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**NUCLEAR ENERGY AGENCY
NUCLEAR SCIENCE COMMITTEE**

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**NUCLEAR SCIENCE COMMITTEE
COMMITTEE ON THE SAFETY OF NUCLEAR INSTALLATIONS**

**Pressurised Water Reactor Main Steam Line Break Benchmark Workshop
Summary of the Fourth Workshop**

**24th and 25th January 2000
Château de la Muette, Paris**

87929

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English text only

**ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
NUCLEAR ENERGY AGENCY**

Nuclear Science Committee

and

Committee on the Safety of Nuclear Installations

Summary

of the Fourth Pressurised Water Reactor
Main Steam Line Break Benchmark Workshop
(PWR-MSLB-4)

OECD/NEA Paris, France

24-25 January, 2000

I. Opening Session

José Maria Aragonés, member of the Nuclear Science Committee (NSC), opened the workshop and welcomed participants. He recalled the main objectives of the meeting. A series of two benchmarks, both concerned with LWR core transients, is co-sponsored by the NSC and the CSNI. This series is designed not only to address reactor physics issues, but aims also at code validation, system simulation, training and safety analyses. This is the fourth workshop covering a PWR main steam-line break (MSLB). The first one, held in Washington, started the project. It was followed by the second, held in Madrid, Spain, followed by the third in Garching, Germany. In between the Third and the Fourth Workshop, an ad-hoc meeting was held in conjunction with the M&C'99-Madrid Conference, with the purpose of monitoring progress and of further clarifying points for Phase II and III of the benchmark.

Enrico Sartori welcomed participants on behalf of the OECD Nuclear Energy Agency.

The meeting was attended by thirty-one participants from twenty-two organisations and ten countries. The list of participants is attached as Annex 1.

The agenda of the meeting, the presentations made, and the papers distributed are listed in Annex 2.

A. Baratta discussed the Penn State experience in defining and coordinating the benchmark activities.

II. Session on First Exercise

In the technical session on the First Exercise, A. Baratta from the Pennsylvania State University (PSU) summarised the status of the final report on First Phase. Comparisons of participant's results were discussed for the majority of the required 26 parameters, important for the MSLB transient. Participants updated their solutions after the issue of the updated Final Benchmark Specifications in May, 1999, containing a number of modelling modifications (accepted at the Third Benchmark Workshop, March,

1999, Garching, Germany). Since then, participants have sent several sets of updated results. During the Fourth Workshop some of them indicated that the plots presented in the graphical comparisons for the First Exercise did not contain their latest results. In order to avoid further misunderstanding a list of participants who have submitted updated results for the First Exercise is provided in Annex 3. The last date (in bold) indicates the date of the final set of results to be used in the final report. The participants confirmed this identification.

The international participation in the First Exercise, consisting of 14 participants from 8 countries, is summarised in Table 1.

Participant	Country	Code
VTT-1	Finland	SMABRE
IPSN/CEA	France	CATHARE2
FZR	Germany	ATHLET
FZK/SKWU	Germany	RELAP5
GRS	Germany	ATHLET
BE	England	RELAP5
GPUN/CSA/EPRI	USA	RETRAN3D
IRERDROLA	Spain	RETRAN3D
Purdue/NRC	USA	RELAP5
Netcorp	USA	DNP/3D
Universities of Pisa/Zagreb	Italy/Croatia	RELAP5
PSU	USA	TRAC-PF1/MOD2
University of Valencia	Spain	TRAC-PF1/MOD3
VTT2	Finland	APROS

Table 1. Participants in the First Phase

A. Irani from GPUN presented a comparative analysis of the selected set of results (RETRAN3D, ATHLET, RELAP5 and TRAC-PF1). The power response and the magnitude of the return to power during the transient as predicted by different codes are functions of the total reactivity time evolution. Since the negative tripped rod reactivity inserted is specified, the differences arise from the predictions of moderator feedback and Doppler feedback reactivity components. The moderator reactivity component follows the cold leg temperature. The discrepancies in the cold leg temperature predictions (after the introduced modelling modifications in the updated Final Specifications) are due mostly to differences in modelling the secondary side. It was observed that the major factors affecting the dynamics of the transient are break flow modelling (critical flow model), liquid entrainment, modelling of the aspirator flow, and nodalization of the steam generator (SG) down comer (one vs eight nodes). The Doppler feedback reactivity predictions are divided in two clusters around different initial values. It seems that some participants are using the specified relation for Doppler fuel temperature (the group which starts with a lower initial value) while the rest are still using the volume averaged fuel temperature to compute the Doppler reactivity.

During the following discussion Prof. D'Auria suggested that the radial and axial nodalization of the heat structure (fuel rod) also be specified. At least the participants should be required to describe their nodalization schemes in order to help in performing a comparative analysis in the final report. It was also recommended that when participants perform comparisons between PK and Coupled 3D models they use the same heat structure nodalization for consistency. The core coolant bypass model and its effect on the moderator feedback reactivity component was also discussed.

It was decided that for the First Exercise only solutions of the basic scenario (V1) would be included in the final report. The draft of this report will be distributed to the review committee at the end of February 2000 and to the participants by mid-March, 2000.

III. Session on Second Exercise

In the technical session on the Second Phase, K. Ivanov from PSU presented an update on the final report followed by an analysis of the Second Exercise, based on the comparison of the participants updated results. About 19 participants from 8 countries have re-submitted their results for the Second Exercise. In general the agreement amongst the global core results is good except for the Netcorp results, which are obviously the extreme in these comparisons. Most of the deviations are observed in the local parameter predictions, which is a consequence of the thermal-hydraulic nodalization and spatial coupling schemes used. The other reason for the larger deviations observed, especially for the transient snapshots comparisons after the scram, is that participants still use different schemes to spatially distribute the decay heat. Some are distributing according to the fission power distributions at the initial hot full power (HFP) nominal conditions and others according to the fission power distribution at each time step.

Participant	Country	Code
ANL	USA	SAS-DIF3DK
British Engineering/Tractebel (1)	England/Belgium	PANTHER (Standard)
British Engineering/ Tractebel (2)	England/Belgium	PANTHER (Reference)
CEA/DRN/DMT/SERMA (1)	France	CRONOS2-FLICA4
CEA/DRN/DMT/SERMA (2)	France	CRONOS2-FLICA4/1D
CSA/GPUN/EPRI	USA	RETRAN-3D MOD2.0
EDF (1)	France	THYC-COCCINELLE
EDF (2)	France	THYC3D-COCCINELLE
GRS	Germany	QUABOX-CUBBOX
KAERI (1)	Korea	MARS/MASTER
KAERI (2)	Korea	MASTER
NETCorp	USA	DNP/3D
PSU	USA	TRAC-PF1/NEM
Purdue/NRC (1)	USA	TRAC-M/PARCS
Purdue/NRC (2)	USA	RELAP/PARCS
Rosendorf	Germany	DYN3D/R
Siemens/FZK (1)	Germany	RELAP5/PANBOX-E
Siemens/FZK (2)	Germany	RELAP5/PANBOX-I
Universidad Politecnica de Madrid	Spain	SIMTRAN
VTT	Finland	TRAB-3D

Table 2. Participants in the Phase 2

K. Ivanov also described the statistical methodology implemented for analysing the four types of data compared in the Second Exercise: time histories, 2-D radial distributions, 1-D axial distributions, and single values.

In the participant presentations and discussion the aforementioned sources of uncertainties were further analysed including some additional issues. Some participants have incorporated new standards for water/steam property tables and have studied the impact of this modification. The FZR team (Germany) noticed that in the current transient scenario (especially in the version V1 – no return to power) there are points in the transient where the moderator density values in the lower part of the overcooled half of the core can exceed the specified range for the cross-section tables. The interpolation procedure provided does not perform a linear extrapolation outside of the density boundaries, which can lead to an underestimation of the moderator density feedback.

It was decided for the MSLB benchmark to use the standards for water/steam properties, which were originally incorporated into the codes. Since for the Second Exercise, the system T-H parameters are provided by the PSU best estimate TRAC-PF1/NEM calculations as boundary conditions, the effect of exceeding moderator density range is not so significant and can be neglected for the purposes of the Second Exercise. In other words for the Second Exercise participants will use the existing interpolation procedure. The local parameter comparisons will be performed in two clusters according to the detail of T-H nodalization and spatial coupling schemes with the core neutronics model (each participant is required to provide the related information).

Prof. D'Auria suggested that generating 2-D and 1-D mean solutions for the radial normalised power (NP) and axial core average and stuck rod relative power distributions using statistical methods should be done in a consistent manner because of the relative nature of these distributions. For Exercises Two and Three, three general parameters are provided as normalised relative distributions for the various steady state cases and transient snapshots: core-averaged radial power distribution (NP), and the core-averaged axial power distribution and axial power distribution in the stuck rod. These parameters must be treated carefully, because under certain conditions the traditional averaging techniques will result in a skewed mean solution that does not obey the normalisation requirements.

For the radial power distribution in the steady state cases, all participants should have the same total core power and core geometry, so that average power density will not vary among the results. It can be shown that under these circumstances, the techniques described above can be applied without skewing the normalisation. However, for the transient snapshots total core power will vary among the participants. In this case, a more complicated technique is being developed whereby the normalised values are first converted into absolute values, averaged by similar techniques, and then re-normalised using a power density that is averaged over all values for total core power. Such a method will provide useful comparisons for the radial power distributions while satisfying the normalisation criteria.

In the case of the two 1D normalised parameters, the main requirement, which has been requested as part of the specifications for this benchmark, is that all participants utilise 24 equal axial layers in the nodalization of the core. Where this is satisfied, the parameters can be treated in a manner similar to that for radial power. In the case of the core averaged axial power distributions, which are analysed for all steady state cases and transient snapshots, the situation is identical. The steady state cases can be analysed using the standard methods described above, since the average power density is a constant for all participants. Transient snapshots will be converted to absolute values, averaged, and re-normalised as with the transient snapshot radial power distributions. The axial power distribution in the stuck rod, which is collected for the HFP steady states and the transient snapshots, will be subjected to a similar method for all cases, keeping in mind that it is extracted from the core 3D relative power distribution.

The benchmark team performed derivations and numerical comparisons demonstrating that the generated mean solutions satisfy the normalisation requirements. These results justify using the statistical analysis for both the required absolute and relative 2-D and 1-D distributions as well as single values and the isolated time history points of interest.

The spatial decay distribution should follow the fission power distribution at the initial HFP nominal steady-state conditions. Additional time was given to participants who want to re-submit their results for the Second Exercise with a deadline end of February 2000. It was suggested that the benchmark team contact Netcorp and ask them to consider re-submittal or removal of their results because of the significant discrepancies with the results of other participants. The draft of final report on the Second phase will be submitted to the review committee by the end of March 2000 and to the participants by the mid-April, 2000.

IV. Session on 3rd Exercise

In the technical session on the Third Exercise K. Ivanov presented preliminary comparisons of participants results following by an analysis of the third phase. Ten participants from 8 countries have submitted their results for the third phase.

Participant	Country	Code
Purdue/NRC	USA	RELAP5/PARCS
FZR	Germany	DYN3D/R-ATHLET
FZK/SKWU	Germany	RELAP5/PANBOX2
GRS	Germany	Q-C/ATHLET
VTT	Finland	TRAB-3D/SMABRE
JAERI	Japan	THYDE-NEU
BE/Tractebell Eng.	England/Belgium	RELAP5/PANHER
PSU	USA	TRAC-PF1/NEM
CEA	France	CATHARE/FLICA4/CRONOS2
Univ. Pisa/Zagreb	Italy/Croatia	RELAP5/PARCS
KAERI	Korea	MARS-MASTER

Table 3. Participants in the Third Phase

Different sets of results contained different amounts of data and this fact needed clarification. It was suggested by SKWU, Germany that there is no need to perform comparisons for the defined four HZP cases in case the participant has already submitted results for the Second Exercise. In any case the requested output of Phase 3 combines the outputs of Phases 1 and 2 and results in a substantial amount of data to be analysed. Among the results submitted so far the JAERI, Japan results are at the extreme. In general the Third Exercise which is a best-estimate coupled core/plant simulation combines discrepancies seen in the First and Second Exercises. The first indicator is the sequence of events. It is observed that the participants have different timing predictions. Some of these differences come from the fact that some participants still are not following the specifications. The modelling sequence of events was outlined again in the Summary of the Ad-hoc meeting in Madrid this year: The double ended break occurs at 0.001 s and immediately all flow from the broken SG goes out to break. The turbine trip begins at the reactor trip. At turbine trip the turbine isolation valve for the intact SG closes with closure time 0.5 s.

In the participants' presentations and discussion that followed similar issues as in the session on the Second Exercise were analysed with an understanding that these issues have more pronounced effects in the Third Exercise because participants use their own system model. Participants' presentations focusing on comparison of PK and coupled 3D predictions were the object of special interest. In general the PK results are more conservative in terms of return to power for both transient scenarios. One difference in the models is the moderator feedback modelling – PK uses the moderator temperature as the feedback parameter while the 3D kinetics is using moderator density. This seems to mostly impact the power

response in the initial part of the transient before the scram occurs. The FZR results demonstrated that if a linear extrapolation option is added to the cross-section interpolation procedure to treat the local changes in moderator density outside of specified range the gap in power response predictions between PK and 3D is narrowed. At this point the major contributor to the remaining difference is the actual value of inserted tripped rod (TR) reactivity. In the PK simulations the model is following the table and inserts exactly the specified amount of negative reactivity. In the 3D coupled models the TR reactivity is inserted by modelling the dynamic scram and the actual inserted value is larger than the statically evaluated TR worth (which is almost equal to the PK TR worth). Prof. Aragonés from UPM suggested that the reason for that is the effect of flux re-distribution during the scram, which the 3D dynamic scram model accounts for while PK does not.

It was decided that PSU would modify existing cross-section interpolation procedure to include a linear extrapolation for points outside of the specified ranges of moderator density and fuel temperature. PSU will provide the updated procedure to participants by mid-February, 2000. The new deadline for submitting results for exercise 3 is the end of March 2000. It was also decided that the maximum number of solutions per scenario per organization is two. Spatial distribution of the decay heat will be done as agreed for the Second Exercise. All power distribution comparisons will be based on total power. The reflector modelling follow the fixed reflector model specified for the Second exercise. HZP results are not needed if the participant has submitted them for the Second Exercise. The rest of decisions made for the Second Exercise are valid also for the Third one.

V. Conclusion

In the concluding session J. Aragonés and E. Sartori summarised the actions for completing the analyses as well as the schedule for reviewing and publishing the final reports on the three exercises. The schedule of the benchmark together with the list of remaining actions is provided as Annex 4. These reports will include inter-comparisons of results and analysis, basic information and information about the codes and models used. A summary of lessons learned and conclusions for each exercise will follow these sections. The overall effort devoted by all participants to this project has been estimated to several tens of man-years.

VI. Kick-off Session on BWR TT Benchmark

The final session of the meeting was a kick-off session of the new proposed BWR TT benchmark for validation of coupled 3D core/plant system codes. In his introductory remarks, E. Sartori informed participants that both NSC and CSNI of NEA, OECD, have endorsed the benchmark. A. Baratta and K. Ivanov from PSU in several presentations introduced the benchmark problem, which is based on experimental data. In the following discussion constructive suggestions were made to be incorporated in the benchmark specification. Most of the specialists (representative of different organisations and countries) attending the session expressed a wish to participate. Based on this information and the list of organisations previously expressing a desire to participate, E. Sartori prepared an updated list of potential participants (see Annex 5). It was decided that a draft of the specifications will be issued by the beginning of July 2000 and the first benchmark workshop was scheduled at the beginning of November 2000 (before the ANS and BE Meetings in Washington, DC) in Philadelphia, PA. Additional information will be provided to the participants together with the benchmark activity schedule at the November meeting.

Annex 1

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* regret not to have been able to attend

Annex 2

**OECD PRESSURIZED WATER REACTOR
MAIN STEAM LINE BREAK (PWR MSLB) BENCHMARK
4TH WORKSHOP**

Agenda, Presentations and Papers Distributed

I. Opening Session: Chair: José M. Aragonés

1. Welcome - E. Sartori - NEA/OECD
Agenda (MSLB4-A)
Participants (MSLB4-P)
Summary of MSLB3 (MSLB3-S)
Summary of MSLB3.5 (MSLB35-S)
2. MSLB PWR Benchmark - Penn State Experience - A. Baratta, PSU Nuclear Safety Center (MSLB4-01)

II. Session on First Exercise Chair: Adi Irani

1. Summary of the Final Report on the 1st Phase - A. Baratta, PSU
2. TRAC-PF1/NEM Solutions to the OECD/NRC/PSU T. Beam, K. Ivanov, A Baratta (MSLB4-02)
3. Analysis of the First Exercise - (MSLB4-03) A. Irani, GPUN
4. Discussion of the First Exercise with A. Irani as moderator

III. Session on Second Exercise: Chair: Kiril Velkov

1. Summary of the Final Report on the 2nd phase (MSLB4-04) - J.B. Taylor, K. Ivanov, PSU
2. Analysis of the Second Exercise - (MSLB4-05) J.B. Taylor, K. Ivanov, PSU
3. Update on the Second Phase of the OECD/NRC PWR MSLB Benchmark , (MSLB4-06) K. Ivanov
 - 3.1. U. Grundmann: Results of DYN3d/R for the Second Exercise (MSLB4-07)
 - 3.2. A. Irani: "RETRAN experience for the second exercise" (MSLB4-08)
 - 3.3. A. Irani: RETRAN Comparison with ATHLET and Other Selected Participants (MSLB-09)
4. Discussion of the Second Exercise

IV. Session on 3rd Exercise: Chair: A. Baratta

1. Preliminary comparisons of participant's results - (MSLB4-10) K. Ivanov, PSU
2. Analysis of the 3rd exercise - K. Ivanov, PSU
 - 2.1. Steady States (MSLB4-11)
 - 2.2. Transients (MSLB4-12)

- 2.3. Time Histories (MSLB4-13)
- 2.4. Axial Power (MSLB4-14)
- 2.5. Stuck Rod (MSLB4-15)
3. Participant's presentations
 - 3.1. S. Kliem, U. Grundmann, U. Rohde: "Comparison of the FZR Exercise 1 and Exercise 3 Calculations (MSLB4-16)
 - 3.2. J.L. Gago, F. D'Auria, G.M. Galassi: Evaluation of the TMI-1 MSLB by the RELAP5/PARCS Coupled Thermalhydraulics 3-D Neutronics Code (MSLB4-17-1,-2,-3)
 - 3.3. A. Daavittila, A. Hämäläinen, E. Kaloinen, R. Kyrki-Rajamäki: TRAB-3D/SMABRE Calculations of the Third Exercise of the OECD PWR MSL Benchmark (MSLB4-18)
 - 3.4. E. Raimond, S. Villalonga, D. Caruge, E. Royer: IPSN & CEA/DRN contribution for Exercise 3 (using CATHARE, CRONOS2, and FLICA4 codes) (MSLB4-19)
 - 3.5. V. Sanchez, A. Knoll, R. Böer, H. Finnemann: RELAP5/PANBOX Analysis of the MSLB-Transient Phase 3 (MSLB4-20)
 - 3.6. P. Bryce, M. Parkes, C. Schneidesch, J.-P. Guisset, J. Zhang: MSLB Benchmark Transients with RELAP5 and PANTHER (MSLB4-21)
 - 3.7. S. Langenbuch, K.-D.Schmidt, K. Velkov: A Comparison of MSLB Phase 3 with Different Numbers of T-H Channels (14, 18 and 178) (MSLB4-22)
 - 3.8. A. Irani: RETRAN 3D versus Point Kinetics (MSLB4-23)
 - 3.9. T. Kozłowski, R.M. Miller, T. Downar: Analysis of the OECD MSLB Benchmark with the Coupled neutronic and Thermal-hydraulics Code RELAP5/PARCS (MSLB4-24)
4. Discussion of the 3rd exercise

V. Conclusion: Chair: **José M. Aragonés**

1. Actions for completing the analysis
2. Actions for completing the publications, schedule
3. Lessons learned and concluding remarks: Aragonés, Baratta, Sartori

VI. Kick-off Session on BWR TT Benchmark: Chair: **Kostadin Ivanov**

1. Introduction Remarks - E. Sartori
2. Overview of PB TT Experiments - (MSLB4-25) A. Baratta
3. Overview of Specifications - (MSLB4-26) K. Ivanov
4. Thermal-Hydraulic Data - (MSLB4-27) A. Baratta
5. Core Neutronics Model and Coupling with Thermal-Hydraulics - (MSLB4-28) K. Ivanov
6. Cross-Section Library and Modelling - (MSLB4-29) K. Ivanov
7. Requested Output and Output Format - (MSLB4-30) K. Ivanov
8. Discussion
9. Other TT Test Studies
 - 9.1. P. Coddington: Results of Analysis of Swiss TT Tests

Closing of the meeting

Summary of MSLB4

Annex 3

Exercise 1: Submitted Final Results

1. ISPN/CEA – France
CATHARE2
June 21, 1999
September 21, 1999
2. FZR – Germany
ATHLET
June 25, 1999
October 26, 1999
3. BE – England
RELAP5
June 30, 1999
4. FZK/SKWU – Germany
RELAP5
June 30, 1999
August 17, 1999
October 21, 1999
October 29, 1999
5. GRS – Germany
ATHLET
August 2, 1999
6. Iberdrola - Spain
RETRAN3D
August 23, 1999
September 22, 1999
7. University of Valencia - Spain
TRAC-PF1/MOD3
September 22, 1999
8. GPUN/CSA/EPRI - USA
RETRAN3D
September 22, 1999
November 3, 1999
9. University of Pisa – Italy and
Univeristy of Zagreb, Croatia
RELAP5
October 30, 1999
10. VTT1 – Finland
SMABRE
June 18, 1999

11. VTT2 – Finland
APROS
October 29, 1999
November 2, 1999
November 19, 1999
12. Purdue University/NRC – USA
RELAP5
October 26, 1999
February 8, 2000
13. Netcorp – USA
DNP/3D
June 9, 1999
14. PSU – USA
TRAC-PF1/MOD2

Annex 4

1. OECD PWR-MSLB Benchmark Schedule

1. December 15, 1996 ** Specifications
2. February 14, 1997 ** Distribution of first draft to potential participants from NSC and CSNI/PWG2 for comments and feedback
3. March 15, 1997 ** Comments and Feedback from NRC, GPUN and NSC and TG-THA, OECD
4. April 7, 1997 ** Second Revised Draft of Specifications
(This is the version to be distributed by NSC to the OECD participants.)
5. April 23-25, 1997 ** First Workshop Washington, D.C.
(Objective: to finalise the 2nd draft taking into accounts the comments and feedback from NRC, GPUN, NSC and TG-THA)
6. June 9-11, 1997 ** NSC Meeting in Paris.
(Short presentation on status of the Benchmark at NSC. Review of comments and changes to final draft.)
7. October 1, 1997 ** Final Draft of Specifications
8. January 15, 1998 ** Deadline for submitting results for the first benchmark exercise (*point kinetics*)
9. June, 1998 ** First Draft of Analysis (*point kinetics*)
10. June 22-23, 1998 ** Second Benchmark Workshop - Europe (Spain)
(Present Point Kinetics Results and Discuss how 3-D results are coming along)
11. July 15, 1998 ** Distribute specification of additional parameters for Phase I and summary of second meeting
12. August 1, 1998 ** Distribute agreed boundary conditions for Phase II
13. October 1998 ** Ad-hoc meeting in connection with the Reactor Physics Conference at Long Island, USA
14. December 1, 1998 ** Deadline for submitting Phase I results
15. March 1999 ** Issue "final" draft for Phase I results, distribute to participants for comments
16. March 24-25, 1999 ** Third meeting at GRS, Garching, presentation of "final" Phase I report and discussion of Phase II results
17. April 20, 1999 ** Deadline for issuing final PWR-MSLB benchmark specification

18. September 27-30, 1999 ** ad-hoc benchmark participants meeting and presentation of progress in the PWR-MSLB benchmark study during the "Mathematics and Computation" '99 conference in Madrid, Spain.
19. October 31, 1999 ** deadline for sending in Phase I results
20. October 31, 1999 ** Deadline for submitting final results for the second benchmark exercise (*3-D kinetics/core T/H boundary model*)
21. November 30, 1999 ** Deadline for submitting results of third benchmark exercise (*best estimate coupled simulation*)
22. January 25-26, 2000** Fourth PWR-MSLB benchmark meeting, Paris, France (*discuss Phase II report, discuss draft Phase III results and report*)
23. February 15, 2000 ** Provide revised cross-section interpolation procedure to participants (*K. Ivanov*)
25. Mid February, 2000 Contact Netcorp concerning decision on their results
26. End February 2000 Final deadline for submitting results for Phase II exercise
27. February 29, 2000 Issue final draft of Phase I report for review by subgroup (*A. Irani, K. Ivanov, A. Knoll, S. Langenbuch, D. Ebert*)
28. March 15, 2000 Distribute Phase I report to participants for final review (*report available on MSLB FTP site, comments within 2 weeks*)
29. March 31, 2000 Issue final draft of Phase II report for review by subgroup (*J.M. Aragonés, H. Finnemann, K. Ivanov, S. Langenbuch, D. Ebert*)
30. March 31, 2000 Deadline for submitting final results for Phase 3 exercise
31. April 15, 2000 Distribute Phase II report to participants for final review (*report available on MSLB FTP site, comments within 2 weeks*)
32. End May, 2000 Issue final draft of Phase III report (best estimate coupled simulation) for review to subgroup (*A. Baratta, S. Langenbuch, F. D'Auria, J.M. Aragonés, D. Ebert*)
33. June 2000 Approval of final draft for Phase I report by NSC and CSNI
33. June 2000 Approval of final draft for Phase II report to NSC and CSNI
34. End June, 2000 Distribute Phase III report to participants for final review.
35. Summer 2000 Publication of Phase I Report
35. Summer 2000 Publication of Phase II Report (*Detailed Appendices with tables will be published on CD-ROM with Excel files*)

36. Summer 2000 submit final Phase III report to NSC and CSNI/PWG2 for approval.
37. Autumn 2000 issue of Phase III report (*Detailed Appendices with tables will be published on CD-ROM with Excel files*)
38. Spring 2001 Organise embedded ANS Topical on MSLB (*A. Baratta*)
39. 2001 Discuss with editor of Nuclear Technology or Nuclear Safety the preparation of a special issue on MSLB, encourage participants to contribute an article (*A. Baratta*)

** tasks accomplished at the time of issue of this summary

2. OECD BWR-TT (Peach Bottom) Benchmark Schedule

1. End July, 2000 Draft Specification is distributed
2. November 8-9, 2000 First meeting in Philadelphia, discussion of specification, agreement on final specification (to be confirmed)
3. End January 2001 Distribution of Final Specification for the 3 Phases (I: *Point-kinetics*, II. *1-D*, III. *3-D*)
4. End September 2001 End of Phase I
5. End December 2001 End of Phase II
6. January 2002 Start of Phase III
7. End September 2002 End Phase III
8. End 2002/ beg. 2003 All reports issued

NB: A more precise schedule will be defined at the November meeting

Annex 5

*BWR Turbine Trip Transient Benchmark - Persons having shown interest in participating
(Preliminary)*

Name	City	Establishment
FINLAND		
KYRKI-RAJAMAKI, Riitta	Helsinki	VTT
PUSKA, Eija Karita	Helsinki	VTT
FRANCE		
RAIMOND, Emmanuel	Fontenay-aux-Roses	IPSN
RAMEAU, Brigitte	Grenoble	CEA
GERMANY		
GRUNDMANN, Ulrich	Dresden	FZR
LANGENBUCH, Siegfried	Garching	GRS
SANCHEZ, Victor Hugo	Karlsruhe	FZK
WEHLE, Franz	Erlangen	SIEMENS/KWU
ITALY		
D'AURIA, Francesco	Pisa	UNI-PISA
JAPAN		
ASAHI, Yoshiro	Tokai-mura	JAERI
ASAKA, Hideaki	Tokai-mura	JAERI
HOTTA, Akitoshi	Tokyo	TODEN
KASAHARA, Fumio	Tokyo	NUPEC
KAWAMURA, Shinichiro	Yokohama	TOSHIBA
NORWAY		
MOBERG, Lars	Kjeller	Studsvik/ScandPower
SPAIN		
ARAGONES BELTRAN, Jose M.	Madrid	DIN-ETSII
GOMEZ, Andres J.	Madrid	UITESA
IGLESIAS DIAZ, Javier	Madrid	UITESA
VERDU, Gumersindo	Valencia	UPVALENCIA
SWEDEN		
KRUNERS, Magnus	Varberg	Studsvik/ScandPower
STEPNIEWSKI, Marek	Vasteras	ABBATOM
SWITZERLAND		
CODDINGTON, Paul	Villigen PSI	PSI
ZIMMERMANN, Martin	Villigen PSI	PSI
UNITED KINGDOM		
HESKETH, Kevin	Preston	BNFL

UNITED STATES OF AMERICA

BARATTA, Anthony

DOWNAR, Thomas J.

IVANOV, Kostadin

KERN, Richard C.

MOON, Hoju

SOLIS-RODARTE, Jorge

Pennsylvania

Lafayette

Pennsylvania

Gaithersburg

Richland

Pennsylvania

PSU

UPURDUE

PSU

NETCORP

Siemens/PowerC

PSU