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**NUCLEAR ENERGY AGENCY
COMMITTEE ON THE SAFETY OF NUCLEAR INSTALLATIONS**

Principal Working Group 2 on Coolant System Behaviour

**TASK GROUP ON DEGRADED CORE COOLING (TG-DCC)
SUMMARY RECORD OF THE SIXTH MEETING**

Château de la Muette, Paris, France, 2nd-3rd February, 1999

75000

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I. Opening of the Meeting and Adoption of the Agenda

1. Dr. Magallon opened the meeting and reviewed the proposed Agenda [NEA/SEN/WG2(98)14], which was accepted without modifications.

II. Approval of the Summary Record of the 5th meeting of the TG-DCC

2. Next, Dr. Magallon presented the Summary record from the 5th TG-DCC meeting [NEA/SEN/WG2(98)9], which was accepted with the following correction:

- p. 6, par. 22, activities of Sweden: "in-vessel" should read "ex-vessel".

III. Status of the Action Items from the 5th TG-DCC meeting

3. Review of the Action Items from the 5th TG-DCC meeting:
- done: 1-6, 9 (project abandoned), 10,
- to be discussed: 7 (point 5.4 of the agenda)
- to be presented: 8, 11 (points 8.1 and 8.2, respectively, of the agenda).

IV. Brief summary of the CNRA and CSNI meetings

4. Mr. Drozd distributed highlights from the CSNI and CNRA meetings in December 1998. Mr. Tinkler asked about the status of SESAR/FAP work regarding the future of test facilities. In particular he asked why TH facilities are given first priority over the SA facilities. Mr. Drozd conveyed the message from Dr. Royen (SESAR's secretary), that current conclusions are very preliminary and there will be two more SESAR meetings within the next few months to discuss the issue. However, according to Dr. Royen, priority is given to TH facilities because of the immediate possibility of closing several of the most important ones.

V. Core degradation issues

5. Mr. Tinkler and Dr. Trambauer raised the issue of the **applicability of SA codes** to operating plants. Mr. Drozd informed that the PWG4, who initiated this issue, has discontinued explicit consideration of this activity, with the assent of CSNI, because of the lack of technical support in major member countries. The PWG4 will request participants in ISP exercises to discuss the applicability of the codes to full-size plants in future Comparison & Interpretation reports. The discussion indicated that this topic is rather poorly defined. Mr. Tinkler stated that the existing SA codes are being used for various analyses of operating plants, but there may be some residual issues to be addressed, and suggested to develop such a list. Dr. Magallon pointed out that Dr. Réocreux, the PWG2 Chairman, is supposed to write a letter to PWG4 and CSNI regarding possible Group activities in this area. Dr. Magallon suggested for the DCC to draft such a letter and forward it to Dr. Réocreux. The group accepted this suggestion.

==> ACTION: Dr. Magallon and Mr. Drozd to collect contributions and suggestions to draft the letter.

6. Dr. Haste presented a draft of the revised **status report on degraded core quench** (hydrogen generation). He recalled, that previous report was issued in August 1996, and the PWG2 requested to

review the progress made since. The new experiments include the QUENCH facility at FZ Karlsruhe, Germany, CODEX facility at AEKI Budapest, Hungary, and the single rod test by CEA/EdF, France. The improved codes include SCDAP/RELAP5 MOD3.1, ICARE/CATHARE V1, MELCOR, ATHLET-CD and SVECHA/QUENCH (Russian/German cooperation). In general there has been further evolutionary progress in understanding the degraded core phenomena which have started to reflect in modelling codes. Nevertheless, quench effects are still taken into account with insufficient parametric models.

7. Discussion. Dr. Magallon recalled that PWG2 suggested to include HBF in the study. Dr. Trambauer indicated that the effect of irradiation should be addressed, since current knowledge on this topic is rather poor. Dr. Adroguer made an observation that French data on irradiated Zircaloy indicate an effect of hydrogen absorbed in the cladding under operating conditions on oxidation kinetics for hydrogen content of about 500 ppm. Dr. Zurita raised the issue of drawing conclusions helpful to reactor operators. Dr. Haste indicated that there are no immediate plans to develop that kind of insight. Dr. Trambauer made a comment that conclusions like that would require first to have well defined separate effect tests, like QUENCH, and then performing system code analysis to get an overall plant response. Mr. Tinkler stated that it would be very interesting to compare oxidation models with operating limits and/or with pre-oxidation data from the operating plants. Also, Mr. Tinkler suggested to provide more clarification/discussion on hydrogen absorption and its subsequent release, which would be helpful to the reader. Dr. Hofmann added that H₂ absorption may be relatively small, but its effect on oxidation seems to be significant.

8. After discussion the DCC decided to send the presented draft to TG-THA for their review with a short summary of comments made during the above discussion. The final version should be issued and discussed at the June DCC meeting and presented to PWG2 in September 1999.

==> ACTION: Dr. Haste to send summary of discussion to the secretary by February 15, 1999.

==> ACTION: Secretary to send the draft report with DCC comments to THA by February 28, 1999.

==> ACTION: Dr. Haste to prepare the draft of degraded quench report by June 15, 1999

9. Dr. Magallon presented the current draft of the **Technical Opinion Paper on FCI**. He recalled that the first draft was sent out for comments after the June 1998 meeting and that PWG4 provided their contribution in July 1998. Both papers were presented to the PWG2 in September 1998 suggesting to "combine" both drafts into one joint paper, which was done. After a short discussion the DCC agreed that the revised draft is well written and ready to be sent out for further comments. The secretary was asked to send the presented draft for comments to PWG4, and the PWG4 contribution to DCC members. The goal is to develop a final draft by the DCC June meeting and then present the paper to PWG2 in September 1999 for approval.

==> ACTION: Secretary ask DCC and PWG4 for comments by the end of March 1999.

==> ACTION: Dr. Magallon to prepare final draft of TOP on FCI by June 15, 1999.

10. Dr. Trambauer presented the status of preparing the proceedings from the **Workshop on In-vessel Core Debris Retention and Coolability**, 3-5 of March, 1998, in Garching, Germany. There were 91 participants from 15 OECD countries and 4 from a non-OECD country (Russia). The objectives of the Workshop was to exchange information on most recent experiments and model development in in-vessel core debris retention and coolability, and to discuss possible additional experimental needs to support the

development of analytical models. The scope of the Workshop was limited to the phenomena relevant to in-vessel debris retention and did not include steam explosion and fission product release issues. The summary and conclusions were approved by the CSNI in December 1998 and are already published, while the master copy of the proceedings was completed just before this meeting. The proceedings will be published by the NEA as soon as possible.

11. Dr. Trambauer presented the status on the update of **In-Vessel Core Degradation Code Validation Matrix**. This activity was approved by the CSNI in December 1998. The revised report will include the most recent information that is, or will be available before the final draft. The added phenomena include melt quenching and relocation into the lower plenum, melt and debris behaviour in the lower plenum, interaction with RPV wall and ex-vessel cooling. It will also include phenomena relevant to eastern PWRs (but not RBMKs). Some old experiments which are not useful anymore are removed from the matrix. The codes under consideration are ICARE/CATHARE V1, ATHLET-CD, SCDAP/RELAP5 and MELCOR. The validation matrix will include elements from individual code matrices. The next draft for comments should be ready for the June meeting. The writing group includes 3 authors (i.e., Messrs. Trambauer, Adroguer and Haste). There is also a contribution from the USA. Suggested expansion of the writing group include Messrs. Sehgal, Frid and Sugimoto. The proposed schedule calls for three more meetings of the writing group (April and October of 1999, and April 2000), and for a final draft in June 2000. The DCC approved the presented working plan.

12. Dr. Magallon introduced the issue of possible future **status report on late phase progression**. He recalled that during the previous DCC meeting there was a proposal to wait with further discussion until after having the draft of revised SA code validation matrix report ready for comments. Dr. Trambauer suggested that it is possibly too early for this status report, especially that the SA code validation matrix report will include available late melt phase data. After a short discussion the Group decided to wait for the SA matrix code as well as for the final RASPLAV findings before discussing the SOAR on late melt phase. Also, the group asked the Chairman/secretary to contact the PWG2 Chairman, Dr. Réocreux, to write a letter to the PWG4 regarding their contribution on fission Product to the SA validation matrix report.

==> ACTION: Magallon/Drozd to contact Dr. Réocreux regarding PWG4 contribution to SA report

VI. ISPs and meetings under discussion

13. Dr. Magallon introduced the issue of the future **ISP based on PHEBUS** experiments. He recalled that the FPT0 data will be available in 1999, while FPT1 data in the year 2000. He also recalled that during previous meetings the DCC members strongly supported the use of FPT1 data, and not the FPT0. Dr. Adroguer reminded that most likely the French will be able to support only one ISP. Mr. Tinkler made an observation that since PWG4 had not yet started work on the FPT0, we should strongly support, again, the use of FPT1 data as the most suitable for a comprehensive exercise on core degradation. The Group strongly endorsed this view. It was noted, that PWG4 also support FPT1 from an ISP (see the summary of the 20th PWG4 meeting in September 1998)

14. Dr. Hofmann described the purpose and the main features of **the QUENCH project**. Dr. Hofmann pointed out the differences between QUENCH and previous CORA experiments. The objective of the CORA was to study high-temperature material behaviour of BWR, PWR and VVER fuel elements in severe accidents and there were only three quench related experiments performed. The purpose of the

QUENCH project is to investigate hydrogen generation during flooding of an overheated core. The program includes:

- large-scale integral experiments with LWR bundle simulators, 2.5 m length, of 20 electrically heated rods with one rod unheated,
- small-scale separate-effect tests with short fuel rod segment,
- experiments on hydrogen uptake and release by metallic Zircaloy,
- modelling of the quench phenomena and the material behaviour,
- pre- and post-test calculations for the various types of experiments.

Dr. Hofmann presented selected test results (QUENCH 1 and 2) along with SCDAP simulation. One of the important observations was that there was a lot of chemical energy released, which in the case of QUENCH-2 (no pre-oxidation) exceeded by far the electrical power. The post-test metallurgical analysis did not fully explain the reason for such a vigorous hydrogen generation. Dr. Hofmann made an observation that the issue of hydrogen generation during quench phase would be a very interesting topic for an ISP and added that the QUENCH data will be available before the PHEBUS data.

15. A short discussion dealt with the possible effects of hydrogen absorption and pressure on the oxidation process. Mr. Tinkler made an observation that some data presented in different tables, regarding the effect of temperature, seem to be inconsistent. Dr. Hofmann explained that it is because of the measurements at different location give "different pictures" of the oxidation, and at the moment it is very difficult to clearly determine what are the major effects that determine the oxidation process. Dr. Hofmann further explained that hydrogen absorption is very effective around 800C. The absorption is connected with a strong heatup of the zircaloy up to about 1200C and higher were the exothermic oxidation reaction by steam becomes important (trigger mechanism). Further temperature escalation is driven by the oxidation. At high temperatures the hydrogen will then be released due to thermodynamic reasons.

16. After discussion Dr. Hofmann stated that FZK will offer the QUENCH data for the ISP. A quick survey of potential interest resulted in:

- Germany: yes, ATHLET-CD code, boil-down and quench preferred,
- Belgium: yes in principle, SCDAP/RELAP5,
- Canada: no,
- US: yes in principle, SCDAP/RELAP5 and MELCOR, boil-down and quench preferred,
- Finland: need more discussion at home,
- France: yes, ICARE/CATHARE, stressed need for having significant H₂ generation during quench,
- Italy: yes, SCDAP or ICARE
- Hungary: Yes, ICARE/CATHARE, QUENCH 3 preferred,
- UK: no position at the moment,
- JRC: yes, ICARE
- Japan: to be confirmed (NUPEC would use MELCOR),
- Czech: yes, ICARE or MELCOR, QUENCH-3 preferred,
- Sweden: yes in principle, ICARE,
- Switzerland: yes in principle, to be confirmed,
- Turkey: cannot participate at the moment, but interested in results.

17. Dr. Magallon summarized that most of the countries would participate. Dr. Hofmann stated that there is still time to modify the test matrix. He was asked to present possible options at the next DCC meeting in June 1999. Preliminary time schedule would be to get the PWG2/CSNI approval in

September/December 1999, test to be performed in May/June 2000, first workshop to take place in September 2000, and calculation done in March 2001.

==> ACTION: Dr. Hofmann to present initial proposal for the ISP test at the June DCC meeting.

18. Regarding **PHEBUS**, an initial proposal may be submitted in June 2000.

19. Dr. Miller presented an update on the **SNL Lower Head Failure project**. The program is a continuation of previous 8 creep failure tests of 1/5 lower head scale. These results were presented at the Garching meeting. The participants of the first meeting of the project committee on December 1998, are: AVN, NRI Rez, VTT/Forum, IPSN, GRS, ANA-CNV&CSN, SKI, USNRC. Due to withdrawal of Japan, the number of test was reduced from 8 to 5. The wall thickness has been increased to better model the cross wall temperature gradient, and the heating rate has been reduce to better distinguish between creep and plasticity. There will be a closed benchmark on the second test. There is a possibility of an ISP based on one of the later tests. Mr. Tinkler added that the NRC initiated the tests in advance of having reached the final agreement, however the additional funding must be in place in March 1999.

VII. Update on RASPLAV project

20. Dr. Miller presented the status of the **RASPLAV Project**. The second phase will finish in mid-2000. Out of three planned 200 kg tests, one was cancelled in exchange for more material testing. The second 200 kg test will be done in 1999. The corium test are limited to modified Rayleigh number of 1012, but beyond this value for salt simulants. Partially oxidized corium stratifies into a U rich ceramic layer and Zr rich metallic layer. Stratification may occur by gravity or by convection, and presence of carbon may accelerate the process. Composition of corium of the last test (C-18) is being investigated to explain the loss of all corium from the vessel. Future work will include more measurements of material properties, two more salt test and fission product distribution. The composition of the corium from the final 200 kg test is still under discussion. IBRAE has developed 2D and 3D CFD codes and distributed them to most of the participants.

VIII. Presentations on selected topics

21. Dr. Hózer presented description of the **CODEX facility** at the KFKI in Budapest, Hungary. The acronym stands for COre Degradation EXperiment. The main purpose is to study early phases of core degradation in both VVER (four 7-rod tests) and PWR (two 9-rod tests) configuration. Dr. Hózer acknowledged help and/or co-operation from FZ Karlsruhe, from the French (calculation) and JRC Ispra. Some of the observations include:

- no fuel failure below 1200 Deg-C in CODEX-3/1, only oxidation,
- no temperature excursion during the quenching of pre-oxidized bundle at 1500 Deg-C in CODEX-3/2,
- evidence of acceleration of accident progression during air ingress in CODEX-AIT-1.

Any possible future test will depend on the EC support. A short discussion dealt with details of the air ingress test. Also, Dr. Hózer indicated that there was a limited aerosol collection, currently under review, but with little evidence of uranium so far.

22. The presentation on **HFB and MOX activities in Belgium** was cancelled, due to the termination of the project.

23. Dr. Adroguer presented **MOX activities at the CEA-IPSN in Accident Conditions**. Currently in France there are 16 PWR units with 30% MOX, a further 28 units are planned. Current MOX burnup of 43 GWd/t may be increased to 50-55 GWd/t. Current UO₂ fuel burnup is 47 GWd/t, to be increased to 52 GWd/t. Dr. Adroguer stated that there is a very poor database on MOX behaviour under accident conditions, and in particular:

- under SA conditions (high burnup): MOX dissolution by molten Zr, early liquefaction of MOX by stainless steel oxides and non volatile FP and Actinides release,
- under RIA conditions (high burnup): impact of fission gas on clad failure and on fuel dispersion,
- under LOCA condition (high burnup): potential core blockage and rod embrittlement under quenching.

The present IPSN research programs which involve some tests with MOX are: VECTORS-RT and -HT on FP releases, and CABRI-REP-Na on RIA transients. There are future programs under discussion on MOX tests such as a new CABRI-Water loop program (for LOCA tests), post-PHEBUS FP program on fuel behaviour under SA conditions and a new MADRAGUE facility with out-of-pile separate effect tests for core material and fuel rod studies under SA conditions.

24. There were two presentations on **TMI-2 accident analysis**. First, **Dr. Trambauer presented GRS analyses using ATHLET-CD**, based on the OECD TMI-2 exercise 10 years ago. Phase 1 (loss of coolant, 100 minutes) was analyzed in 1990, Phase 2 (core heat-up and melting, 175 min.) in 1997 and Phase 3 (pump transient and HPSI, 224 min.) was performed last year. Analysis of the Phase 4 (core melt in lower plenum, 300 min.) is planned for 2001. Needed improvements to ATHLET-CD include the model of flow blockage and cross flow (modelling underway). The core was modelled by 4 parallel channels. The two cold legs per loop were modelled separately to account for the flow reverse. The presented analysis was performed to match conditions at 120 minutes and simulate the next 100 minutes. It took 16 hours of the CPU time to calculate 4 hours of accident. No time step studies were performed. The simulation of the first three phases Dr. Trambauer described as "successful", and computing time as "reasonable". The modelling of melt relocation and debris coolability in the lower plenum is underway. During a short discussion Dr. Trambauer stated that with respect to the status 10 years ago, the improvements are in material properties and relocation of metallic and ceramic materials. He also added, that because of the lack of a debris model the heat transfer estimate is rather poor.

25. Next, **Dr. Bandini presented TMI-2 accident analysis with SCDAP/RELAP5/Mod3.2** code, performed within the COBE project of the 4th EU Framework. The input information and boundary conditions were based on the IPSN ICARE/CATHARE calculation to better compare the two codes results. The presented calculations cover the first two phases of the transient. In general, the pressure during Phase 1 compares well with the ICARE calculation, while the water level does not compare as well. The sensitivity calculations indicate that the clad failure criteria and make-up flow rate have a significant influence on hydrogen generation. Dr. Adroguer made a comment that he is surprised with reported large effect of the fuel clad failure temperature on H₂ generation. According to Dr. Adroguer, the source of this effect may lay in material relocation uncertainties rather than in failure temperature. During further discussion Dr. Bandini explained that the secondary side of SG was modelled as boundary conditions with 12-15 nodes, and the CPU time was 24 hrs. Also, regarding phases 3 and 4, there are only preliminary results.

26. Dr. Magallon posed the question of what should be the further course of action? Discussion:
 - Mr. Tinkler pointed out that the TMI case is in the qualification package of SCDAP/RELAP5. He stated, that possibly the failure temperature criteria affects not so much the H₂ generation, but rather the amount of relocated material. He also said that the pool formation and its relocation is still the major source of uncertainties. Mr. Tinkler expressed an opinion, that we should concentrate on the major "trend" of the event rather than on the details of pressure and temperature simulation. He also stated, that

since TMI seems to be a standard problem for codes validation, the proposed benchmark has some merit, since the late phase core degradation is still rather poorly simulated. In his opinion, we should try to find a consensus on remaining uncertainties.

- Dr. Adroguer: there is a continuous evaluation of ICARE/CATHARE against TMI-2. Also, IPSN co-operates in these areas with ENEA and EU (CATHARE and MAAP-4). The "frozen" version of ICARE/CATHARE V1 will be presented and distributed in March 1999.

Dr. Magallon summarized the discussion on TMI activities as being carried out in the US, Germany, France, Italy and within the EU. He asked Dr. Adroguer to make presentation on TMI activities at IPSN. Dr. Adroguer agreed to contact the persons responsible. Dr. Magallon also asked other members to do the same in their home organisations and called for more presentations on TMI analysis at the next DCC meeting.

==> ACTION: More reviews of TMI analyses at the next DCC meeting (All)

IX. Member countries' reports on degraded core cooling activities

27. There was no presentation made on national activities beyond those already indicated during the meeting. **Dr. Zurita presented** the latest state of the **Fifth Euratom Framework Program**. It concentrates on four areas: Controlled Thermonuclear Fusion, Nuclear Fission, generic research on Radiological Science, and support from research infrastructures. The budget calls for 142 M Euros for Nuclear Fission out of a total of 1260M. The key actions in the nuclear fission area are operational safety of existing installations, safety of the fuel cycle, safety and efficiency of future systems, and radiation protection. Dr. Zurita also described the new elements in the EC approach to evaluation of research proposals. There are now possibilities for non-EC members to have a co-operation agreements with Euratom (that includes Eastern European countries).

28. Dr. Magallon informed that the recent EC budget reduction will affect the JRC SA program, e.g., the FARO facility will be closed by the end of 1999. Both Dr. Trambauer and Dr. Adroguer expressed their support for keeping the FARO and/or KROTOS projects "alive" because of its unique features and ability to produce data of very high quality using prototypic corium.

29. Mr. Drozd distributed the updated **matrix of SA activities** in member countries. Dr. Sanderson promised to send more information on activities in Canada.

X. DCC priorities and long term DCC activities

30. Dr. Magallon raised the issue of **future work on SA issues of the high burnup and MOX fuels**. He suggested to wait for the draft report on fuel safety criteria, which, according to Mr. Drozd, should be ready for comments within the next 2-3 months.

==> ACTION: Mr. Drozd to distribute the draft on fuel safety criteria ASAP

31. Regarding co-operation with PWG4 on **applicability of SA codes**, Mr. Drozd informed that PWG4 had discontinued this activity because of the lack of technical support in major member countries. After a short discussion on codes validation and scaling issues, Dr. Magallon stated that for the DCC this activity is closed as the topic will be addressed in the updated SA validation matrix report.

32. Regarding co-operation with PWG4 on **FP and AM related issues** the group agreed that the proposed future ISP on PHEBUS FPT1 will be the forum for such a co-operation. Dr. Trambauer added that defining a FP source term from the vessel to containment is another area where the DCC can provide relevant expertise to PWG4. Mr. Tinkler stressed that since there is a close correlation between the core degradation and FP releases, we should ask PWG4 to contribute with a description of relevant experiments to the SA validation matrix report.

33. Regarding **future meetings/workshops** Dr. Magallon stated that the next FCI meeting will most likely be organised in the year 2001, and that the DCC should start working on it in January 2000. In addition, the DCC should contribute to the final meeting of the RASPLAV Project. Dr. Magallon also mentioned a possibility of organising an ISP based on VVER data as a long-term perspective. Dr. Zurita invited DCC members to participate in the next FISA meeting in November/ December 1999, in Luxembourg.

XI. NEA activities in support of CEEC and NIS

34. The secretary, Mr. Drozd, presented an update on the **NEA activities in support of CEEC and NIS**. The activities continue to concentrate on three areas, i.e.,

- VVER code validation matrix: there was a meeting in Moscow in November 1998. The draft report should be ready in April 1999. The biggest problem is still the collection of Russian data.
- bubbler condenser tests: the funding for the test program has been approved by the EC. The facility is basically completed and the test program should be completed by the end of 1999.
- large scale PSB test facility: there is a slow progress in completing the test facility, especially in the area of instrumentation. The initial testing should start during this year.

XII. Other matters

35. Mr. Drozd informed that he is leaving the NEA soon and there will be a new secretary assigned as of May 1 1999. He thanked the DCC Chairman and all the members for their co-operation and support during his tenure. The Group thanked Mr. Drozd for the excellent performance of his secretarial duties.

XIII. Next Meeting

36. The Group accepted the proposal for the next meeting to take place on 15-16(Noon) June 1999, in Paris, followed by the proposed THA meeting on 16(2pm)-18 June 1999. There was a proposal for the following DCC meeting to take place in the spring of 2000 in the USA. As a result, the Group agreed to consider changing the two meetings per year into a 9-months cycle.

XIV. Adjourn

37. The meeting was adjourned.

Annex 1.**ACTION ITEMS:****from the Sixth Meeting of the TG-DCC, Chateau de la Muette, Paris, 2-3 February, 1999**

Action	Record #:	Action Item:	Assignee:	Due:
1.	5.	collect contributions and suggestions to draft a letter to PWG4 and CSNI regarding PWG2 activities on the use of SA codes for plant analysis.	Magallon Drozd	ASAP
2.	8.	summary of discussion on draft report on quenching to the secretary	Haste	15.02.99
3.	8.	draft report on quenching with DCC comments to THA for comments	Drozd	28.02.99
4.	8.	final draft of degraded core quench report	Haste	15.06.99
5.	9.	Secretary to ask DCC and PWG4 for comments on TOP on FCI by the end of March 1999.	Drozd	ASAP
6.	9.	final draft of Topical Opinion Paper on FCI	Magallon	15.06.99
7.	12.	contact Dr. Réocreux regarding PWG4 contribution to SA report	Magallon Drozd	ASAP
8.	17.	initial proposal for the ISP on QUENCH test.	Hofmann	15.06.99
9.	26.	Presentations on TMI analyses at the next DCC meeting	All	15.06.99
10.	30.	distribute the draft on fuel safety criteria report to DCC	Drozd	ASAP

Annex 2

List of PWG2 Reports (1998)

NEA/CSNI/R(98)20
VVER-Specific Features Regarding Core Degradation
Status Report

NEA/CSNI/R(98)21
In-Vessel Core Debris Retention and Coolability
Summary and Conclusions

NEA/CSNI/R(98)22
Good Practices for User Effect Reduction
Status Report

Annex 3

List of Documents Distributed

NEA/SEN/SIN/WG2(98)9

Task Group on Degraded Core Cooling
Summary Record of the Fifth Meeting

SNL Lower Head Failure Project
Viewgraphs presented by Mr. Alex Miller

Status of Rasplav Project
Viewgraphs presented by Mr. Alex Miller

Brief secretariat report on CNRA and CSNI meetings December 1998

Technical Opinion Paper on Fuel-Coolant Interaction
2nd Draft January 1999

Degraded Core Quench: Summary of Progress 1996-1998
T.J. Haste, Ispra

Degraded Core Research Programs in OECD Countries
February 1999

Latest State of the Fifth Euratom Framework Programme
A. Zurita, European Commission, Brussels

TMI-2 Accident Analysis with SCDAP/RELAP5/Mod3.2 Code
G. Bandini, ENEA, Italy

TMI-2 Analysis with Athlet-CD
Klaus Trambauer, GRS, Garching, Germany

MOX Activities at the CEA-IPSN in Accident Conditions
B. Adroguer, CEA-IPSN, Cadarache, France

OECD/CSNI-WS on In-Vessel Core Debris Retention and Coolability
Klaus Trambauer, GRS, Garching, Germany

Flooding Experiments on the Determination of the Hydrogen Source Term
P. Hofmann, Forschungszentrum Karlsruhe, Germany

Zircaloy Cladding Tube Behaviour of PWR Fuel Rods During Quenching From High Temperatures

P. Hofmann, Forschungszentrum Karlsruhe, Germany

Update on In-Vessel Core Degradation Code Validation Matrix

Klaus Trambauer, GRS, Garching, Germany

The Codex Experiments

Z. Hózer, KFKI Atomic Energy Research Institute, Budapest, Hungary

Table: Vercors RT

Annex 4: List of Participants

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