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## THE TIC CHRONICLE

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The Temporary International Collective (TIC) brief history is presented from the time of its establishment in 1972 (and even earlier) till the termination of its activity in 1990 (and even later). Works in the TIC framework demonstrate an example of successful cooperation of specialists from different countries in the field of calculation-theoretical and experimental research on the VVER reactor physics. The results of experimental and calculation studies were reported to the topical meetings, workshops, conferences, and symposia as well as were published in the TIC reports and proceedings. The answers to the questions about the TIC activity – What? Where? When? – are presented in this chronicle.

**1971**

**August 23-26.** The conference of specialists on development of the comprehensive program of research at the critical test facility of the VVER type (Budapest, Hungary).

**1972**

**February 23.** The Agreement on the establishment of the temporary international research collective (TIC) to perform reactor-physics studies at the critical test facility of the VVER type was signed in Warsaw. The TIC works at the AS ЦИФИ of Hungary. The critical test facility of the VVER type in ЦИФИ was the experimental base of the temporary collective. The TIC participants represented seven countries: PRB (People's Republic of Bulgaria), PRH (People's Republic of Hungary), GDR (German Democratic Republic), PRP (People's Republic of Poland), SRR (Socialist Republic of Romania), USSR (Union of Soviet Socialist Republics), CzSSR (Czecho-Slovak Socialist Republic).

**April 11-14.** The conference of specialists from CMEA countries on kinetics of nuclear reactors (Zakopane, PRP). Reports were presented on the parameters of the ZR-6 critical test facility and on the program of the research first stage.

**June 20-24.** The first meeting of the TIC Scientific Council (Budapest, PRH). The "Program on reactor-physics studies at the critical test facility of the VVER type" was approved. The regulation for the TIC Scientific Council procedure was passed.

**October 31 – November 03.** The first conference on neutron statics of the VVER-type reactors (Marianske Lazne, CzSSR). The first three topical groups were initiated at the conference (diffusion codes in hexagonal geometry, libraries of multi-group constants, comparison of calculations and experiments at the ZR-6 critical test facility).

**November 28.** The first start-up of the ZR-6 critical test facility (ЦИФИ, Budapest, PRH).

**December 5-8.** The second meeting of the TIC Scientific Council (Budapest, PRH). The decision was made on the initiation of a topical group to perform works on the diagnostics of boiling in the core of the VVER-type reactor.

### 1973

**February 15.** The beginning of experiments at the ZR-6 critical test facility.

**March 19-23.** The conference of the TIC specialists on the reactor noise diagnostics (Rossendorf, GDR).

**June 26-29.** The third meeting of the TIC Scientific Council (Budapest, PRH). The issue on the reconfiguration of the TR-0 heavy-water critical test facility (Rez, CzSSR) into the critical test facility of the VVER type.

**October 2-5.** The second conference on kinetics of nuclear reactors of the VVER type. (Zakopane, PRP).

### 1974

**March 12-15.** The fourth meeting of the TIC Scientific Council (Budapest, PRH). The decision was made to publish the results of performed research works in the form of the TIC reports.

**December 2-7.** The third conference of the TIC specialists on the VVER reactor physics (Bintz, GDR).

### 1975

**January 14-17.** The fifth meeting of the TIC Scientific Council (Budapest, PRH). The decision was made on the initiation of a topical group "Review of neutronic data of the VVER-type reactor operation and their comparison with calculations".

**October 6-10.** The fourth conference of the TIC specialists on the VVER reactor physics (Frunze, USSR).

**November 25-28.** The sixth meeting of the TIC Scientific Council (Budapest, PRH). The decision was made to name henceforth the conference of the TIC specialists as "Symposium of the TIC specialists on the VVER reactor physics". The following topical groups were approved (the country-coordinator is given in parentheses):

1. The analysis of experiments (PRH)
2. The preparation and analysis of small-group effective cross-sections (PRP)
3. The preparation and analysis of multi-group libraries (PRH)
4. Development of codes and solution of small-group diffusion problems in hexagonal geometry (CzSSR)
5. Mathematical issues of the VVER reactor physics (USSR)
6. Review of neutronic data of the VVER reactor operation (USSR)
7. Noise diagnostics of the VVER reactor core (GDR).

### 1976

**June 13.** At the meeting of the CMEA standing committee on the peaceful use of atomic energy, the term of the Agreement on the TIC establishment was prolonged till December 31, 1980. The representative of Cuba signed the Protocol on joining to the TIC.

**September 12-19.** The fifth Symposium of the TIC specialists on the VVER reactor physics (Varna, PRB).

**November 26-29.** The seventh meeting of the TIC Scientific Council (Budapest, PRH).

### 1977

**September 5-10.** The sixth Symposium of the TIC specialists on the VVER reactor physics (Bucharest, SRR).

**October 10.** Experiments were started at the LVZ-II of the TR-O critical test facility (Rez, CzSSR).

**November 25-28.** The eighth meeting of the TIC Scientific Council (Budapest, PRH). The decision was made to initiate a new topical group on the development of the software package for the calculation of the VVER-1000 reactor as a whole.

#### 1978

**October 5-10.** The seventh Symposium of the TIC specialists on the VVER reactor physics (Добржиховице, CzSSR).

**November 14-17.** The ninth meeting of the TIC Scientific Council (Budapest, PRH). The issues on the publication of generalized results of the TIC activity were considered.

#### 1979

**May.** The modernization of the ZR-6 critical test facility (that was named the ZR-6M critical test facility) was completed that enabled to give the opportunity to perform experiments at the higher temperature (up to 135°C).

**September 16-22.** The eighth Symposium of the TIC specialists on the VVER reactor physics (Zegzinek-Jadvisin, PRP).

**October 23-26.** The tenth meeting of the TIC Scientific Council (Budapest, PRH).

**December 17.** Experiments were completed at the LVZ-II of the TR-O critical test facility (Rez, CzSSR).

#### 1980

**June 13.** The Protocol was signed on the prolongation of the Agreement on the TIC establishment till 1985. On the initiative of the TIC Scientific Council, the contracting parties decided to change the collective name for the "Temporary international collective for the performance of joint research on the VVER reactor physics".

**June.** Within the framework of the topical group on the noise diagnostics of the VVER reactor core, the first experimental assembly DK1.2 was loaded into the NPP Reinsberg reactor.

**September 9.** The Protocol was signed on cooperation between AS ЦИФИ PRH (that acted on behalf of the TIC) and ЦТИ of Finland in the performance of studies on the VVER reactor physics.

**September 15-22.** The ninth Symposium of the TIC specialists on the VVER reactor physics (Нойбранденбург, GDR).

**October 28-31.** The eleventh meeting of the TIC Scientific Council (Budapest, PRH).

#### 1981

**October 12-17.** The tenth Symposium of the TIC specialists on the VVER reactor physics (Yerevan, USSR).

**November 24-27.** The twelfth meeting of the TIC Scientific Council (Budapest, PRH). The information on the involvement of CBP specialists into the TIC works.

#### 1982

**September 5-11.** The eleventh Symposium of the TIC specialists on the VVER reactor physics (Varna, PRB)

**December 14-17.** The thirteenth meeting of the TIC Scientific Council (Budapest, PRH). The Scientific Council considered it worthwhile to terminate temporarily the work of the topic group No. 7 due to the conclusion of four-lateral (PRH, GDR, USSR, CzSSR) contract on diagnostics.

### 1983

**October 2-8.** The twelfth Symposium of the TIC specialists on the VVER reactor physics (Татранска Ломница, CzSSR).

**November.** The agreement between USSR SCAE and CzS CAE was signed on performance of works on the "Studies of the VVER-type reactor neutronic characteristics at the LR-0 reactor" in the NRI, Rez, CzSSR.

**November 22-25.** The fourteenth meeting of the TIC Scientific Council (Budapest, PRH). The prospects for the TIC activity after 1985 were discussed.

### 1984

Volume I of the TIC final report "Experimental investigations of the physical properties of the VVER-type uranium-water lattices" was issued in which experiments performed at the ZR-6 critical test facilities were presented.

**October 1-7.** The twelfth Symposium of the TIC specialists on the VVER reactor physics (SRR).

**November 19-23.** The fifteenth meeting of the TIC Scientific Council (Budapest, PRH).

### 1985

**September 23-27.** The fourteenth Symposium of the TIC specialists on the VVER reactor physics Warsaw, PRP)

**November 25-30.** The sixteenth meeting of the TIC Scientific Council (Budapest, PRH). The Scientific Council recognized the activity of old topical groups to be completed as they fulfilled the set tasks and initiated new topical groups to fulfill new tasks (the country-coordinator is given in parentheses):

1. The analysis of experiments (PRH)
2. The review of the operation neutronics data and improvement of fuel use (USSR)
3. Development of a software package (CzSSR, PRB – in the part of the program library)
4. Noise diagnostics (GDR).

Working groups are established to fulfill short-term tasks.

### 1986

**October 26 – November 26.** The fifteenth Symposium of the TIC specialists on the VVER reactor physics (Rostok, GDR)

**November 24-28.** The seventeenth meeting of the TIC Scientific Council (Budapest, PRH).

### 1987

**September 21-25.** The sixteenth Symposium of the TIC specialists on the VVER reactor physics (Moscow, USSR)

**November 23-27.** The eighteenth meeting of the TIC Scientific Council (Budapest, PRH).

### 1988

**September 25 – October 1.** The sixteenth Symposium of the TIC specialists on the VVER reactor physics (Varna, PRB)

**November 21-25.** The nineteenth meeting of the TIC Scientific Council (Budapest, PRH). The prospects for the TIC activity after 1990 were discussed.

## 1989

**September 12-15.** The eighteenth Symposium of the TIC specialists on the VVER reactor physics (Прахагига, CzSSR)

**November 27 – December 1.** The twentieth meeting of the TIC Scientific Council (Budapest, PRH). The issues on the TIC activity prolongation and plans were discussed for the period after 1990. The necessity of a new Agreement on the establishment of a new international collective was pointed out.

## 1990

**September 30 – October 6.** The eighteenth Symposium of the TIC specialists on the VVER reactor physics (Шкофок, Hungary)

**November 26–30.** The twenty-first meeting of the TIC Scientific Council (Budapest, Hungary). The Document on the TIC activity termination was discussed and adopted. The Document presented the main results of the TIC activity that evidenced the completion of the TIC all major tasks. The TIC activity was terminated at the end of 1990.

## 1991

Volume III of the TIC final report "Experimental investigations of the physical properties of the VVER-type uranium-water lattices" was issued in which a series of experiments performed at the ZR-6M was presented. Studies described in volume I of the TIC final report were continued at different temperatures and with other lattices.

## 1993

Volume II of the TIC final report "Theoretical investigations of the physical properties of the VVER-type uranium-water lattices" was issued.

## 1996

The evaluations of experiments at the ZR-6 and ZR-6M critical test facilities "Z. Szatmary (evaluator). The VVER experiments: regular and perturbed hexagonal lattices of low enriched  $UO_2$  fuel rods in light water" were included as benchmark experiments LEU-COMP-THERM-015 into the International handbook of evaluated criticality safety benchmark experiments, NEA/NSC/DOC/(95)03/IV. Volume IV.

## 1999

The evaluations of experiments at the ZR-6M critical test facility "Z. Szatmary (evaluator). The VVER experiments: regular and perturbed hexagonal lattices of low enriched  $UO_2$  fuel rods in light water, part 2" were included as benchmark experiments LEU-COMP-THERM-036 into the International handbook of evaluated criticality safety benchmark experiments, NEA/NSC/DOC/(95)03/IV. Volume IV.

## 2000

Volume 4 of the TIC final report "Experimental investigations of the physical properties of the uranium-water lattices" was issued in which a cycle of further experiments performed at the ZR-6M critical test facility was presented.

Volume 5 of the TIC final report "Diffusion theoretical investigations of the physical properties of the uranium-water lattices" was issued.

Volumes 4 and 5 of the TIC final report were published in one book.

**2001**

The supplement to the TIC final report "Z. Szatmary. Additional data, amendments, reevaluations. Supplement to the final report of TIC" was issued.

Within the framework of the TIC activity, a large scope of information on the VVER reactor physics was accumulated a significant part of which is still urgent at the present time. In particular, many reports were presented to nineteen symposia. However, this information is known not to all interested persons and is not always available. Therefore, if the proceedings of the TIC Symposia were collected together and recorded on DVDs (as it is done in the ICSBEP project) then it would be a good gift to the whole VVER community.