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|  | EUROPEAN COMMISSION  DIRECTORATE-GENERAL ‘RESEARCH’ | INTERNATIONAL  SCIENCE AND  TECHNOLOGY  CENTRE |  |

## NON PROLIFERATION THROUGH SCIENCE AND CO-OPERATION

**CONTACT EXPERT GROUP**

**on**

**SEVERE ACCIDENT MANAGEMENT**

**(CEG-SAM)**

**MINUTES OF THE 10th MEETING**

**Institute of Atomic Energy (IAE), National Nuclear Centre (NNC)**

**Kurchatov-City, Republic of Kazakhstan**

**September 5-8, 2006**

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| Dissemination level: RE  PU: public  RE: restricted to EC and a group specified by the CEG-SAM members  CO: confidential, only for EC and CEG-SAM members |

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Final minutes, March 8, 2007 CEG-SAM / M-10

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| Subject: 10th Meeting of the ISTC  “Contact Expert Group on Severe Accident Management” (CEG-SAM)  Place: IAE NNC, Kurchatov-City, Republic of Kazakhstan  Date: September 5-8, 2006  Participants: 30 participants of 18 organizations from 6 countries:  Mr. E.Altstadt FZR, Rossendorf  Mr. D.Bottomley EC, DG JRC / ITU, Karlsruhe  Mr. B.Clement IRSN, Cadarache  Mr. G.Ducros CEA, Cadarache  Mr. L.E.Herranz Ciemat, Madrid  Mr. P.Hofmann Consultant, Karlsruhe (**secretary**)  Mr. M.Hugon EC, DG-RTD / J.4, Brussels (**chairman**)  Mr. Z.Hozer AEKI, Budapest  Mr. A.Miassoedov FZK, Karlsruhe  Mr. J.Stuckert FZK, Karlsruhe  Mr. K.Trambauer GRS, Garching  Mr. W.Tromm FZK, Karlsruhe  Mr. H.G.Willschütz FZR, Rossendorf  Mr. S.Baitkhanov IAE NNC, Kurchatov-City, RK  Mr. S.Bechta RIT-NITI, Sosnovy Bor  Mr. V.Bezlepkin SPAEP, St.Petersburg  Mr. A.Goryachev RIIAR, FRD, Dimitrovgrad  Mr. A.Kisselev IBRAE, DNS, Moscow  Mr. A.Kolodeshnikov IAE NNC, Kurchatov-City, RK  Mr. V.Kotov IAE NNC, Kurchatov-City, RK  Mr. S.Kotov IAE NNC, Kurchatov-City, RK  Mr. V.Nalivaev NPO LUCH, Podolsk  Mr. A.Palagin JRC / ITU, Karlsruhe  Mr. N.Parshin NPO LUCH, Podolsk  Mrs. T.Ryast IAE NNC, Kurchatov-City, RK  Mr. V.Semishkin OKB GIDROPRESS, Podolsk  Mr. A.Tkachenko IGR NNC, Kurchatov-City, RK  Mr. Y.Vassiliev NNC, Kurchatov-City, RK  Mr. A.Vurim IAE NNC, Kurchatov-City, RK  Mr. V.Zhdanov IAE NNC, Kurchatov-City, RK  Distribution list: Mr. J.M.Silva Rodríguez DG-RTD  (Shortened version Mr. Z. Stancic DG-RTD  of the minutes) Mr R. Burmanjer DG-RTD / D.3  Mr. J.Sanders DG-RTD / D.3  Mr. P. Fernández Ruiz DG-RTD / J  Ms. M. A. Soares DG-RTD / J.1  Mr. S. Webster DG-RTD / J.2  Mr. R.Schenkel DG-JRC  Mr. P. Frigola DG-JRC / 2  Mr. G. Sadler DG-JRC / 2  Intranet of Unit J.2  Mr. N. Jousten ISTC, Moscow  Mr. L.Tocheny ISTC, Moscow  EU CEG-SAM members  Contact person: Mr. M. Hugon Tel.: +32 2 296 5719 – DG-RTD / J.2 |

Revised final agenda of the meeting see Annex 1, list of participants see Annex 2.

The 10th CEG-SAM meeting was organized by the Institute of Atomic Energy (IAE) of the National Nuclear Research Centre (NNC) in Kurchatov-City, Republic of Kazakhstan. The meeting took place in the Hotel “Mayak” in Kurchatov-City, September 5-8, 2006.

The CEG-SAM meeting is divided into restricted and extended sessions. The restricted sessions are to discuss internal matters and the status of current ISTC projects. The extended sessions are dedicated to presentations of the progress of on-going ISTC projects and of new or revised ISTC proposals by scientists of Russia and Kazakhstan.

The chairman M.Hugon opened the meeting and welcomed the participants of the 10th meeting of the Contact Expert Group on Severe Accident Management (CEG-SAM) of the International Science and Technology Centre (ISTC) as well as the participants from Russia and Kazakhstan. He expressed his thanks to V.Zhdanov and to the Director General K.Kadyrzhanov from the National Nuclear Centre of the Republic of Kazakhstan who kindly offered to organize and host the 10th CEG-SAM meeting in Kurchatov-City. Of special interest will be the visits of the various research facilities at the NNC.

M.Hugon also mentioned that there are currently negotiations on an agreement for co-operation in the Peaceful Uses of Nuclear Energy between the European Atomic Energy Community and the Government of the Republic of Kazakhstan.

Z. Zhotobaev, Deputy Director of NNC, and E. Kenzhin, Director of the IAE, welcomed the participants of the 10th CEG-SAM meeting on behalf of the National Nuclear Centre of Kazakhstan and presented a short overview on the various activities of the NNC.

Unfortunately, Lev Tocheny (ISTC) was not able to attend this CEG-SAM Meeting in Kurchatov City due to other obligations.

**Restricted session**

**Topic #1:** Welcome and opening remarks

The chairman M.Hugon opened the first part of the restricted session and welcomed the EU participants of the 10th CEG-SAM meeting. For the first time L.E.Herranz from CIEMAT participated in the meeting and he was welcomed by M.Hugon and the group members.

**Topic #2:** Adoption of the agenda of the 10th CEG-SAM meeting

An additional presentation was proposed by K.Trambauer on “PARAMETER test SF-1; Sensitivity study with ATHLET-CD” (topic #17b), which would be of particular interest to the PARAMETER project #3194. A new additional project proposal on “Investigation of corium melt interaction with NNP reactor vessel steel (METCOR-P)” was announced by S.Bechta for the extended session (topic #28b). M.Hugon proposed to submit this ISTC project proposal (#3592) to the ISTC GB meeting that will take place in December 2006. Topic #22 will not be presented since S.Bogatov could not attend the meeting.

With these changes, the appended agenda (see Annex 1) was accepted.

**Topic #3:** Approval of the minutes of the previous 9th CEG-SAM meeting in Paris, France, March 8-9, 2006.

The secretary took into account the comment received by G.Ducros on the draft minutes, dated April 21, 2006, in the revised minutes dated May 5, 2006. The revised minutes were then approved by the CEG-SAM members without any additional changes at the meeting in Kurchatov-City on September 5, 2006.

**Topic #4:** Discussion of the “Specific action list” of the 9th CEG-SAM meeting in Paris

Action 9/1: General procedure for “Letters of Support”

The collaborators should send the letter of support and/or advice by air mail to the Executive Director of ISTC, Norbert Jousten, with scanned copies by e-mail or by fax to the CEG-SAM chairmen M.Hugon (EC) and L.Tocheny (ISTC), the secretary P.Hofmann and Mrs. Barbara Rhode (EC).

Action 9/2: Ongoing actions:

L.Tocheny will contact all Russian coordinators (project manager) of running ISTC projects to send the progress and final reports of their project to him. L.Tocheny will then send these reports to A.Miassoedov (FZK) who will include them in the ISTC CEG-SAM webpage.

L.Tocheny was asked once more to remind the Russian colleagues that in the future for each project proposal a one page summary should be provided at least 2 weeks before the meeting otherwise it can not be accepted for presentation.

*Action not completed since no reports were sent to A.Miassoedov by L.Tocheny. A.Miassoedov (FZK) collected himself all available reports and put them on an image of the ISTC CEG-SAM webpage in his computer. However, no information (reports) is available for projects in which FZK is not involved. In future the responsible Russian managers of ISTC projects should send a copy of the progress reports to A.Miassoedov*.

*The action regarding the one page summary of new ISTC project proposals was fulfilled in most cases.*

Action 9/3: ISTC proposals and work plans of ongoing projects should be sent by P.Hofmannn to the EC-SARNET topical coordinators concerned: J.M.Bonnet, responsible for core degradation and corium behaviour, L. Meyer, responsible for containment behaviour, or to T.Haste, responsible for fission product behaviour (topics #7 and #11). *Done on April 2006.*

Action 9/4: L.Tocheny will check the situation concerning the reception of the Sarov proposal for “Large-scale corium experiments” in ISTC before the end of March (topic #25). *Task by L.Tocheny not executed.*

Action 9/5: Ch.Journeau will send to A. Kondrashenko his Power Point presentation on remarks on the proposal for “Large-scale corium experiments” (topic #25). *Done.*

Action 9/6: P. Hofmann will send the proposal for “Large-scale corium experiments” for comments to J.M.Bonnet, the responsible SARNET topical coordinator for CORIUM issues (topic #25). *Done on April 2006.*

Action 9/7: Ch.Journeau will prepare an advice on the project proposal of RFNC-VNIIEF “Large-scale corium experiments” and distribute it to the group members for comments (topic #25). *Done.*

Action 9/8: A.Miassoedov will organise a meeting with RFNC-VNIIEF regarding topic #25 that should take place in conjunction with the project progress meetings on 1648.2 and 2936.

*On this subject a meeting took place with members of the VNIIEF and IVTAN institutes in Moscow on July 4, 2006. It was proposed that they should request a development grant to the ISTC to perform a small-scale scoping test and then put forward a detailed project planning. The concrete composition has still to be defined by the CEG-SAM members* (action 10/5)*.*

Action 9/9: D.Bottomley will collect the recommendations on the project proposal VERONIKA (topic #26) and send them to IBRAE and NIIAR. *Done.*

Action 9/10: P.Hofmann will send the project proposal VERONIKA (topic #26) to the responsible SARNET topical coordinator T.Haste for comments. *Done on April 2006.*

Action 9/11: Concerning the prolongation of the project METCOR-2, D.Bottomley will prepare a joint advice for the new project proposal in addition to the letter of support already submitted to ISTC in Jan '06 (topics #19 and #29).

*D.Bottomley sent an example of a letter of support for the new project proposal METCOR-P to the foreign collaborators.*

Action 9/12: M.Hugon and L.Tocheny will contact J.Sanders regarding the situation of the ISTC CEG-SAM webpage. The current procedure is not working. A.Miassoedov should be able to have direct access to the webpage to store documents or a contact person in the ISTC Secretariat in Moscow should update regularly the CEG-SAM webpage based on the input of A. Miassoedov (topic #5).

*On-going task. A.Miassoedov has not yet access the ISTC CEG-SAM webpage; see topic #5* (action 10/2)*.*

Action 9/13: M.Hugon will thank the acting Director-General K.Kadyrzhanov from the National Nuclear Centre of the Republic of Kazakhstan who kindly offered to organize and host the 10th CEG-SAM meeting in Kurchatov-City.

*M.Hugon sent a letter to K.Kadyrzhanov on 8 May 2006 to thank him for the invitation.*

**Topic #5**: Status of the official ISTC CEG-SAM webpage

The password-protected website of the CEG-SAM group within the official ISTC webpage has been set up by Alex Miassoedov (FZK) in co-operation with Olga Myznikova (ISTC) and is now operational and providing an access to the CEG-SAM related documents. The website can be accessed at <http://ceg-sam.istc.ru> (the login and password were sent to the group members by separate mail). The objective of the webpage is to serve as a file repository and to provide an easy access to all CEG-SAM related documents.

A.Miassoedov developed a new structure for the ISTC CEG-SAM webpage in his computer. All documents (project proposal, advice, work plan, progress reports) are collected under the ISTC project number. The problem is that A.Miassoedov has no direct access to the ISTC CEG-SAM webpage to deposit documents. This procedure is not yet operational, since the ISTC CEG-SAM webpage has not been updated despite several reminders of A. Miassoedov.

The CD prepared by A. Miassoedov containing a mock-up of the updated CEG-SAM webpage, which was sent to L. Tocheny last spring, has still not been downloaded on the ISTC webpage by the ISTC Secretariat. M.Hugon will therefore discuss this matter with L .Tocheny in September in Brussels to find a satisfactory solution. If there is no satisfactory solution, K. Trambauer will investigate with SARNET the possibility to host the CEG-SAM website on the SARNET ACT (action 10/2). However, Korea should have no access to the SARNET data.

**Topic #6**: Report by the secretariat; update of the list of collaborators and new members

M.Hugon mentioned that the CEG-SAM will be enlarged by two new members: K.Trambauer (GRS Garching) and L.Herranz (CIEMAT). The group welcomed the enlargement of the CEG-SAM by the two experts.

M.Hugon reported on a visit to different Russian organizations (Rosatom, RRC-KI, IBRAE) in Moscow on June 2006 to discuss on present and future reactors regarding safety investigations. The purpose of the meeting with IBRAE was to discuss the possibility for this institute to co-ordinate the research activities on Severe Accident Management (SAM) in Russia that are linked to the ISTC CEG-SAM.

In the subsequent discussion the general question came up on the task and role of a Russian project co-ordinator on SAM (action 10/3). IBRAE is considered by the CEG-SAM as the appropriate, independent organization to take the lead for this challenging task. Regarding the responsible person (M.Veshchunov) no clear statement could be made.

**Topic #7**: Update on the information exchange and interaction between ISTC CEG-SAM and SARNET

The modalities of interaction between CEG-SAM and EC-SARNET are defined in the document entitled “Interaction between EC-SARNET and CEG-SAM activities”, which was endorsed by the CEG-SAM at its 7th meeting in Cologne and by the EC-SARNET Governing Board in Paris, both in 2005. M.Hugon and L.Tocheny mentioned at that time that no new body should be created in the ISTC project evaluation process; EC-SARNET should act only in the background. The evaluation procedure should be considered as an internal advice.

Up to now the interaction between CEG-SAM and EC-SARNET works well and the EC-SARNET recommendations were considered in the final work programmes of the ISTC project proposals. In this connection the CEG-SAM decided to send the draft project proposals as early as possible to the responsible EC-SARNET topical co-ordinators to avoid extensive changes of the proposals at the end (actions 10/8 and 10/12).

**Topic #8**: SARNET source term comments on the draft ISTC project proposal VERONIKA

L.E.Herranz presented the comments of EC-SARNET on the ISTC project proposal VERONIKA. The essential recommendations have been to address in the experimental investigations the whole range of possible oxygen potentials, to measure the oxidation state of the clad before the test, to characterize well the fuel properties and the pre- and re-irradiation histories, and to use B4C and steel next to the fuel sample to study the possible enhancement of released fission products. The results will contribute to valuable source term information concerning air-ingress scenarios. VERONIKA will supplement the VERCORS and VERDON programmes. A new test matrix was proposed.

**Topic #9**: Future co-operation with Russian research institutes in the area of nuclear fission.

See topic #6 and action 10/3.

**Topic #10**: Preliminary discussion of new ISTC project proposals

The new ISTC project proposals will be presented under topic #23 and topics #25 until #28.

Comments on the proposal “Large scale MCCI experiments” (topic #23).

A meeting between CEG-SAM members and the VNIIEF and IVTAN institutes was organized in Moscow, July 4, 2006. An extensive exchange of information between CEG-SAM and the Russian partners took place regarding the continued heating method of the molten materials. A small-scale scoping test was recommended to be performed to test the heating method. It is important that the corium melt will stay liquid in the concrete crucible for a few hours. The applied sustained heating method from the top should also guarantee that the bottom material will be molten otherwise the experiments will not be of interest. To improve the project proposal further technical exchange will be necessary. This could be done in the frame of an ISTC project development grant (action 10/5).

Comments on the proposal “Study of fission products release and behaviour of VVER fuel with high burn-up under severe accident conditions (VERONIKA)” (topic #25).

The CEG-SAM is interested in this proposal since it will support and/or supplement similar on-going European programmes such as VERDON (VERCORS continuation). Some of the planned fission product release tests should be conducted with and without cladding under inert and oxidizing conditions. A well defined characterization of the fission product distribution in the fuel by various analytical methods should be performed before and after the tests. Additional recommendations are described under topic #8.

Comments on the presentation “In-pile tests in the IGR research reactor” (topic #26).

As already mentioned at the last CEG-SAM meeting, a working group is reviewing at present the future of PHEBUS. As its conclusions will be available by the end of the year, the CEG-SAM decided therefore at the 9th CEG-SAM meeting to postpone the discussion on the IGR proposal after the end of the PHEBUS review. The further discussion on the paper, which should not be considered as a project proposal, was shifted after its presentation (action 10/9).

Comments on the proposal “37-rod fuel assembly tests under severe accident conditions” (topic #27).

A bundle test with 37 fuel rods (19 + 18) will be very expensive and requires besides a new test section a new electric power supply and additional measuring devices. Since the first test PARAMETER-SF1 with 19 fuel rod simulators had some difficulties concerning the temperature control it seems reasonable to repeat this test. In the test SF-1 too high temperatures were reached resulting in melt formation and relocation that was not planned. As a result, the water from top-flooding, that was initiated too late, flowed around and not through the overheated bundle. A recommendation is therefore to perform the test SF-1 once more under well-controlled conditions but it was also agreed to wait for more results before deciding. (action 10/10).

Comments on the proposal “Risk assessment of thermal reactor accidents with maximal reproduction of fissile material” (topic #28a)

The proposal is new reactor generation related and is out-of-scope of the CEG-SAM (action 10/11).

Comments on the proposal “Investigation of corium melt interaction with NNP reactor vessel steel; METCOR-P (topic #28b)

It is no longer possible to ask for prolongation of ISTC projects. A new project proposal has to be submitted to ISTC.

The main objective of the project proposal METCOR-P is the NNP reactor safety enhancement in case of a severe accident with core degradation and meltdown. The specific subject of the project is the experimental study of physico-chemical phenomena occurring at the interaction between a molten corium pool and reactor vessel steel. The CEG-SAM supports this project.

# Extended session

**Topic #11**: Welcome of the Russian colleagues; approval of the shortened minutes of the 9th CEG-SAM meeting in Paris; adoption of the agenda

M.Hugon opened the extended session of the meeting and welcomed the Russian and Kazakh participants. He expressed once more his thanks to V.Zhdanov and to the Director-General K.Kadyrzhanov for organising and hosting the 10th CEG-SAM meeting in Kurchatov-City.

The shortened minutes of the 9th CEG-SAM meeting, distributed to the Russian participants in May 2006, were accepted without any changes. The agenda with the additional presentations of K.Trambauer (topic #17b) and S.Bechta (topic #28b) was approved and adopted.

**Topic #12:** Status of the information exchange and interaction between ISTC CEG-SAM and EC-SARNET

The interaction between EC-SARNET and CEG-SAM will bring mutual benefits and will further assure a critical mass of expertise for ISTC proposals addressing specific issues in the SAM area. The objective of the interaction is the resolution of still-pending questions that are important for reactor safety, and the knowledge transfer for safety application.

B.Clement described briefly the interactions between EC-SARNET and CEG-SAM for the two considered project proposals on MCCI and VERONIKA. Whereas for the MCCI proposal a SARNET review was considered as premature since there are still too many unknowns, for the VERONIKA proposal an extensive review was conducted resulting in several recommendations on the work programme (topic #8).

For future review processes EC-SARNET recommended the CEG-SAM to send them the first drafts of ISTC project proposals to interact at earlier stage. The CEG-SAM considers the SARNET advice as a valuable input to prepare recommendations for project revisions to be discussed with the Russian or Kazakh project coordinators at the following CEG-SAM meeting.

Results of EC-SARNET's definition of priorities in terms of R&D needs should be periodically presented to the CEG-SAM members and Russian organisations. This list should be updated continuously within EC-SARNET.

**Topic #13:** Essential results of the PHEBUS programme

B.Clement presented essential results of the PHEBUS FP programme and additional safety needs examined by an international group of experts. The main outcomes of the five PHEBUS tests conducted on fuel degradation, fission product and material release, fission product and aerosol transport in the reactor cooling system, thermal-hydraulics and aerosol behaviour in the containment, and on the iodine chemistry were briefly described. The international group of experts defined three areas of research on severe accidents for which additional experiments are needed: air ingress situations, behaviour of high burn-up and MOX fuel, and reflooding of a degrading core. Higher priority was given by the group to air ingress and reflooding tests compared to high burn-up fuel tests. Consideration of research needs for Generation IV reactors is foreseen. Another topic is also taken into account by the international group of experts: it concerns the behaviour of a bundle under LOCA conditions. The specialists meeting aimed at given recommendations on this issue is scheduled end of 2006.

**On-going project presentations**

**Topic #14:** Progress report on the ISTC project # 1648.2 “Examination of VVER fuel behaviour under severe accident conditions, Quench state” (VVER-QUENCH)

A.Goryachev (RIIAR) presented the status of the project that consists of three stages. Stage 1: Study of the irradiated fuel rod segment behaviour under reflood conditions to determine the hydrogen generation and fission product release, stage 2: conduct of one integral quench experiment with 31 VVER fuel element simulators, and stage 3: development of models and codes to describe VVER core behaviour under severe accident reflood conditions (quench stage).

Altogether 10 quench tests with un-irradiated fuel rod simulators have been conducted in the temperature range between 1400 and 1700oC under hot-cell conditions (cladding oxidation in steam) and conditions outside of hot cells (cladding oxidation in an argon/oxygen mixture). Three tests were performed using irradiated fuel rod segments. One of the primary objectives of the tests with un-irradiated simulators was to check the working capacity of the test rig and create the data base for comparison with the irradiated fuel rod simulator tests. As a result of tests the hydrogen generation at initiation of the reflood condition is obtained. There was good agreement with the results obtained in FZK in the tests with fuel rod simulators with claddings from E110 alloy. However, unlike the experiments in FZK, no surface oxidation of the brittle cracks occurred at quenching. First test using irradiated fuel rod segments, re-fabricated from VVER fuel rods at burn-ups of 54 and 65 MWd/kgU, reveal some differences with the un-irradiated fuel rod simulator test results. The differences are: a) the enlarged hydrogen generation during the test that may be attributed to the release of hydrogen accumulated in the cladding during the base irradiation; b) intensive α-Zr(O) layer formation on the cladding inner surface due to tight fuel cladding contact that lead to the enhanced cladding embrittlement in comparison with the un-irradiated simulators tested under similar conditions. A problem that occurred during the tests was the embrittlement and subsequent cracking of the central heating tube.

**Topic #15:** Progress report on the project # 2936 “Modelling of reactor core behaviour under severe accident conditions. Melt formation, relocation and evolution of molten pool” (Reactor Core Melting)

A.Palagin (ITU) presented the status of the project #2936 that is divided in 8 tasks starting with modelling of the early stage melt formation and relocation up to a thermo-hydraulic model for the molten corium pool behaviour in the reactor pressure vessel including the crust formation. Tasks 1, 3, 7 and 6 have been completed. The results of the tasks 4 and 8 were presented. The physico-chemical behaviour of short pre-oxidized fuel rod simulators during quenching and the resulting hydrogen generation were analytically described. The experimental data were obtained in the frame of the ISTC project #1648.2 (topic #14).

A topical meeting on the ISTC projects #1648.2 and #2936 was organized by IBRAE in Moscow, July 3-5, 2006. The development of new models and codes in the frame of the ISTC project #2936 was presented. The analysis of various tests on corium melt behaviour with these advanced analytical tools was presented and discussed in detail. It was agreed that all tasks have been performed as foreseen in the work programme.

**Topic #16**: Progress report on the ISTC project # 3194 on “Fuel assembly tests under severe accident conditions” (PARAMETER Facility)

V.Nalivaev (FSUE SRI SIA “LUCH”) presented the current status of the project PARAMETER that includes the conduct of two VVER-1000 bundle experiments under severe reactor accident conditions, similar to the experimental conditions of the QUENCH-06 experiment. In the first test the overheated bundle should be flooded from the top; in the second test the bundle will be flooded simultaneously from the bottom and from the top. The test parameters for the first bundle experiment (heat-up rate, steam flow rate, extent of pre-oxidation of the cladding, maximum cladding temperature before quenching, flooding rate) were fixed on the basis of SVECHA code predictions by IBRAE.

The first test PARAMETER-SF1 was conducted on April 2006. The conditions of the test simulated a severe stage of a LOCA-type accident, in which the core will be superheated to about 2000°C and is then flooded from the top in case of recovery of the emergency core cooling system (ECCS) operation. The planned SF-1 test scenario consisted of a preliminary phase of about 7000s to heat-up the bundle, the cladding oxidation phase at about 1200°C for about 8000s and the subsequent heat-up phase to about 2000°C before quenching of the bundle from the top with a water flow rate of 40g/s was initiated. During the test the measured data partially deviated from the predicted calculated values which resulted in higher bundle temperatures. The higher temperatures resulted in a stronger melt formation and relocation that may have influenced the planned flooding of the bundle from the bottom. The maximum hydrogen generation rate was 0.19g/s and the total amount of produced hydrogen amounts to about 91g. Destructive post-test examinations of the bundle were performed and the results were presented showing an extensive bundle blockage formation at the bundle elevation of about 724mm.

**Topic #17a**: Post-test assessment of the top-flooding test PARAMETER-SF1 (ISTC project #3194)

A.Kisselev (IBRAE) presented the results of post-test calculations for the test PARAMETER-SF1 which were performed with the code systems RATEG/SVECHA, RELAP, MAAP4, MELCOR, PARAM-TG, ATHLET-CD and ICARE/CATHARE. The applied nodalisation of the bundle simulator and of the test section was different for the different code systems. In addition, the PARAMETER-SF1 test will be the first where flooding of the bundle will be from the top. Top quenching is difficult to calculate and most code systems do not have specific models. For this reason, the code users should reach agreement on the physical approach to model top flooding phenomena. Nevertheless, the agreement in the obtained results (cladding and shroud temperatures, axial temperatures profiles, steam consumption, steam flow rate through the bundle, volume of condensed water in the lower plenum, cladding oxidation, total hydrogen generation, released energy) is satisfying. The analytical results of the different code systems indicate an acceptable simulation of the thermal and hydraulic SF1 bundle behaviour. Future steps and code improvements comprise the models for cladding and shroud oxidation during top-flooding of the bundle and that for melt formation and relocation under quench conditions.

**Topic #17b**: PARAMETER test SF1; Sensitivity study with ATHLET-CD

K.Trambauer (GRS) presented results of calculations performed with the code system ATHLET-CD for the test PARAMETER-SF1. The motivation for the pre- and post-test calculations was to prove the code capabilities, to detect deficiencies of the models and to obtain hints for modelling of reactor calculations. The comparison of the analytical results with the experimental data show that for top-flooding of the bundle, the temperature distribution within the bundle, and the oxidation of the cladding and shroud are well predicted. However, the obtained analytical results are sensitive with respect to the assumed boundary conditions, the nodalisation of the lower test section and out-flow, and the model options. Additional measurements of the temperature and the water inventory in the lower test section would be helpful (action 10/10).

**Topic #18:** Progress report on the project # 833.2 “Investigation of corium melt interaction with NPP reactor vessel steel” (METCOR-2)

The work carried out within the ISTC METCOR-2 project is aimed at studying physico-chemical phenomena taking place during the interaction of molten corium with reactor vessel steel in the case of in-vessel melt retention (IVR).

S.Bechta (RIT-NITI) described the progress of the project since the last CEG-SAM meeting in Paris. The experimental part of the project METCOR phase 2 has been fulfilled and was presented at the last steering committee meeting in St. Petersburg on June 14, 2006. The project is in strict compliance with its work plan and was finished on 31 May 2006.

In the frame of phase 2 of the ISTC project the physico-chemical behaviour of vessel steel with sub-oxidized corium or with oxidized corium in steam were performed. The results with oxidized corium in air or steam result in similar corrosion rates of the vessel steel. With increasing concentration of iron oxides in the corium melt the corrosion rate decreases. The corrosion rate increases after reaching the eutectic temperature at the interface between corrosion layer and corium. The transfer of the results to a plant application show that the evaluated thickness of undamaged vessel wall is much smaller if the vessel steel ablation is taken into account.

The overall conclusions of the METCOR-2 project are: the VVER steel corrosion mechanisms have been clarified for different melt compositions. The developed correlations can be used in the analysis of in-vessel melt retention with oxidized and sub-oxidized corium compositions under different environmental conditions. However, to study the complete corrosion processes requires additional experiments with oxidized corium in the temperature range of the steel surface exceeding 1200°C and for sub-oxidized corium the interaction of molten corium with vertically positioned vessel steel specimens, experiments under time-varying oxygen potentials and for vessel steel compositions typical for European reactors. The experimental test matrix for the new ISTC project METCOR-P (#3592) was presented (see topic #28b; action 10/12).

**Topic #19:** Progress report on the project #1950.2 “Phase diagrams for multi-component systems containing corium and products of its interaction with NPP materials” (CORPHAD-2)

The CORPHAD-2 project focuses on experimental studies of phase diagrams of corium/NPP material mixtures to obtain information on liquidus and solidus temperatures, on temperature-concentration regions of miscibility gaps and on solubility limits. The reactor application of the results is based on the thermodynamic NUCLEA database optimisation. Improvements are expected regarding corium behaviour modelling. The experimental part of the project CORPHAD phase 2 has been fulfilled since the last meeting and was presented at the last steering committee meeting in St. Petersburg on June 14, 2006.

S.Bechta (RIT-NITI) presented the results of experimental investigations in the systems Zr-Fe-O, UO2-SiO2, and a complex corium mixture composed of seven oxidic components. The objectives of the investigations have been to determine the liquidus temperatures of the mixtures and evaluate a possible miscibility gap in the systems. In the system Zr-Fe-O a miscibility gap was observed that was narrower than the calculated gap using GEMINI-2/NUCLEA-05. Also in the system UO2-SiO2 a miscibility gap was found but not in the complex composed corium mixture. In the system UO2-SiO2 a stratification of the melts was observed above 2000°C; the monotectic temperature was found to be in the temperature range between 2000 and 2080°C. In all systems the liquidus temperatures were determined. The project is in strict compliance with its work plan and will be finished on 30 November 2006. The plans for the final period of the project will be the completion of the post-test analysis and the preparation of the reports on the individual examined systems. The final report of the project CORPHAD-2 will be prepared by March 2007.

The foreign collaborators of CORPAD-2 recommend a continuation of the project to clarify the additional questions that came up in the course of the current work. The reason for continuing this project immediately is that the practical experience has already been accumulated in surmounting the technical difficulties for such experiments. Moreover the advantages of continuing the investigation, while the expertise of the operating team and their initiatives are still fresh, are additional bonuses. As soon as the first draft of the new ISTC project proposal will be ready it should be sent to the secretary to the CEG-SAM who will transfer it to EC-SARNET for comments.

**Topic #20:** Status of the ISTC project # K-1265 “Study of the processes of corium-melt retention in the reactor pressure vessel” (INVECOR)

The project started on May 1, 2006. A first progress meeting of the ISTC project INVECOR took place in St.Petersburg on June 16, 2006, where the latest developments were discussed and appropriate actions recommended clarifying the various problems in the planned test conduct.

V.Zhdanov (IAE NNC RK) described once more the objective of the in-vessel corium retention experiments (INVECOR), e.g. the improvement of the safety assessment of LWR corium in-vessel retention (IVR) and the modelling of the thermal and physico-chemical processes of the prototypical corium pool and its retention in the water-cooled RPV lower head. The project is divided into 4 tasks. Task 1: Modernization of the available facilities and optimization of melting technology and simulation of decay heat, development of crucible surface protection technology including experiments on coating application for large-scale crucible tests. Task 2: Conduct of pre-test and post-test calculations and the development of a molten pool model. Task 3: Conduct of large-scale experiments with maintenance of the energy release into the molten pool. Task 4: Conduct of post-test analysis of the corium samples and the RPV steel.

The main results have been the improvement of the electric melting furnace, the test section design, design and testing of a device for decay heat modelling, preparation of the melt receiver, testing and upgrading of the data measurement and acquisition system, life time tests of zirconium coated graphite electrodes and supporting small-scale experiments. The results/conclusions of the various activities were presented. The calculations of the electric melting furnace to improve the heating mode and to increase the loaded mass are under way. The tests with the heater (plasmatrons) to heat the corium homogeneously have been continued and new electrode designs were developed. The technique of Zr-coating application on large-scale crucibles and electrode nozzles is continued. The data measuring and acquisition systems were improved. The corium pool behaviour has been calculated and different RPV model designs (shape, diameter, wall thickness, type of steel) have been considered and various calculations have been performed.

**Topic #21:** Status of the ISTC project #3345 “Ex-vessel source term analysis” (EVAN), phase 1

S.Bezlepkin (SPAEP) presented the status and work plan of the project EVAN. The project includes theoretical and experimental research of the processes affecting the late phase fission product release into the containment atmosphere. This stage is characterised by corium melt release from the reactor pressure vessel into the containment compartment. At this stage, the fission products are released from the core melt into the containment atmosphere. The assessment of radiological consequences for severe accidents includes the determination of fission product release into the containment atmosphere and time-dependent and physical-chemical composition of the environmental source term.

The project is divided in four work packages consisting of altogether seven tasks which were described once more in detail: WP1) Analysis of severe accident scenarios (SPAEP, IBRAE). WP2) Experimental and theoretical investigations on fission product release from molten corium pool (NITI, IBRAE). WP3) Experimental and theoretical investigation of the aerosol transport, deposition and re-vaporization in the primary circuit pipes (NPO CKTI, SPAEP, IBRAE). WP4) Experimental and theoretical investigations on the impact of containment parameters on the behaviour of iodine species (VNIPIET, SPAEP).

The seven tasks and the proposed test matrices and schedule for the different experiments were presented in detail. The overall project is divided in two phases: Phase 1 (1 year) comprises the mounting, installation and conduct of pilot experiments. Phase 2 (2 years) covers a more detailed testing and analysis of phenomena based on the evaluation of the results obtained in phase 1. The project will be initiated as soon as the ISTC contract is signed.

**Topic #22:** Current results of the ISTC project #2916 (CHESS)

S.Bogatov (RRC KI) was not able to attend the meeting. The presentation was therefore cancelled.

The CEG-SAM requested the available data sets for phase 2 of the Chernobyl accident and the initial conditions of the reactor before the accident to perform its own independent calculations. The data will be provided in the frame of a report on a CD (actions 10/6 and 10/7).

**New project proposals**

**Topic #23:** Comments on “Large-scale corium experiments”; Results of the meeting with RFNC-VNIIEF in Moscow on July 4, 2006

Current NPP safety analyses require studies of the consequences of corium-concrete interactions. In most current NPPs it is not possible to demonstrate in-vessel retention. Thus, ex-vessel sequences resulting in corium-concrete interactions have been studied in the frame of various national and international programmes. However, there are still open questions and uncertainties that could be clarified by additional experiments: for example, melt layering during the ex-vessel sequence, heat transfer between the oxide and metal layers, early- and late-phase crust formation and crust stability, long-term concrete erosion and cavity formation.

At the last CEG-SAM meeting, A.Kondrashenko presented the proposal on “Development of large-scale installation for heating and retention of 1000 kg melts”. The project proposal comprises the development of a large-scale installation for heating and retention of melts that simulate the reactor core melt with melt masses up to 1000 kg at temperatures of about 2500˚C and melt retention times of 1-2 hours. The CEG-SAM members asked additional questions and expressed some concern on the feasibility of the experiments. To clarify the questions a meeting of some CEG-SAM members with A.Kondrashenko (RFNC-VNIIEF) and his team took place in Moscow on July 4, 2006. Since V.Kondrashenko could not participate at the 10th CEG-SAM meeting in Kurchatov-City, A.Miassoedov (FZK) reported on the outcome of the meeting in Moscow.

A new proposal was presented to conduct 2 tests applying a modified heating method for the corium by combustion of (U+FeO) and (Zr+FeO) briquettes. After initial thermite ignition, both from the bottom and from the top, these briquettes are regularly added to increase the melt volume and maintain the temperature. Some concern has been expressed regarding the melt separation into metal and oxide layers. The VNIIEF experts proposed an alternative solution for the melt heating. Several gas burners can be installed at the circumference of the test crucible and will be used to heat the melt surface in-between the addition of the thermite briquettes. The combination of the two methods of heat generation will lead to substantially longer test duration (about 2 hours) which is of high importance for the MCCI tests.

It was proposed that a project development grant be requested from the ISTC in which they could do a scoping test to melt 100kg of (UO2+ZrO2+Fe) and then put forward a detailed project planning. For the test a siliceous concrete should be used; the concrete composition has to be discussed by the CEG-SAM members (action 10/5).

**Topic #24:** SARNET source term comments on the draft ISTC project proposal VERONIKA

L.E.Herranz from CIEMAT presented the comments of EC-SARNET on the ISTC project proposal VERONIKA. The essential recommendations have been to address the whole range of possible oxygen potentials in the test, to measure the oxidation state of the clad before the test, to characterize well the fuel properties and the pre- and re-irradiation histories, and to use B4C and steel next to the fuel sample to study the possible enhancement of released fission products. The results will contribute to valuable source term information concerning air-ingress scenarios. VERONIKA will supplement the VERCORS and VERDON programmes. The comparison of the VERONIKA with the VERCORS results could provide insights on the fuel effect for PWR and VVER. A new test matrix was proposed.

**Topic #25:** Study of fission product release and behaviour of VVER fuel with high burn-up under severe accident conditions (VERONIKA)

A.Goryachev (RIIAR) presented the revised project proposal VERONIKA (**V**VER **E**xperiments on **R**elease due to **O**ver-heating: **N**ormal**i**zation and **K**nowledge **A**ugmentation). This proposal will investigate fission product release from high burn-up fuel annealed under oxidizing and reducing conditions. The objective is to obtain experimental data on the release of fission products (Kr, Xe, I, Cs, Ru, Ce, Mo, Ba, Zr) from highly irradiated VVER fuel of 60 MWd/kgU in the range between 1400 and 2300°C. The results will be used to develop, validate and improve physical models and numerical codes to describe the high burn-up fuel behaviour and fission product release under severe accident conditions (e.g. **M**odel for **F**ission **P**roducts **R**elease (MFPR)). In contrast to earlier similar tests (VERCORS), it is planned to perform comparative tests with and without cladding, as well as turning off the heating at intermediate temperature before fuel collapse, in order to thoroughly analyze the fuel microstructure and fission product distribution at each stage.

In the revised test matrix the SARNET recommendations were taken into account (topic #24). To meet the comments by SARNET some changes and improvements were made in the proposal regarding experiments to be conducted in air, the fuel characterization and the cladding oxidation, and the re-irradiation history. Tests in steam should be considered also in the first phase of the planned project.

In the subsequent discussion, details on the preparation and handling of the fuel rod segments for the fission product release tests were discussed: especially, how to remove the cladding from the fuel, what type of crucible material will be used and what methods will be used for the pre- and post-test characterisation of the fuel. Additional comments were the different oxidation behaviour of the test specimen in air compared to steam and its influence on the fission product release and the chemical state of the release species (action 10/8).

It is planned to conduct the proposed project in 2 phases of altogether 5.5 years. In the first phase of the project (3 years) altogether 10 experiments in pure steam and in an inert-reducing atmosphere will be performed. In the second phase (2.5 years) 10 tests in hydrogen/argon and air/argon mixtures are planned. The experimental matrix may be corrected, if necessary, on the basis of the first phase's results and results of other related European projects (VERCORS, VERDON). This approach will provide the important feedback necessary for long-term projects. The estimated costs of phase one is 777400$ and that of phase two 494000$.

**Topic #26**: In-pile tests in the IGR research reactor

A.Vurim (IAE NNC RK) presented the capabilities of the IGR research reactor to conduct safety-related in-pile tests with individual fuel pins or small fuel rod assemblies. A similar presentation was given at the last meeting in Paris by V.Zhdanov.

The IGR reactor achieved its first critically in 1960. It is an impulse uranium-graphite thermal self-shutdown nuclear reactor with graphite moderator and reflector. There exists no special cooling system for the reactor core. The reactor has a maximal neutron flux density of 7×1016 n/cm2s and a maximal neutron fluence of 3.7×1016 n/cm2 in the central experimental channel. These parameters allow the simulation of severe accident conditions that are typical for power reactors.

Since 1983 various reactor safety-related tests have been performed in the IGR reactor, mainly to simulate reactivity initiated experiments (RIA). A few experimental devices were created for so-called ampoule tests, some of them allow to use coolant (water, steam, sodium, air) with pressures up to 20 MPa and temperatures up to 250°С. There was a unique series of 23 RIA tests with spent fuel rod segments of VVER-1000 type with burn-ups up to 50 MWd/kgU. The results of these tests and the methods used to perform them caused great interest among foreign specialists. At the beginning of 1990 the possibility to perform tests in the IGR research reactor with fuel pins of the PHWR Indian reactor, French PWR and Canadian CANDU was discussed intensively. However, organizational problems at that time prevented the possibility of any test conduct in the IGR reactor.

Various types of experiments were performed or were planned in the IGR reactor in the past. One of the performed projects was EAGLE-1 to show the experimental evidence for the elimination of the re-criticality in sodium cooled fast reactors. These experiments demonstrated also the possibility to conduct experiments under SA conditions. For example, experiments with 75 fuel rod bundles, molten fuel behavior under disruptive core conditions, melt relocation experiments (10 kg UO2 or corium) and melt interaction experiments with different catcher materials under realistic simulation of the decay heat in the melt may be implemented.

The current preliminary proposal is the preparation and performance of an in-pile test to study the interaction of molten corium with construction materials or lower head debris cooling. The proposed activities comprise in the first phase pre-analysis, design of the experimental equipment, description of the main technologies of preparation and conduction of the test. The time schedule will be one year, the costs 70-100k$. The second phase comprises the manufacturing of the experimental devices and equipments, test preparation and conduction, and the analysis of the results. The time schedule will be two years, the estimated costs will be, based on the experience of the EAGLE project, about 500k$ (action 10/9).

**Topic #27:** 37-rod fuel assembly tests under severe accident conditions

V.Nalivaev (LUCH) presented the project proposal of quench tests with larger fuel assemblies in the PARAMETER facility. Once more the essential results of the first top-flooding test PARAMETER-SF1 with a 19 rods VVER bundle simulator were described (topic #16). In this test two phenomena were identified. The upper part of the bundle simulator was rapidly and effectively cooled within 3-5s from about 1500°C to 50°C accompanied with blocking of the water in the middle part of the bundle by the generated steam and as a result of the bundle degradation in the central part. Due to by-passing of the water outside the bundle the lower part of the bundle was cooled from the bottom in the time range 400-600s. The melt formation and relocation in the middle part of the bundle resulted in the solidification of the (U, Zr, O) melt in the lower colder part of the bundle.

In order to reduce the effect of water by-passing during top-flooding and to study the dynamics of water cooling of the bundle from the top in more detail it was proposed to add an additional row of 18 heated fuel rods to the 19 rod fuel element assembly. The 7 fuel rods of the inner part of the bundle should be pre-pressurized and contain no tungsten heaters to better simulate and study the cladding deformation and bundle degradation phenomena during top-flooding. All other test parameters should be similar to those applied in the performed test PARAMETER-SF1. The desired maximum cladding temperatures in the central part of the bundle simulator at quench initiation from the top should be around 1800°C. The time schedule for the conduct of the two proposed test will be 2 years; the estimated total costs will be about 800k€.

**Topic #28a:** Risk assessment of thermal reactor accidents with maximal reproduction of fissile materials

V.Kotov (IAE NNC RK) presented the paper on the above topic and calculations for different reactor types and various boundary conditions. The paper is not a project proposal but only a demonstration to show what possibilities exist to use the fuel more effectively. A high production of fissile materials in thermal reactors will only be possible by increasing the number of secondary neutrons in the fissile material. The investigations of such development have good prospects. The principle notions are the elimination of compensatory burnable absorbers in the core, an optimal concentration of fissile materials in the range of 0.7 to 1.3%, the use of structural materials with minimum neutron losses, the use of additional neutron sources due to “n-2-n” reactions by placement of beryllium in the fuel assembly, and the use of thorium fuel. The implementation of these conditions results in a small addition of fissile material in spent fuel. The economic feasibility of this technology is shown. The profit would be the elimination of fuel enrichment and multiple decreases of expenses on fuel raw materials. A smaller concentration of fissile materials in the fuel would result in a safer fuel cycle concerning nuclear accidents (action 10/11).

**Topic #28b:** Investigation of corium melt interaction with NPP reactor vessel steel (METCOR-P)

S.Bechta (RIT-NITI) presented this project proposal METCOR-P (ISTC project #3592) which is a prolongation of METCOR-2 to clarify important uncertainties and to provide answers to questions that came up in the past project. For example, the vessel steel temperature and oxygen potential growth in the system when the neutral atmosphere is replaced by an oxidizing atmosphere. In comparison to the previous METCOR studies, the melt reactor vessel interaction can be substantially different, if the melt undergoes oxidation caused by the steam (water) on its surface. The melt oxidation is accompanied by additional heat generation, the intensity of which depends on the oxidation kinetics. This causes the melt superheating and increases the thermal and corrosion loads on the vessel.

*Interactions at vertical orientation of steel specimen surface:* in this case the gravity effects on the interaction of sub-oxidized corium with a vertical vessel steel surface could be critical in comparison to the horizontally-positioned vessel steel studied in METCOR. With a horizontal steel surface, the liquid metal interaction zone remains on the surface of the vessel steel, while with a vertical position the difference in densities can cause the liquid metal flow from the interaction zone down to the molten pool bottom. This can influence both the kinetics and thermal characteristics of the interaction.

*Physico-chemical behaviour of the European reactor vessel steel:* the compositions of European reactor vessel steels are different from those of Russian reactors. For example, the European vessel steel 16MND5 has a noticeable difference in the content of Mn, Cr and S, which may influence the strength characteristics and the eutectic temperatures of corium.

For all types of experiments different corium compositions, steel surface temperatures and atmospheres (Ar, steam) should be applied. The duration of the project will be 3 years. The total estimated costs requested from ISTC will be 554k$.

**Topic #29:** Next CEG-SAM meeting in Dresden at FZR, March 2007

E.Altstadt from the Forschungszentrum Rossendorf (FZR) invited the participants for the 11th CEG-SAM meeting in Dresden in March 7-9, 2007. The meeting itself will take place in the Research Centre in Rossendorf near Dresden.

S.Bechta (RIT-NITI) and V. Bezlepkin (SPAEP) offered to host the 12th CEG-SAM meeting in St.Petersburg in September 2007.

Z.Hozer (AEKI) offered to hold the 13th CEG-SAM meeting in Budapest in spring of 2008.

M.Hugon thanked once more IAE NNC RK and K.Kadyrzhanov for the organisation of the 10th CEG-SAM meeting and the participants for their engagement.

**Restricted session** (continued)

**Topic #30:** Detailed discussion of presented ISTC project proposals and preparation of specific CEG-SAM advices

After the presentation of the various ISTC project proposals by the Kazakh and Russian scientists, the restricted session of the meeting continued with detailed discussion on the presented project proposals to elaborate recommendations. Of special interest are proposals which fit into ongoing European research activities (EC-SARNET).

To topic #19: A continuation of the project CORPHAD-2 was recommended; S.Bechta should prepare an ISTC project proposal and send it to ISTC, the CEG-SAM members and to the secretary who will transmit it to EC-SARNET.

To topic #23: The CEG-SAM is still interested in large-scale melting experiments with “real” corium. But what has to be demonstrated first is the feasibility of the proposed tests especially the long-time heating of the melt. It was therefore proposed that RFNC-VNIIEF requests a project development grant from ISTC in which they could do a scoping test to melt about 100kg of (UO2+ZrO2+Fe) and then put forward a detailed project planning. The project proposal could then be finalized in co-operation with the CEG-SAM during the project development grant period. For the test a siliceous concrete should be used; the concrete composition has to be discussed by the concerned CEG-SAM members. The final composition should be transmitted to Mr. Kondraschenko (VNIIEF) by 30th Sept. (action 10/5).

To topic #25: The project proposal is of general interest for the CEG-SAM and should therefore be submitted to ISTC for funding. L. Herranz from CIEMAT presented the comments of EC-SARNET on the ISTC project proposal VERONIKA. Some changes in test matrix were proposed by SARNET and discussed at the meeting (see topic #24). The collaborators of VERONIKA, who are CEG-SAM members, should therefore discuss with T.Haste, the responsible EC-SARNET topical coordinator for SOURCE TERM issues, to revise the test matrix once more (action 10/8).

To topic #26: The IGR research reactor has been used to conduct reactor safety-related tests with single fuel rods or small fuel element assemblies (see topic #26). What would be of interest are tests simulating LOCA conditions on a bundle as well as on the meltdown of fuel rods and the interaction of molten fuel containing material with structural materials. This could link up with the Phébus objectives (Klaus Trambauer agreed to bring the possibilities of the IGR reactor to the attention of the Phebus International Review Committee (Prof. Yadigaroglu, ETH)). A second possible action was to link IGR with an FP6 project networking material test reactors in Europe (MTR+I3) (see action 10/9).

To topic #27: An extensive discussion took place if flooding tests with 37 rod fuel assemblies in the PARAMETER facility are currently reasonable. Since in the first top-flooding test PARAMETR-SF1 with a 19 fuel rod assembly the objectives were not all reached, it was recommended instead to repeat this test once more under the same boundary conditions. However, top-flooding should be initiated earlier to avoid melt formation and relocation. From the thermo-hydraulic point of view a test with the larger bundle size will not necessarily give more information, but it will be more complex and expensive (action 10/10).

To topic #28a: The presentation is outside the scope of the CEG-SAM; see action 10/11.

To topic #28b: The METCOR-2 project was terminated in May 2006. The Steering Committee recommended an extension of the on-going work. Strong reasons for the immediate continuation of the project are the practical experience that has already been accumulated in surmounting the technical difficulties and the expertise of the operating team. The CEG-SAM supports the project proposal called METCOR-P (ISTC #3592). An advice will be prepared to support METCOR-P, which should be submitted for funding to the next ISTC GB meeting (action 10/13).

**Topic #31:** Strategy for the future of CEG-SAM

In the EU a slight re-orientation on reactor safety-related problems will take place in the future which will also have some impact on the activities of the CEG-SAM. For example research to prevent the onset of an accident and coupling of thermo-hydraulic and neutronic code systems will be given higher priority. Ageing is covered by another CEG.

**Topic #32:** Other matters

No specific comments.

The chairman M.Hugon thanked once more IAE NNC RK for hosting the meeting and for all their related efforts and he thanked also the participants for their efficient work and contributions and wished them a safe journey back home.

**M. Hugon** (chairman) **P.Hofmann** (secretary)

**Annexes:**

1. Revised final agenda of the 10th CEG-SAM meeting
2. List of participants at the CEG-SAM meeting
3. Specific action list (appended below)

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Annex #3:

**Specific Action List**: 10th CEG-SAM meeting; Kurchatov-City, September 5-8, 2006

Action 10/1: General procedure for “Letters of Support” (LoS).

The collaborators should send the letter of support and/or advice by air mail to the Executive Director of ISTC, Norbert Jousten, with scanned copies by e-mail or by fax to the CEG-SAM chairmen M.Hugon (EC) and L.Tocheny (ISTC), the secretary P.Hofmann, and R. Burmanjer and J. Sanders (EC).

Actions 10/2: The general situation concerning the ISTC CEG-SAM webpage did not improve. The CD prepared by A. Miassoedov containing a mock-up of the updated CEG-SAM webpage, which was sent to L. Tocheny last spring, has still not been downloaded on the ISTC webpage by the ISTC Secretariat. M.Hugon will therefore discuss this matter with L .Tocheny in September in Brussels to find a satisfactory solution. If there is no satisfactory solution, K. Trambauer will investigate with SARNET the possibility to host the CEG-SAM website on the SARNET ACT.

Action 10/3: D.Bottomley, A.Miassoedov and W.Tromm will prepare a short paper describing the tasks and scope of a possible Russian SAM coordinator by beginning of October, 2006. The description should be then sent to L.Tocheny for further consideration.

Action 10/4: K.Trambauer will discuss within GRS its possible interest in an ISTC project proposal on RBMK reactors and severe accident analysis (in- and ex-vessel) by beginning of October 2006.

Action 10/5: A.Miassoedov will contact the members of the CEG-SAM interested in the large-scale MCCI tests to define with them the test conditions and the chemical composition of the concrete by the end of September and send this information to V. Kondrashenko by beginning of October 2006. A.Miassoedov should then inform V. Kondrashenko and L.Tocheny that a Project Development Grant should be prepared and sent to ISTC Secretariat and P. Hofmann.

Action 10/6: The collaborators (Ch. Journeau) of the ISTC project #2916 (CHESS) should prepare a joint e-mail requesting from A.Borovoi the promised data sets for phase 2 of the Chernobyl accident and the ISTC project proposal on the long term behaviour of Chernobyl lava.

Action 10/7: M.Hugon will ask L.Tocheny if he received the promised data set on Chernobyl data (see action 10/6) on a CD from A. Borovoi. G.Ducros received an e-mail from A. Borovoi saying that the CD should be transmitted at the 10th CEG-SAM with the help of L.Tocheny.

Action 10/8: The collaborators of VERONIKA, who are CEG-SAM members, should discuss with T.Haste, the responsible EC-SARNET topical coordinator for SOURCE TERM issues, the test matrix so that it includes tests in steam in the first stage of the ISTC project proposal. After the discussion the new test matrix should be discussed with A.Goryachev (action of B.Clement) to prepare a revised VERONIKA project proposal. The revised proposal should be sent to ISTC and the secretary of CEG-SAM.

Action 10/9: K.Trambauer will inform G. Yadigaroglu (ETH) that there exists a possibility to conduct LOCA and SA in-pile tests in the IGR reactor with fresh fuel rod segments but probably not with pre-irradiated fuel rods. M. Hugon will discuss with F. Serres (CEA), the co-ordinator of the MTR+I3 project on material test reactors in FP6, the possibilities to link the IGR reactor to this project.

Action 10/10: K.Trambauer will interact with V.Nalivaev to propose needed modifications to perform the second bundle test in the frame of the ISTC project #3194 (PARAMETER test facility) and additional measurements (outflow of water, temperature measurements).

Action 10/11: M.Hugon will contact the chairman of the CEG on transmutation regarding the presentation on “Risk assessment of thermal reactor with maximal reproduction of fissile material” and send him the paper.

Action 10/12: P.Hofmann will send the "Corium Melt Interaction with Reactor Vessel Steel" ISTC project proposal METCOR-P (# 3592) to J.M.Bonnet, the responsible EC-SARNET topical coordinator for CORIUM issues, for comments within two months.

Action 10/13: D.Bottomley and W.Tromm will prepare an advice for the "Corium Melt Interaction with Reactor Vessel Steel" ISTC project proposal METCOR-P (# 3592) by the end of September, 2006. The proposal should be submitted for funding to the next ISTC GB meeting in December 2006.

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