

12TH INTERNATIONAL CONFERENCE ON WWER FUEL PERFORMANCE, MODELLING AND EXPERIMENTAL SUPPORT

16 to 23 September 2017, Sol Nesebar Resort, Nesebar, Bulgaria

Hosted by the Institute for Nuclear Research and Nuclear Energy – BAS,
in co-operation with the International Atomic Energy Agency,

AGENDA

16–17 September (Saturday – Sunday): Participants arrival and registration, excursions on request

17 September (Sunday evening): Welcome cocktail dinner at hotel Sol Nesebar

18 September (Monday), Hotel Conference Hall

09:00–10:45 Morning session

Session O: Opening session

Chairpersons: *Dimitar Tonev (INRNE-BAS), Mikhail Veshchunov (IAEA), Yancho Yankov. (Kozloduy NPP), Vladimir Molchanov (JSC TVEL), Oleg Aydemirov, (JS Rosenergoatom)*

Opening and greetings:

Dimitar Tonev (INRNE-BAS), Mikhail Veshchunov (IAEA), Yancho Yankov. (Kozloduy NPP), Vladimir Molchanov (TVEL),

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| 0.1. Dimitar Tonev | NUCLEAR TECHNOLOGIES IN BULGARIA, <i>D.Tonev, A.Nikolov, M.Manolova INRNE-BAS, Bulgaria</i> |
| 0.2. Mikhail Veshchunov | IAEA ACTIVITIES IN THE AREA OF NUCLEAR POWER REACTOR FUEL ENGINEERING, <i>M.Veshchunov, IAEA, Austria</i> |
| 0.3. Oleg Aydemirov | EXPERIENCE OF VVER-1000 FUEL OPERATION IN THE RUSSIAN FEDERATION, <i>O. Aydemirov, JSC Rosenergoatom, Russian Federation</i> |
| 0.4. Alexey Dolgov | WWER NUCLEAR FUEL – DEVELOPMENT AND PERSPECTIVES, <i>A.Dolgov, JSC “TVEL”, Moscow, Russian Federation</i> |

10:45–11:00 Coffee break

SESSION 1 FUEL PERFORMANCE AND OPERATIONAL EXPERIENCE

11:00–12:30 Morning session

Chairpersons: *Krassimir Kamenov, Vaclav Mecir*

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| 1.1. Krasimir Kamenov | EXPERIENCE OF TVSA-12 FUEL IMPLEMENTATION AT KOZLODUY NPP, <i>K. Kamenov, Ml. Milchev, Kozloduy NPP, Bulgaria</i> |
| 1.2. Yuri Ryzhkov | EXPERIENCE OF NUCLEAR FUEL OPERATION AT BALAKOVO NPP, <i>Yu.A. Ryzhkov, Subsidiary of JSC “Concern Rosenergoatom”, Balakovo NPP, Russian Federation</i> |
| 1.3. Ville Peri | RECENT FUEL RELATED ACTIVITIES AT THE LOVIISA NUCLEAR POWER PLANT, <i>Ville Peri, Fortum Power and Heat Ltd, Fortum, Finland</i> |
| 1.4. Dmitry Kolotushkin | MEASUREMENT OF REACTIVITY AND NEUTRON-PHYSICAL CHARACTERISTICS OF THE REACTORS OF NOVovorONEZH NPP, <i>D. S. Kolotushkin, I. A. Boev, K. B. Zalyotnykh, Novovoronezh NPP, Russian Federation.</i> |

12:30–14:00 **Lunch**

14:00–15:30 **Afternoon session**

Chairpersons: *Krassimir Kamenov, Jan Höglund*

1.5. Aleksander Lazarenko SOFTWARE PACKAGE KASKAD FOR NEUTRONIC CALCULATION OF VVER CORES. STATUS AND FEATURES, *A. P. Lazarenko, M. Ju. Tomilov, NRC "Kurchatov Institute", Russian Federation*

1.6. Denis Zlobin "REACTOR SIMULATOR" PROGRAM FOR THE CORE MODELLING OF VVER-1000, VVER-1200, VVER-TOI, *Denis Zlobin, NRC "Kurchatov Institute", Russian Federation*

1.7. Jiří Zýbal THREE YEARS OF OPERATIONAL EXPERIENCE WITH GD-2M+ FUEL AT DUKOVANY NPP, *M. Borovička, J. Zýbal, Dukovany NPP, ČEZ, a.s.*

1.8. Gábor Bóna OPERATIONAL EXPERIENCE WITH 15 MONTHS CYCLES AND PLANNED INTRODUCTION OF MODIFIED FUEL TYPES AT MVM PAKS NPP, HUNGARY, *Gábor Bóna, MVM Paks NPP, Hungary*

15:30–16:00 **Coffee break**

16:00–17:00 **Afternoon session**

1.9. David Nesaraj OPERATIONAL EXPERIENCE OF UTVS TYPE FAS AND REFUELLING CONTINGENCY PLANS IN KKNPP UNIT-1, *David Nesaraj, Y. K. Pandey, H.P. Ram Mohan, G. Biswas, Nuclear Power Corporation of India Limited, Mumbai, India*

1.10. Jan Höglund PERFORMANCE OF THE WESTINGHOUSE WWER-1000 FUEL DESIGN, 2017 UPDATE, *J. Höglund, Westinghouse Sweden*

1.11. Carina Önneby EXPANDING ON THE VVER FUEL MARKET, *C. Önneby, J. Höglund, Westinghouse Sweden*

18:30–21:30 **Dinner**

19 September (Tuesday), Hotel Conference Hall

SESSION 2 IMPROVEMENT OF FUEL DESIGN AND OPERATION

09:00–10:30 Morning session

Chairpersons: *Ivan Vasilchenko, Victor Makarov*

2.1. Ivan Vasilchenko TASKS FOR FUTURE EVOLUTION OF VVER CORE DESIGN, *I.N. Vasilchenko, S.A. Kushmanov, V.V. Vyalitsyn, OKB "GIDROPRESS", Russian Federation*

2.2. Evgeny Kosourov WWER-1000 FUEL CYCLES: CURRENT SITUATION AND OUTLOOK, *E. Kosourov, A. Pavlovichev, E. Spirkin, E.Volkov, M.Sumarokov, NRC "Kurchatov Institute", Russian Federation*

2.3. Andrey Churkin ANALYSIS OF THE INFLUENCE OF MIXING GRIDS ON THE HEAT TRANSFER IN THE POST-CHF REGIMES, *Y. A. Bezrukov, A. N. Churkin, S. I. Zaytsev, I. N. Vasilchenko, OKB "GIDROPRESS", Russian Federation*

2.4. Sergey Zotov OPERATING EXPERIENCE WITH THE TVSA FUEL ASSEMBLY AND ITS VERSIONS, PERSPECTIVE ON THE DEVELOPMENT, *O.B. Samoylov, A.I. Romanov, O.N. Morozkin, S.A. Zotov, JSC "Afrikantov OKBM", Nizhny Novgorod, Russian Federation*

10:30-11:00 **Coffee break**

11:00–12:30 **Morning session (cont)**

- 2.5. Oleg Morozkin** DEVELOPMENT AND VALIDATION OF THE TVSA-12 FUEL ASSEMBLY FOR THE KOZLODUY NPP, *O.B. Samoylov, A.I. Romanov, A.A. Falkov, O.N. Morozkin, E.V. Sholin, D.L. Shipov, M.A. Samsonov, V.A. Bolnov, M.V. Zotova, V.V. Shashkov, A.S. Gusev, JSC "Afrikantov OKBM", Nizhny Novgorod, Russian Federation*
- 2.6. Tobias Strömgren** PREDICTION OF CRITICAL HEAT FLUX IN FUEL BUNDLES USING CFD, *Tobias Strömgren, Yann Le-Moigne, Westinghouse Electric Sweden AB*
- 2.7. Viktor Makarov** EXPERIMENTAL STUDIES OF THE STRENGTH OF FUEL ASSEMBLIES FOR PRESSURIZED WATER REACTORS, *V.V. Makarov, A.V. Seleznyov, A.V. Afanasev, I.V. Matvienko, OKB "GIDROPRESS", Russian Federation*
- 2.8. Artem Nosenko** EXPERIMENTAL RESEARCH VIBRATIONS FUEL ASSEMBLY WWER, *V.V. Makarov, A.P. Nosenko, A.V. Afanasev, Y.V. Egorov, I.V. Matvienko, M.V. Puchkov, OKB "GIDROPRESS", Russian Federation*

12:30 – 14:00 Lunch

SESSION 3 FUEL MODELLING AND EXPERIMENTAL SUPPORT

14:00–15:30 Afternoon session

Chairpersons: *Boris Volkov, Igor Evdokimov*

- 3.1. Boris Volkov** ROLE OF HALDEN REACTOR PROJECT FOR WWER FUEL DEVELOPMENT AND MODIFICATIONS, *B. Volkov, Institute for Energy Technology, OECD Halden Reactor Project, Norway*
- 3.2. Anton Dolgov** METHODS AND RIGS FOR IN-REACTOR TESTS OF STRUCTURAL MATERIALS AND COMPONENTS OF STRESSED FUEL ASSEMBLIES, *A.V. Burukin, A.I. Dolgov, A.L. Izhutov, M.A. Mokeichev, V.A. Ovchinnikov, JSC "SSC RIAR", Dimitrovgrad, Russian Federation*
- 3.3. Anatoly Zakharov** MATERIAL TESTING OF ROD CLUSTER CONTROL ASSEMBLIES WITH COMBINED ABSORBING KERNEL-BASED RODLETS AFTER A 10-YEAR OPERATION AT KALININ NPP, *A.V. Zakharov, E.M. Muraleva, A.V. Stozhuk, G.V. Shevlyakov, JSC "SSC RIAR", Dimitrovgrad, Russian Federation*
- 3.4. Anatoliy Sorokin** MODELING IN SUPPORT OF EXPERIMENTS IN THE MIR REACTOR FOR JUSTIFICATION OF FISSION PRODUCT RELEASE FROM FAILED FUEL OF ADVANCED DESIGN AND FROM (U,GD)O₂ FUEL, *A. Sorokin at al., JSC "SRC RF TRINITI", Moscow, Russian Federation*

15:30–16:00 Coffee break

16:00–18:00 Afternoon session (cont)

- 3.5. Márton Király** OVERVIEW OF THE EXPERIMENTS PERFORMED WITH RUSSIAN CLADDINGS AT MTA-EK, *Márton Király, Hungarian Academy of Sciences Centre for Energy Research, Fuel and Reactor Materials Department, Budapest, Hungary*
- 3.6. Artem Lunev** HOT PRESSING OF URANIUM DIOXIDE ADU POWDER AT 250–600 °C: MICROSTRUCTURAL CHANGES AND DENSIFICATION MECHANISM, *Artem Lunev at all., Joint Institute for High Temperatures of the Russian Academy of Sciences, National Research Nuclear University MEPhI, Moscow, Russian Federation*
- 3.7. Artem Lunev** A MULTI-SCALE APPROACH TO MODELLING DISLOCATION SUBSTRUCTURES IN DEFORMED URANIUM DIOXIDE, *Artem Lunev, Sergei Starikov, Alexei Kuksin, Joint Institute for High Temperatures of the Russian Academy of Sciences, Moscow, Russian Federation*
- 3.8. Marcin Szuta** MATHEMATICS OF HELIUM BEHAVIOR IN URANIUM DIOXIDE FUEL DURING NEUTRON IRRADIATION IN TERMS OF DEFECT TRAP MODEL, *Marcin Szuta, Ludwik Dabrowski, National Centre for Nuclear Research, Otwock-Swierk, Poland*

3.9. Dong-Seong Sohn MICROSTRUCTURAL CHANGES OF ZR-1NB-1SN-0.1FE CLADDING TUBE DURING LOCA SIMULATED CONDITIONS, *Cheol Min Lee, Dong-Seong Sohn, Ulsan National Institute of Science and Technology, Ulsan, Republic of Korea*

18:30–21:30 Dinner

20 September (Wednesday), Hotel Conference Hall

SESSION 3 FUEL MODELLING AND EXPERIMENTAL SUPPORT (cont.)

09:00–11:00 Morning session

Chairpersons: Arndt Schubert, Lena Oliver

3.10. Arndt Schubert EXTENSION AND VALIDATION OF THE TRANSURANUS CODE IN THE COURSE OF THE ESSANUF PROJECT, *A.Schubert et al, EC JRC, ITU, Karlsruhe, Germany*

3.11. Vitezslav Matocha DEVELOPMENT AND VALIDATION OF THE PELLETT-CLADDING MECHANICAL INTERACTION MODELS AT UJV, *J. Klouzal, V. Matocha, M. Dostál, ÚJV Řež, a.s., Prague, Czech Republic*

3.12. Stanislav Linhart SINGLE SIDE AND DOUBLE SIDE OXIDATION OF SPONDE-BASED AND OPTIMIZED E110 ZIRCONIUM ALLOY, *Stanislav Linhart¹, Josef Belac¹, Vera Vrtilkova², Jakub Krejci², Jitka Kabatova², Frantisek Manoch², ¹ – ALVEL, a.s., Prague, Czech Republic,² – UJP PRAHA a.s., Prague, Czech Republic*

3.13. Evgeny Mikheev PECULIARITIES OF THE INFLUENCE OF AN INCREASE IN THE CONTENT OF GADOLINIUM OXIDE FROM 5 TO 8% ON THE STRUCTURE OF URANIUM-GADOLINIUM TABLETS, *Mikheev E.N.¹, Novikov V.V.¹, Lisakov A.V.¹, Fedotov A.V.¹, Sivov R.B.¹, Missorin D.S.¹, Bahteev O.A.¹, Kalin B.A.², Tenishev A.V.², ¹ VNIINM JSC, Moscow, Russia, ²- NRNU “MEPhI”, Moscow, Russian Federation*

3.14. Vladimir Kuznetsov REACTOR JUSTIFICATION OF WWER FUEL RODS WITH INCREASED URANIUM CONTENT. OPERATING EXPERIENCE AND RAMP TESTS, *V. Kuznetsov, JSC “VNIINM”, Moscow, Russian Federation*

11:00-11:30 Coffee break

11:30 –12:30 Morning session (cont.)

3.15. Olga Vilkhivskaya ENGINEERING MODELS FOR EXPRESS-METHOD OF BURNUP EVALUATION OF WWER 1000 FUEL ELEMENTS, *A.V. Ugryumov, Yu.N. Dolgov, JSC “TVEL”, Moscow, Russian Federation, O.V. Vilkhivskaya, V.V. Likhanskii, A.A. Sorokin, M.G. Chernetskiy, JSC “SRC RF TRINITY”, Moscow, Troitsk, Russian Federation, E.A. Zvir, S.S. Sagalov, V.N. Kupriyanov, V.N. Momotov, JSC “SSC RIAR”, Dimitrovgrad, Russian Federation*

3.16. Jakub Krejčí AIR OXIDATION OF SPONGE BASED E110 CLADDING ALLOY AT HIGH TEMPERATURES, *Jakub Krejčí^{1,2}, Pavel Vrbka², Jitka Kabátová¹, Jan Kočí¹, František Manoch¹, Věra Vrtílková¹, ¹UJP PRAHA a.s., Czech Republic, ²Czech Technical University, Prague, Czech Republic*

3. 17. Lena Oliver FISSION PRODUCT ANALYSIS USING THE FPA CODE, *Lena Olivera^a, Olga Pulver^b, Kendal Bishop^b, ^aWestinghouse Electric Sweden AB, ^bWestinghouse Electric Company LLC*

3.18. Anatolii Gusev RESULTS OF PRE-REACTOR AND REACTOR TESTS OF FUEL CLADDINGS, *A. Yu. Gusev, A. G. Malgin V. A. Markelov, V. I. Kuznetsov, V. V. Novikov, M. M. Peregud, V. F. Konkov, B. I. Nesterov, JSC “VNIINM”, Moscow, Russian Federation*

<u>12:30–13:30</u>	Lunch
<u>13:30- 19:00</u>	Excursion
<u>19:00–21:30</u>	Dinner

21 September (Thursday), Hotel Conference Hall

SESSION 4 FUEL SAFETY AND QUALITY ASSURANCE

09:00–10:45 Morning session

Chairpersons: *Vladimir Novikov, Sergey Kryukov*

- 4.1. Joakim Karlsson** THE STUDSVIK CLADDING INTEGRITY PROJECT (SCIP) III - OVERVIEW, *J. Karlsson¹, P. Magnusson¹, P. Tejlund¹, A. Puranen¹, M. König¹, P. Beccau¹, Gerardo Grand², ¹Studsvik Nuclear AB, Nyköping, Sweden, ²Studsvik Scandpower Inc., Idaho Falls, USA*
- 4.2. Sabina Kristensson** ESSANUF – European Supply of SAfe NUclear Fuel, *J Höglund, S. Kristensson, Westinghouse Sweden.*
- 4.3. Sergey Kryukov** EXPERIENCE OF RIA SAFETY ANALYSES PERFORMANCE FOR KOZLODUY NPP CORE ARRANGED WITH TVSA-12 FUEL ASSEMBLIES, *S.A Kryukov, RRC "Kurchatov Institute", Moscow, Russian Federation*
- 4.4. Petya Vryashkova** NEW ZIRCALOY OXIDATION CORRELATIONS OF THE COMPUTER CODE MELCOR 2.1 ANALYSED ON THE BASE OF QUENCH-10 TEST DATA, *Petya Vryashkova, Institute for Nuclear Research and Nuclear Energy-BAS, Sofia, Bulgaria*
- 4.5. Martina Mala** SEVEN YEARS OF INSPECTIONS ON TVSA-T FUEL ASSEMBLIES AT TEMELIN NPP, *Martina Mala, Centrum vyzkumu Rez s.r.o., Czech Republic*

10:45–11:00 Coffee break

SESSION P POSTER SESSION

11:00–12:00

Chairperson: *Mladen Mitev*

- P.1. Marcin Kopec** FUEL ASSEMBLY DEFORMATION MEASUREMENTS, *M. Kopeć, M. Malá, CV Rez, Czech Republic*
- P.2. Aleksander Yashin** INCREASING THE CORROSION RESISTANCE OF THE E110 ALLOY IN A HIGH-TEMPERATURE STEAM BY ION BEAMS, *A.S. Yashin, NRNU "MEPhI", Moscow, Russian Federation*
- P.3. Dobromir Dimitrov** CORONA ACADEMY - A COMMON SOURCE OF KNOWLEDGE IN SUPPORT OF VVER TECHNOLOGY, *Mladen Mitev, Dobromir Dimitrov, Maria Manolova, INRNE-BAS, Bulgaria*
- P.4. Yuri Egorov** EXPERIMENTAL RESEARCH OF THE ADF DESIGNS, *Yu.V. Egorov, V.V. Makarov, V.N. Ulyanovskiy, A.V. Afanasev, I.V. Matvienko, OKB "GIDROPRESS", Podolsk, Russian Federation*

12:00–15:30 Lunch

SESSION 5 **SPENT FUEL PERFORMANCE AND MANAGEMENT**

15:30–16:00 **Coffee break**

16:00–17:30 **Afternoon session**

Chairpersons: *Surik Bznuni, Mladen Mitev*

- 5.1. Surik Bznuni** DEVELOPMENT OF BOUNDING AXIAL BURNUP PROFILE FOR WWER-440 SPENT FUEL ASSEMBLY TRANSPORT CASK DOSE ANALYSIS, *S. Bznuni, N. Bagdasaryan, A. Amirjanyan, Nuclear and Radiation Safety Center, Armenia, P. Kohut, Brookhaven National Laboratory, J. Ramsey, US Nuclear Regulatory Commission*
- 5.2. Teymur Aliev** DEVELOPMENT OF SOFTWARE PACKAGE FOR SAFETY ANALYSIS OF RUSSIAN NUCLEAR FUEL, *V.V. Likhanskii¹, T.N. Aliev¹, I.A. Evdokimov¹, D.V. Ivonin¹, M.Yu. Kolesnik¹, A.A. Sorokin¹, K.E. Ulibishev¹, V.G. Zborovskii¹, E.A. Zvir², P.A. Ilyin², A.B. Dolgov³, A.V. Ugryumov³, A.A. Shishkin³, B.A. Gurovich⁴, O.O. Zabusov⁴, V.N. Proselkov⁴, A.S. Frolov⁴, ¹)JSC “SRC RF TRINITI”, Moscow, ²)JSC “SSC RIAR”, Dimitrovgrad, ³)JSC “TVEL”, Moscow, ⁴)NRC “KI”, Moscow, Russian Federation*
- 5.3. János Bencze** INTERIM STORAGE OF SPENT NUCLEAR FUEL IN PAKS MVDS FACILITY, *János Bencze, MVM Paks NPP, Hungary*
- 5.4. Mikhail Kolesnik** HYDRIDE REORIENTATION MODEL FOR SPENT FUEL CLADDINGS IN DRY STORAGE CONDITIONS, *M. Kolesnik, T. Aliev, V. Likhanskii, State Research Center of Russian Federation “Troitsk Institute for Innovation and Fusion Research”, Troitsk, Moscow, Russian Federation*

18:30-23:30 **Traditional Bulgarian Dinner**

22 September (Friday), Hotel Conference Hall

SESSION 6 **SPECIFIC ISSUES OF WWER-1000 FUEL RELIABILITY**

9:30 – 11:00 **Morning session**

Chairpersons: *Anatoly Enin, Vladimir Molchanov*

- 6.1. Vladimir Molchanov** PROJECT «ZERO FAILURE LEVEL»: STATUS, PROBLEMS, TASKS FOR THE FUTURE, *V.L.Molchanov, JSC“TVEL”, Moscow, Russian Federation*
- 6.2. Vaclav Mecir** ZERO LEVEL DEFECT PROJECT - EFFECTIVITY, *Vaclav Mecir, CEZ a.s., Prague, Czech Republic*
- 6.3. Igor Evdokimov** WORKOUT APPROACHES TO DEVELOP AN EXPERT SYSTEM FOR FUEL FAILURES MONITORING AND ANALYSIS. TRENDING OF RECENT DATA ON WWER FUEL FAILURES, *I.A. Evdokimov, V.V. Likhanskii, E.Yu. Afanasieva, V.D. Kanukova, M.G. Chernetskiy, V.G. Zborovskii, A.A. Sorokin, I.O. Gorushin, A.Yu. Burtsev, A.P. Ponomarev, JSC “SRC RF TRINITI”, Moscow, Troitsk, Russian Federation*
- 11:00 – 11:15** **Coffee break**
- 11:15 – 13:15** **Morning session (cont.)**
- 6.4. Alexander Morylev** MASHINOSTROITELNY ZAVOD – 100 YEARS OF AGE. ADVANCES IN TECHNOLOGY OF WWER FUEL MANUFACTURE, *A. Morylev, PJSC “MSZ”, Elektrostal, Russian Federation*
- 6.5. Anatoly Enin** IMPROVEMENT OF VVER FA DESIGN AND MANUFACTURING TECHNIQUE AT PJSC NCCP, *S. Buymov, A. Enin, L. Kustov, D. Pluzhnikov, PJSC “NCCP”, Novosibirsk, Russian Federation*
- 6.6. Iosif Asatiani** OPERATIONAL EXPERIENCE OF VVER FUEL FABRICATED BY PJSC MSZ, *Iosif Asatiani, PJSC “MSZ”, Elektrostal, Russian Federation*
- 6.7. Dmitry Davydov** OPERATION RESULTS OF VVER FUEL ASSEMBLIES MANUFACTURED AT PJSC NCCP, *D. Davydov, O. Brovkin, Y. Bezborodov, PJSC “NCCP”, Novosibirsk, Russian Federation*

6.8. Anatolii Kutiavin MANUFACTURING OF ZIRCONIUM PRODUCTS AT CMP, SC. IMPROVEMENT OF MANUFACTURING PROCESSES AND METHODS OF ZIRCONIUM COMPONENT QUALITY CONTROL, A. Kutiavin, CMP, Glazov, Russian Federation

13:15–14:15 **Lunch**

14:15 – 16:00 - **Conference overall discussion and conclusions**

*Chairpersons: Alexey Dolgov, Arndt Schubert. Ivan Vasilchenko,
Boris Volkov, Krassimir Kamenov, Vaclav Mecir,
Jan Höglund, Vladimir Novikov, Vladimir Molchanov,
Victor Makarov, Igor Evdokimov. Anatoly Enin.*

16:00–16:15 **Coffee break**

16:15–17:30 **Closing session**

Conference closure: Dimitar Tonev

23 – 24 September (Saturday–Sunday): Departure of participants