Catch Up!'

*The following are some of the reactions from scientists, specialists in strategic assessment and the press to the revelation of the imminent Soviet "beam weapon" deployment.*

*Scientist, Livermore Laboratories*

Yes, it is quite believable.

*Gerald Yanos, Electron Beam Program Director, Sandia Weapons Laboratory (New Mexico)*

Yes, the Soviets have in their literature said they have a water capacitor for storing high energies, and which operates under very high pressures. The U.S. has been unable to duplicate it.

*Harold Agnew, Director, Los Alamos Weapons Laboratory*

Yes, we are quite concerned.

*Philip Morrison, nuclear physics, Massachusetts Institute of Technology; advisor, Pentagon; advisor, Democratic Party; Board of Directors, Federation of American Scientists*

It can't be a beam. Yes, I believe they have the thermonuclear power system working, but it's not a beam, not a particle beam. I don't believe the Soviets are ahead in basic science, though you may be right that they are working in the right areas and we are not.

*Die Welt (West Germany):*

If what General Keegan says of the significance of the

Soviet breakthrough is true, this completely alters the Western strategic situation.

*Dr. William Van Cleave, Strategic Studies, University of Southern California: Committee on the Present Danger*

This is a very healthy development. I've just started reading the article and I am quite excited about it, having been in touch with General Keegan for some time. The scientific gap between us and the Soviets is now so enormous that I'm not sure we can make it up. But at least this will motivate us.

*Dr. Stefan Possony, Hoover Institute for War, Revolution and Peace*

If the Soviets get this thing deployed before we can develop something comparable, there exists the definite possibility that the U.S. could lose its retaliatory capability. There are several ways people will come up with to get around this sort of ABM, such as cruise missiles and so forth, but that stuff is a lot of crap. The technology is the key. We have a specific tradition of scientific incompetence in this country that goes back

thirty years to when these same scientists were saying that the Soviets could never explode an atomic bomb.

*Paul Bracken, Military Research Analyst, The Hudson Institute*

General Keegan was here recently talking about all sorts of classified things. Personally I think he's some kind of nut.

*Alain Enthoven, Stanford University; former Dept. of Defense "whiz kid" under Robert McNamara*

Take this stuff with a grain of salt. Although I've been out of the field for some time, I know the psychology of these things and most of them are scare stories.

*Boston Globe, Editorial*

Buck Rogers is back again campaigning for a bigger military budget.

*Corriere Della Sera (Italian "newspaper of record")*

The U.S. doubts the reports of this Soviet capability, but if anyone possesses it, it is the Soviets.