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COORDINATING COMMITTEE

MEMORANDUM FROM THE UNITED STATES DELEGATION

CONCERNING

EMBARGO OF ELECTRONIC COMPUTERS (ANALOG AND DIGITAL)

REF: W.P. 1565/2

The United States wishes to acquaint other Participating Governments with the considerations which have convinced it that an effective embargo on electronic analog and digital computers should be continued, and to explain the reasoning lying behind the redefinition proposal which the United States has submitted (W.P. 1565/2).

This presentation consists of four parts:

I. The vital strategic role of the computer;
II. The Soviet computer shortage;
III. The ability of computers to perform both business and strategic functions;
IV. The rationale of the United States redefinition proposal (W.P. 1565/2).

I. The Vital Strategic Role of the Computer.

The electronic computer made possible the nuclear-missile age. It is the sine qua non of defense and warfare in our time. Without electronic computers missiles cannot be launched, nuclear weapons could not be developed, major new weapons and defense systems could not function effectively. The electronic computer is the indispensable brain of modern warfare.

Both digital and analog computers are complex devices permitting the rapid solution of mathematically stated problems which often could not be solved even in many human lifetimes of work. Computers are capable of simulating enormously complex scientific phenomona (e.g., nuclear explosions, rocket flights or jet aircraft performance) and solving them mathematically with savings of many millions of dollars and incalculable savings of time and materials. It is apparent that computers used directly for tactical purposes are highly strategic. The same must be said for computers which enable the development of nuclear weapons, missiles, rockets and other "space age" implements of war.

II. The Soviet Computer Shortage

There is abundant evidence from Soviet sources and from competent Western observers that the Soviet Union is experiencing a critical shortage of computers with military applications. All available evidence shows that Soviet military needs for computers are not being met. Khrushchev himself, in speaking of the new Seven Year Plan said that the value of Soviet production of both analog and digital electronic computers in 1958 was only about $55 million. The cost of a single digital computer of a type for which the United States military has substantial use runs to many millions of dollars. Procurement of computers for military purposes in the United States runs to hundreds of millions of dollars annually. By contrast it is

evident that Soviet production of these highly sophisticated modern devices is extremely limited even for military purposes. There is little evidence of commercial or business use of these computers within the bloc; most research is not directed toward civilian or consumer use. The proportions and causes of the Soviet computer shortage are major factors which must be considered in deciding the nature of COCOM controls.

A. Soviet Production Problems and Shortages.

The shortage of electronic computers in the USSR results from a series of problems which continue to plague the Soviet computer industry. Despite the importance of electronic computers for control and guidance of satellites and missiles, for radar data handling and fire control, and for industrial automation, electronic computer production in the Bloc still appears to be a victim of past and present inadequate planning and priority. This has resulted in continued deficiencies in the quality and quantity of components available for computer production; in a shortage of trained specialists; in an inadequate production base; in an excessive lag time between development and production of computers; in a too lengthy testing and installation time lag, and in inadequate material allotment to plants.

Public Soviet complaints about these difficulties are an indication of their seriousness. The president of the Academy of Sciences, Nesmeyanov, recently reported (Vestnik Akademii Nauk SSSR) that "the number of machines (high-speed computers) available entirely fails to satisfy the rapidly increasing demand for mathematical computations". In 1958, Academician Blangonravov stated in Izvestiva that electronic computers must be given preferential treatment. Shortcomings in planning, he stated, largely explained the lack of production of high-speed computers. Such fully tested computers as the BESM, the M-2 and the M-3 (medium speed, general purpose digital types) should have been in series production but had been produced only in prototype. At that time, (1958) there was no comprehensive plan for the development of computer engineering in the immediate future. In the Seven-Year Plan verbal emphasis was placed on the development of computer production. In spring 1959, however, there were still complaints that the Coordinating Scientific and Technical Committee for computer technology was completely inactive and that the Sovnarkhozy were quite disinterested in organizing series production of electronic computers. (Elektrichestvo, March 1959). This is a criticism made as long ago as early as 1957.

B. Poor Components

Perhaps the most serious problem retarding computer production and limiting their quality is the poor grade and inadequate supply of components. This is blamed on poor planning in the radio-electronics industry. Without high quality components reliable machines cannot be made. Semiconductors now being produced are admitted to be unreliable for use in computers. It is standard procedure in the USSR that components for computers are produced in the computer production plants as well as at the 20 or more organizations which are engaged in the research and development of computers. This is a cause of waste and delay in the series production of the computers. (Komsomolskaya Pravada, 27 May 1958)

In the middle of 1959, the parts problem was further elaborated in the Soviet press:

"Experience indicates that the rapid introduction of computer machinery is being impeded by insufficnent standardization of the components and assemblies of machines. For this reason, the development of each new machine requires the efforts of large scientific staffs. If the problem of standardization were solved and the production of standard components and subassemblies were organized, even plant laboratories and design bureaus could develop and design mathematical and control computers."

"To make components and assemblies of control machines, reliable electronic devices and components are urgently needed, especially crystal triodes and diodes, ferrite cores and rings, delay lines, miniature resistors and capacitors, and other devices and components. The demand for these components is so great that industry is unable to satisfy it. This in turn brings out the problem of organizing series production of basic components for digital machines in the Ukrainian SSR." (Pravda Ukrainy, 21 June 1959).

The future improvement of digital computers will depend mainly on the successful production of high-quality semi-conductors, magnetic elements and miniature resistors and capacitors.

C. Poor Input-Output Equipment.

Another problem restricting Soviet computer production is the insufficient quantity and often poor quality of input-output equipment (e.g. magnetic tape, perforated tape and card devices) which significantly lowers the effectiveness of existing machines and impedes their use for overall production automation. As late as late June 1959 it was still being said that a single system of page printing and conversion equipment, perforating mechanisms and magnetic tape external storage units for computers had to be developed and put into series production. (Pravda Ukrainy, 21 June 1959).

D. Inadequate Personnel

A third Soviet problem is a shortage of specialized computer personnel, especially for production. The shortage of engineers and program mathematicians for checking new computers causes delays in deliveries, in installation and in testing installed equipment. Soviet sources reveal that a full six months are required for adjusting a machine after installation.

As late as 1956 there were public complaints that absolutely nothing had been done to train skilled electronic computer mechanics. In 1957 Acamedician Letov said that 4,500 automation students graduate from Soviet universities and institutions; 1,500 of these specialize in computers. Most of these students go into industry and analog computer work. The students who go into digital control work usually become theorists and in the USSR control theorists do not work for industry but in the fields of scientific military research and development.

The lack of communications between the theorists and applied scientists and engineers in the field of computers is also a serious difficulty. A. Petrov, of the Penza computer plant said in June 1959 that "the output of electronic machinery will increase every year, but even now this young branch of industry is experiencing a shortage of radio-electronics engineers and program mathematicians. At the Penza plant the shortage of cadres is the cause of delivery delays which can run into two or three months; the completed machines must be tuned up and tested and the shortage of experts in this field delays their completion." Last year the Penza works had planned to obtain 50 experts in this field but in received only seven and the shortage has to be made good by employing specialists in allied fields who have to be retrained.

In 1959, when P.D. Lebedev and other computer specialists visited the United States they admitted that there was still a shortage of engineers in the electronics and computer technology fields. During the same period Soviet computer authorities attempted to induce Western firms to establish training facilities in the USSR for computer technicians.

E. Inadequate Production Facilities.

A fourth Soviet problem is inadequate production facilities for electronic computers. At the present time there are only two known computer plants of any size in operation while three other plants will reportedly begin operation in the future. The two existing plants are not allowed to specialize. They produce both analog and digital computers, as well as most of the specialized components for these computers, and probably all the auxiliary input-output equipment for both the computing systems and for non-electronic calculators. In addition, these plants produce some experimental models of new computers and the Penza plants has its own design bureau as well.

These inadequate manufacturing facilities for electronic computers are also partly responsible for the excessive time required from the beginning of the development of electronic computers to their series production. In the USSR this was, according to Academician Nesmeyanov, 4 - 7 years while in the US it is from 1 - 2 years. For example, the M-3 small digital computer was designed in 1954, built in prototype in 1956, and was placed in limited production only in 1958 after Gosplan had spent a full year deciding where and how to put this machine in serial production (Promyshlennaya Ekonomicheskaya Gazeta, 14 May 1958). The excessive time (2 - 3 years) required for the development and the construction of new experimental models of electronic computers is blamed mainly on the lack of satisfactory facilities for experimental production.

American computer experts who have inspected the Moscow and Penza plants have criticized the poor engineering techniques and the inefficient use of existing facilities. This has been recognized by Soviet computer specialists as well, one of whom wrote: "It is paradoxical that in a plant which is producing complicated machinery for the automatic process, manual labor is still exclusively employed, as a result of which production costs rise to impressive heights". A simple way out, he suggested, would be use of printed circuits. But this technique is very little used in the USSR even at this late date.

All of these problems, and others, have meant that Soviet needs for computers have not been satisfied and that the shortage of reliable computers promises to continue to be a significant Soviet strategic weakness.

III. Computer Versatility.

The problem of distinguishing relatively less strategic computers from the relatively more strategic types is very difficult. Electronic computers to solve mathematical problems are necessarily as versitile as mathematics itself. Nevertheless, some meaningful distinctions are possible and necessary to make.

First, analog computers are by their nature unsuited to statistical, bookkeeping, or other commercial tasks. Their principal application is military especially in fire control mechanisms. Analog computers are also employed to simulate physical phenomena, e.g. nuclear reactions, and are beginning to be used in some types of industrial automation.

Second, digital computers used for commercial work, (e.g. preparing gas and telephone bills, keeping bank accounts, inventories, life insurance records, analyzing census results, etc.) are relatively slow in operation compared to types better adapted to military and scientific work. Thus, a digital computer which requires a full day to prepare gas bills for an entire city is fast enough for these purposes but not fast enough to perform the thousands of operation per second necessary to guide a space missile during its few minutes of powered flight. However, the faster type is fully capable of doing the billing and statistical work of the slower types and may even perform both commercial and scientific tasks simultaneously. The overall speed of a computer depends largely on: 1) from the speed at which stored information can be found and 2) the speed at which new information can be put into the machine and processed information taken from it.

Third, reliability is even more important in strategic uses than in commercial work. The most reliable Free World computers using vacuum tubes require constant expert attention to assure against tube failures. One of the principal weaknesses in Soviet computers lies in the low level of tube and other component reliability. The chief advantage of transistorized computers lies in their far superior degree of reliability, a consideration making transistorized computers a top military priority.

IV. The rationale of the United States redefinition proposal (W.P. 1565/2).

The proposed United States redefinition of Item 1565 distinguishes between the relatively less strategic and the relatively more strategic computers in the light of the above considerations.

First, it would continue the embargo of all analog types because their applications are primarily military both in the Free World and in the USSR.

Second, it would continue the embargo of the faster digital types because these are most suitable for strategic applications. This is most easily done by covering magnetic core memories, the fastest of all types now known and a technique only recently perfected in the Free World. In order to cover other unusually

fast computers, the definition would also embargo equipment with a minimum memory access time of 20 microseconds. Moreover, it would embargo high speed input and output equipment necessary for use with high speed computers and one of the most difficult parts of a computer to build. The speeds specified would accord with those in Item 1519 which embargoes equipment often directly connected to electronic computers.

Third, the United States proposal would embargo all transistorized logic and arithmetic units thus protecting the crucially important reliable types so rare in the Soviet Union.

The US proposal would free a wide range of series produced digital computers adapted to commercial and industrial application.

Finally, the clear, objective criteria proposed would make administration relatively easy and avoid any possibility of divergent national interpretations. Most important, it would protect the security interests of all COCOM members.