# From the Archive of the President, Russian Federation

A number of original documents and materials concerning the history of work on controlled nuclear fusion were recently found in the Archive of the President, Russian Federation and declassified.

This section [1] displays documents from the Archive of the President, Russian Federation that were selected and prepared for publication in the collection of papers *USSR Atomic Project: Documents and Materials* published by the Ministry of the Russian Federation on Atomic Energy; the editor is the first deputy of the Minister of the Russian Federation on Atomic Energy, L D Ryabev. We publish here the text of the Resolution of the USSR Council of Ministers of May 5, 1951 "On conducting research and experimental work to clarify the feasibility of building a magnetic thermonuclear reactor" (in an abridged form: annexes 3–7 were not included); the text of the first paper written by O A Lavrent'ev (July 1950), and the referee comments on this paper by A D Sakharov (August 18, 1950).

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USSR COUNCIL OF MINISTERS
RESOLUTION
No. 1463-762ts/sd of May 5, 1951
Moscow, Kremlin
"On conducting research and experimental work to clarify the feasibility of building a *magnetic thermonuclear reactor*"

Recognizing the importance of the proposal made by Cde. Sakharov A D to use the *intranuclear* energy of *light* elements by running a *magnetic thermonuclear reactor* ('MTR' facility), the USSR Council of Ministers ORDERS:

1. To bind the First Main Directorate (Cdes. Vannikov, Zavenyagin, Kurchatov) to organize research, design and construction work on clarification of the feasibility of generating a self-sustained *thermonuclear* reaction using a *magnetic thermonuclear reactor*; they will support and guarantee the fulfillment of the following tasks:

(a) to develop the theory of gas discharge processes in a magnetic field;

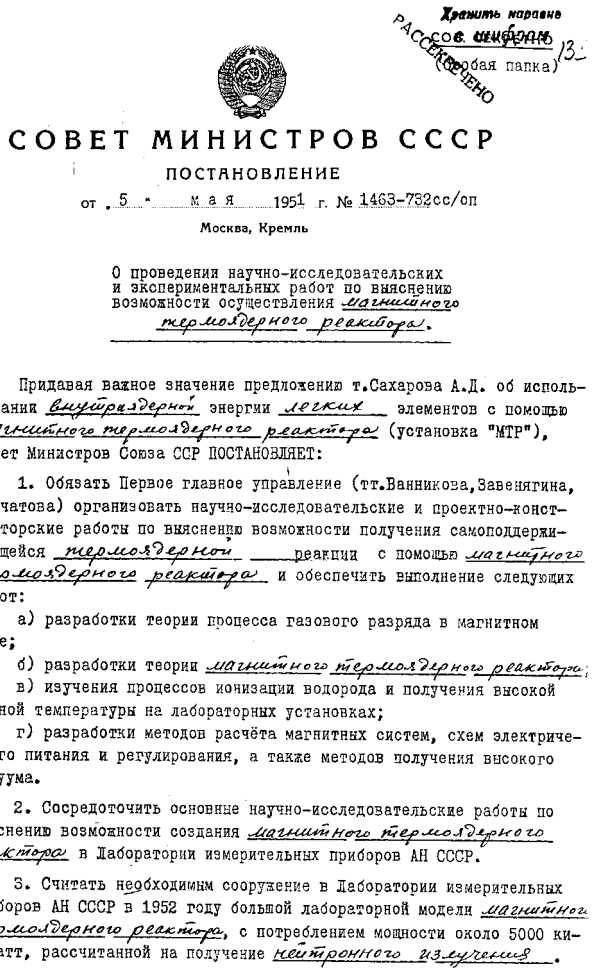
(b) to develop the *magnetic thermonuclear reactor* theory;

(c) to study the processes of hydrogen ionization and of achieving high ion temperature in laboratory units;

(d) to develop computational methods for designing magnetic systems, electric supply and control circuits, and also for high vacuum production techniques.

2. To concentrate the basic research work on clarifying the feasibility of building a *magnetic thermonuclear reactor* in the Laboratory of Measuring Instruments of the USSR Academy of Sciences.

[1] The documents from the Archive of the President, Russian Federation included in this section were prepared for publication by G A Goncharov. (The spelling in the original documents was left unchanged.) [APRF, Fond 93. Collected resolutions and orders of the USSR Council of Ministers, 1951.]



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РАССЕКРЕЧЕНО

СОВЕТ МИНИСТРОВ СССР

ПОСТАНОВЛЕНИЕ

от 5 мая 1951 г. № 1463-732сс/оп

Москва, Кремль

О проведении научно-исследовательских и экспериментальных работ по выяснению возможности осуществления магнитного термоядерного реактора.

Придавая важное значение предложению т.Сахарова А.Д. об использовании внутриядерной энергии легких элементов с помощью магнитного термоядерного реактора (установка "МТР"), Совет Министров Союза ССР ПОСТАНОВЛЯЕТ:

1. Обязать Первое главное управление (тт.Ванникова, Завенягина, Курчатова) организовать научно-исследовательские и проектно-конструкторские работы по выяснению возможности получения самоподдерживающейся термоядерной реакции с помощью магнитного термоядерного реактора и обеспечить выполнение следующих работ:

а) разработки теории процесса газового разряда в магнитном поле;

б) разработки теории магнитного термоядерного реактора;

в) изучения процессов ионизации водорода и получения высокой ионной температуры на лабораторных установках;

г) разработки методов расчёта магнитных систем, схем электрического питания и регулирования, а также методов получения высокого вакуума.

2. Сосредоточить основные научно-исследовательские работы по выяснению возможности создания магнитного термоядерного реактора в Лаборатории измерительных приборов АН СССР.

3. Считать необходимым сооружение в Лаборатории измерительных приборов АН СССР в 1952 году большой лабораторной модели магнитного термоядерного реактора, с потреблением мощности около 5000 киловатт, рассчитанной на получение нейтронного излучения.

First page facsimile of USSR Council of Ministers Resolution "On conducting research and experimental work to clarify the feasibility of building a magnetic thermonuclear reactor" of 5 May 1951.

3. To consider it necessary to build in 1952 at the Laboratory of Measuring Instruments of the USSR Academy of Sciences a large laboratory model of a *magnetic thermonuclear reactor* with a power consumption of about 5000 kW, designed to generate *neutron emission*.

4. To approve:

Cde. Artsimovich L A, Corresponding Member of the USSR Academy of Sciences, as scientific leader of research work on clarifying the feasibility of 'MTR' construction;

A D Sakharov, Candidate of Physicomathematical Sciences, as deputy of the scientific leader of research over the theoretical part of the problem;

Efremov D V, Professor, as deputy of the scientific leader of research on the design and construction part of the problem;

Leontovich M A, Full Member of the USSR Academy of Sciences, as scientific leader of theoretical research on 'MTR' problem in the Laboratory of Measuring Instruments of the USSR Academy of Sciences.

To bind Cde. Artsimovich to devote at least one half of his working time to work on the *magnetic thermonuclear reactor*.

5. To bind the Academy of Sciences of the USSR (Cde. Nesmeyanov) and the P N Lebedev Physics Institute of the Academy of Sciences of the USSR (Cde. Skobel'tsyn) to assign Academician Leontovich M A to work exclusively at

the Laboratory of Measuring Instruments of the USSR Academy of Sciences for 18 months.

To bind the War Ministry of the USSR (Cde. Vasilevskiĭ) to release Academician Leontovich M A from his work in the Research Institute No. 108.

6. To permit the Laboratory of Measuring Instruments of the USSR Academy of Sciences (Cdes. Golovin and Artsimovich) to focus the experimental work and theoretical research on the 'MTR' facility in the Departments of Electric Equipment and Optical Instruments, having transferred part of the work on the gravitational technique of isotope separation to the Base No. 9 [2]; to transfer all design and construction and research work on the 'AM' plant [3] to Laboratory 'V' of the First Main Directorate of the USSR Council of Ministers [4].

To charge the First Main Directorate of the USSR Council of Ministers (Cde. Zavenyagin) and the Laboratory of Measuring Instruments of the USSR Academy of Sciences (Cde. Kurchatov) to compile and submit for approval by the Council of Ministers of the USSR, within one month, the proposals on sending required experts on a mission to the Base No. 9 and Laboratory 'V', the times of dismantling of equipment and a timetable for transfer of the special equipment and instruments and secret documentation to these objects.

7. To bind the Laboratory of Measuring Instruments of the USSR Academy of Sciences (Cdes. Golovin and Artsimovich), Base No. 112 [5] (Cde. Khariton), the Physico-Technical Institute of the Academy of Sciences of the USSR (Cde. Komar), the Physico-Technical Institute of the Academy of Sciences of the Ukrainian SSR (Cde. Sinel'nikov), the Thermo-Technical Laboratory of the USSR Academy of Sciences [6] (Cde. Alikhanov) and the Special Design Bureau of the Ministry of Electric Industry (Cde. Efremov) to carry out theoretical and experimental research programs on clarifying the feasibility of building the 'MTR' facility in accordance with Annexes Nos 1, 2, 3.

8. To bind the War Ministry of the USSR (Cde. Vasilevskiĭ) and the Research Institute No. 108 (Cde. Kugushev) to carry out theoretical and experimental research programs on models to clarify the feasibility of hydrogen ionization and heating in a magnetic field to temperatures above *one million* degrees using RF fields from $10^5$ to $3 \times 10^9$ cps in accordance with the technical specifications of the Laboratory of Measuring Instruments of the USSR Academy of Sciences.

9. To approve Professor Kalashnikov S G the scientific leader of the research program on 'MTR' at the Research Institute No. 108 of the War Ministry of the USSR.

10. To bind the Ministry of Higher Education of the USSR (Cde. Stoletov) to release Professor Kalashnikov S G from heading the Chair of Physics at Moscow State University.

11. To bind the Ministry of Electric Industry and the Special Design Bureau of the Ministry of Electric Industry (Cde. Efremov) together with the Laboratory of Measuring Instruments of the USSR Academy of Sciences (Cdes. Artsimovich and Golovin) to complete by September 1, 1952 the research program and the draft project of the industrial 'MTR' facility to establish the main technical and economical parameters of the facility.

12. To bind the First Main Directorate of the USSR Council of Ministers (Cdes. Vannikov, Zavenyagin, Kurchatov), the Laboratory of Measuring Instruments of the USSR Academy of Sciences (Cdes. Artsimovich, Golovin), the Base No. 112 (Cdes. Khariton, Sakharov, Tamm) and the Special Design Bureau of the Ministry of Electric Industry (Cde. Efremov) to submit to the Council of Ministers of the USSR by October 1, 1952 their conclusions on the feasibility of building the 'MTR' facility on an industrial scale, indicating the main technical characteristics of the facility.

13. To organize a Scientific and Technical Commission at the Laboratory of Measuring Instrument of the USSR Academy of Sciences with the task of discussing all aspects connected with the development of the 'MTR' project, comprising:

| | | |
|---|---|---|
| Academician | Kurchatov I V | Chairman of the Commission |
| USSR AS Corresponding Member | Artsimovich L A | Deputy chairman |
| Cand. phys.-math. sciences | Golovin I N | Deputy chairman |
| Cand. phys.-math. sciences | Sakharov A D | Member of the Commission |
| USSR AS Corresponding Member | Tamm I E | Member of the Commission |
| Academician | Leontovich M A | same |
| Cand. phys.-math. sciences | Vladimirskiĭ V V | same |
| Professor | Efremov D V | same |

14. To bind the Ministry of Electric Industry and the Special Design Bureau of the Ministry of Electric Industry (Cde. Efremov) to design, in accordance with the technical specifications of the Laboratory of Measuring Instruments of the USSR Academy of Sciences, and build a large laboratory model, 'MTR-L2', by May 1, 1952.

15. To bind the Laboratory of Measuring Instruments of the USSR Academy of Sciences (Cdes. Artsimovich and Golovin) and the Special Design Bureau of the Ministry of Electric Industry (Cde. Efremov) to submit to the Council of Ministers of the USSR by November 1, 1951 the program of measures needed to support and guarantee the building of the large laboratory model, 'MTR-L2'.

16. To approve the list of measures to support the construction of the 'MTR-L' and 'MTR-L2' facilities at the Laboratory of the Measuring Instruments of the USSR Academy of Sciences in accordance with Annex No. 4.

Chairman
of the Council of Ministers of the USSR I Stalin

Head of the Administration
of the Council of Ministers of the USSR M Pomaznev

Sent to Cdes. Poskrebyshev, Vannikov, Kurchatov, Khariton, Makhnev (the entire document); copies of individual items according to a special delivery list.

[2] Base No. 9 — the uranium isotope separation plant in the Sverdlovsk region: the Ural Electromechanical Plant (UÉZ).

[3] 'AM' plant — the nuclear reactor of the first atomic power plant in the USSR, built in Obninsk.

[4] Laboratory 'V' is currently known as the State Research Center 'Physico-Energy Institute'.

[5] Base No. 112 is currently the Russian Federal Nuclear Center 'All-Russia Research Institute of Experimental Physics' (RFYaTs – VNIIÉF).

[6] The Thermo-Technical Laboratory is now the State Research Centre 'Institute of Theoretical and Experimental Physics' (ITÉP).

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Annex No. 1
to the Resolution of the Council of Ministers of the USSR
of 5 May 1951, No. 1463-732ts/sd

## P R O G R A M
of theoretical research into clarifying the feasibility of the construction of a *magnetic thermonuclear reactor*

(Scientific heads of the program:
Academician Leontovich M A,
USSR AS Corresponding Member Tamm I E,
Candidate of Physicomathematical Sciences Sakharov A D)

| Work specification | Date of completion | Executor |
|---|---|---|
| 1. Statistical theory of plasma in a magnetic field | | |
| (a) Derivation of plasma kinetic equations taking into account fluctuations and oscillation processes | August 1, 1951 | Base No. 112<br>Bogolyubov |
| (b) A study of plasma stability in a magnetic field with the magnetic field intensity, temperature and density variable through the volume. Theory of plasma stability when low-frequency and high-frequency currents are passed through it. Theory of turbulent processes | January 1, 1952 | Base No. 112<br>Bogolyubov<br>Lab. Meas. Instr.<br>Davydov |
| (c) Calculation of heat transfer, degree of ionization, temperature and particle number density in incompletely ionized plasma in the absence of thermal equilibrium | July 1, 1951 | Lab. Meas. Instr.<br>Davydov |
| 2. Theory of elementary processes | | |
| (a) Calculation of energy transfer to plasma during fast nuclear particle slowing-down | September 1, 1951 | Lab. Meas. Instr.<br>Migdal<br>Poluéktov |
| (b) Calculation of charge exchange of neutral atoms, probability of hydrogen ionization processes over the energy range from 1 eV to 100 KeV | May 1, 1951 | |
| (c) More precise calculation of electron bremsstrahlung in plasma | October 1, 1951 | |
| (d) Calculation of plasma electron emission in a magnetic field (spectral composition of emission, line broadening, reabsorption of emission) | July 15, 1951 | |
| 3. Theory of a *magnetic thermonuclear reactor* | | |
| (a) Study of possible approaches to eliminating magnetic drift of plasma particles | October 1, 1951 | Base No. 112<br>Sakharov, Tamm<br>Lab. Meas. Instr.<br>Artsimovich<br>Thermo-Techn. Lab.<br>Vladimirskiĭ |
| (b) Work investigation of various MTR versions in steady-state mode | January 1, 1952 | Base No 112<br>Sakharov, Tamm<br>Thermo-Thechn. Lab.<br>Vladimirskiĭ<br>Lab. Meas. Instr.<br>Migdal |
| (c) Development of a theory of gas discharge ignition in a magnetic field | September 1, 1951 | Lab. Meas. Instr.<br>Davydov |
| (d) Development of a theory of MTR heating | July 1, 1951 | Lab. Meas. Instr.<br>Artsimovich |
| (e) Calculation of working modes of laboratory 'MTR-L' model | May 1, 1951 | Lab. Meas. Instr.<br>Golovin |
| Head of the Administration of the USSR Council of Ministers | | M Pomaznev |

Top secret
(Special dossier)

Annex No. 2
to the Resolution of the Council of Ministers of the USSR
of 5 May 1951, No. 1463-732ts/sd

## P R O G R A M
of experimental research into clarifying the feasibility of the construction of a *magnetic thermonuclear reactor*

(Scientific heads of the program:
USSR AS Corresponding Member Artsimovich L A,
Candidate of Physicomathematical Sciences Golovin I N)

| Work specification | Date of completion | Executor |
|---|---|---|
| 1. Study of hydrogen ionization and reaching of high ion temperatures in laboratory setups and in the large laboratory 'MTR-L' model using: | | |
| (a) electrodeless discharge in a magnetic field and without magnetic field, in continuous burning regime; | May 1952 | Lab. Meas. Instr.<br>Golovin |
| (b) electrodeless discharge in a magnetic field and without magnetic field, under pulsed discharge and field excitations | same | Lab. Meas. Instr.<br>Andrianov |
| 2. Study of the possibility of plasma ionization and heating in a magnetic field by RF oscillations | same | Res. Inst. No. 108<br>Kugushev<br>Kalashnikov |
| 3. Development of methods and instruments for measuring the electron and ion temperatures in MTR plasma | December 1951 | Lab. Meas. Instr.<br>Luk'yanov |
| 4. Development of the design of high-performance low-temperature hydrogen pump for pressures below $10^{-8}$ mm Hg and a study of materials properties in deep vacuum (below $10^{-8}$ mm Hg) | same | FTI AN Ukr SSR<br>Sinel'nikov<br>Lazarev |
| 5. Verification of the main conclusions of the theory of plasma in a magnetic field (oscillation spectrum, turbulization, energy exchange between ions and electrons, etc.) | May 1952 | LFTI<br>Komar<br>Dukel'skiĭ |
| The seal of the protocol service of the Council of Ministers of the USSR | | Head of the Administration, CM USSR<br>M Pomaznev |