



**EUROPEAN FEDERATION OF CORROSION
EUROPÄISCHE FÖDERATION KORROSION
FÉDÉRATION EUROPÉENNE DE LA CORROSION**

**MINUTES OF THE WP4 FALL MEETING
HELD IN PALAZZO DEI CONGRESSI OF PISA, PISA, ITALY
WEDNESDAY, SEPTEMBER 10TH, 2014**

Written by:

Damien Féron

Diffusion:

Present and apologized participants

EFC WP4 Members

Roman Bender (EFC Scientific Secretary)

Dagmar Glänzer (Dechema)

Ines Honndorf (EFC Website)

EFC WP4 "NUCLEAR CORROSION"

Chairman	Damien Féron	CEA/Saclay	DEN/DANS/DPC/SCCME	Bât. 458 - PC 50	F-91191 GIF SUR YVETTE Cedex
Vice-Chairman	Thierry Couvant	EDF	DMMC - Les Renardières	BP46	F-77818 MORET SUR LOING Cedex
Secretary	Mylène Belgome	CEA/Saclay	DEN/DANS/DPC/SCCME	Bât. 458 - PC 50	F-91191 GIF SUR YVETTE Cedex



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Attendance:

Patrice Castagna	Bureau Veritas, France
Raluca Fakor	CITON, Romania
Damien Féron	CEA, France
Dolores Gomes Briceno	CIEMAT, Spain
Tadeja Kosec	ZAC, Slovenia
Aneta Krausova	ICT, Czech Republic
Bruno Kursten	SCK-CEN, Belgium
Christina Lilja	SKB, Sweden
Jan Macak	Institute of Chemical Technology, Czech Republic
Juha Piippo	CORMET, Finland
Paul Rebak	GE, Usa
Stefan Ritter	PSI, Swizerland
Michel Schlegel	CEA, France
Bojan Zajec	ZAC, Slovenia

Apologies for absence received from:

Mylène Belgome	CEA, France
Thierry Couvant	EDF, France
Odile de Bouvier	EdF, France
Andraz Legat	ZAG, Slovenia
Philippe Prené	CEA, France
Stuart Lyon	University of Manchester, UK
Valérie L'Hostis	CEA, France
Benoît Gwinner	CEA, France

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- * Document available only on the private space of the EFC WP4 website, for WP4 Members
 - ✓ Annex 1 Agenda of the Pisa Fall Meeting
 - ✓ Annex 2 Best Oral and Poster Presentation Awards
 - ✓ Annex 3 Rules for the WP4 Oral and Poster Presentation Awards
 - ✓ Annex 4 LongTermCorr 2013 in "Matériaux & Techniques"
 - ✓ Annex 5 Slides presented by D. Féron*

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1. OPENING AND APPROVAL OF THE AGENDA

D. Féron opened the Fall Meeting and thanked the audience for coming.

Agenda was presented and approved, as no comment was made (see Annex 1).

2. APPROVAL OF THE MINUTES OF THE ESTORIL FALL MEETING (2013)

No comments were received by D. Féron and no corrections have been asked. These minutes are approved.

3. EFC INTERNAL MATTERS

3.1. Presentation of the EFC WP4

A short presentation of the WP4 (history, objectives) was made.

3.2. EFC WP4 Members

D. Féron informed the participants that the members of the Working Party include delegates by the member Societies of the EFC and individuals nominated by the Chairman. Those who are interested by the WP but not member of an EFC member Society and not nominated by the Chairman are "Friends".

3.3. EFC WP4 Awards

D. Féron recall that two prizes are given during this EUROCORR:

- ✓ The "Best Poster presentation Award" which is given for the third time. The prize includes a diploma, a book given by CEA and a Swiss knife given by PSI. The modification of the rules for the WP4 Poster prize has been accepted (see new rules in Annex 3).

The 2014 prize for the Best Poster presentation of the Nuclear Corrosion Session has been awarded to Renato de Mendonça for his presentation entitled "Investigation of the temperature effect on the oxide layer formed on Alloy 182 in simulated PWR environment";

- ✓ The "Best Oral presentation Award" for young researchers and engineers (7 candidates) which has been given for the first time during this EUROCORR in Pisa. The prize includes a diploma and two books given by CEA and by EDF. The modification of the rules for the WP4 oral prize has been accepted (see new rules in Annex 3).

The 2014 prize for the Best Oral presentation of the Nuclear Corrosion Session has been awarded to Jacqueline Caballero Hinojosa for his presentation entitled "Intergranular oxidation of Alloy 600 exposed to simulated PWR primary water".

"Honorary medal" of the Nuclear Corrosion Working Party: this new EFC WP4 Award decided during the Fall Meeting in Stockholm (2011) has not been given, as no sponsor has been found up to now. We need at least to find a sponsor for the medal or/and a given amount of money. All participants are encouraged to ask for sponsorship.

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4. EFC WP4 PUBLICATIONS

On behalf of the EFC WP4, two publications have been made:

- ✓ **Proceedings of NUCPERF 2012 (EFC event 351)** published in European Physics Journal Vol. 56 (2013), edited by V. L'Hostis and R. Gens (26 papers);
- ✓ **Special issue of "Corrosion Engineering, Science and Technology"** - "Issue 6: Long-Term Prediction of Corrosion Damage in Nuclear Waste Systems" (EFC event 360), September 2014 (401-587, 30 papers).

One publication is planned:

- ✓ Green book "50 years of stress corrosion cracking of nickel based alloys", from the presentations made during the Jubilee day (January 26th, 2010): all papers. The publication is planned for the beginning of 2015.

Two publications are cancelled:

- ✓ Proceedings of the EUROCORR workshop "Radiation and corrosion in nuclear power plant";
- ✓ "Degradation, modelling and mitigation of SCC in LWRs", Springer Publishing.

5. EFC WP4 EVENTS

5.1. Past events

Besides EUROCORR Nuclear Corrosion Session, another event has been organised during the last year: the 5th International Workshop on "Prediction of Long Term Corrosion Behaviour in Nuclear Waste Systems (LTC2013)", on October 6-10th, 2013, in Asahikawa, Japan (EFC event 360). It gathered 67 registered participants from 13 countries, more than 60 papers (oral and posters). The meeting included a technical tour to JAEA Horonobe Underground Research Center on Thursday. It has been reported in the CEST journal and in the "Matériaux & Techniques" Journal (see Annex 4).

The Spring School "Modelling of corrosion for Nuclear Reactors" was organized by INSTN/Saclay, on March 31st-April 4th, 2014 (not EFC event).

5.2. Future events

The 1st Nuclear Corrosion Summer School (NuCoSS-15) will be organized for the first time in Slovenia (Bled) by A. Legat, T. Kosec, B. Zajec and M. Leban from the Slovenian National Building and Civil Engineering Institut (ZAG) with the support of S. Ritter (PSI) and also of the University of Manchester (F. Scenini) and the CEA (F. Martin and D. Féron). A decision meeting has been held on January 28th, 2014 in Paris. The program and the location of this Summer School are presented by the organisers.

The 6th International Workshop on "Prediction of Long Term Corrosion Behaviour in Nuclear Waste Systems" (LongTermCor2016) will be organized for the first time in Canada (May 2016). These workshops (co-funded by Digby Macdonald and Damien Féron) have been organised from the beginning with the EFC WP4; WP4 gives agreement for this organization by NWMO (Canada). A Scientific Committee will be created.

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Damien Féron informed the members that a new Fall School is organised by INSTN/Saclay (France) on "Modelling of corrosion", on October 26-30th 2014 with the same organisation as the previous Spring School: conferences in the morning, training on computer in the afternoon. The content will include thermodynamics, atomistic and molecular modelling of corrosion, passivity with the point defect model, flow accelerated corrosion, localised corrosion and cathodic protection. Around 20 participants are expected.

6. EFC WP4 WEBSITE

The WP 4 website is described and shown. It is updated frequently thanks to Stefan Ritter. The audience is encouraged to pass by from time to time and/or feel free to send events or any other useful information to [S. Ritter](#).

The address is: http://www.efcweb.org/Working_Parties-p-104085/WP_4.html.

A restricted area (for members only) has been added to the WP 4 website. The password provided only to members by Stefan Ritter on request.

D. Féron expressed his thanks to Stefan Ritter for taking care of and updating the WP4 website.

7. EUROCORR_s

- ✓ EUROCORR 2015 "Earth, Fire, Water, Air, Corrosion happens everywhere", September 6-10th, 2015, Graz (Austria). A Nuclear Corrosion Session is planned.
- ✓ EUROCORR 2016 "Advances in linking science and engineering", September 11-15th, 2016, Montpellier, France.
- ✓ EUROCORR 2017 "Corrosion control for safer living", September 03-07th, 2017, Praha, Czech Republic.

8. MISSING ITEMS, CONCLUSION AND CLOSURE

The meeting is closed as no other point is raised.

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Enclosure 1:

- ✓ Annex 1 Agenda of the Pisa Fall Meeting



Fall meeting of the Nuclear Corrosion Working Party (EFC WP4)

Wednesday, 10 September 2014 (14h-16h)

Palazzo dei Congressi of Pisa (room will be specified on site)
Pisa, Italy

(Information on WP4 webpage <http://www.efcweb.org/Working+Parties/WP+Nuclear+Corrosion.html>)

The proposed agenda is the following:

1. Opening of the meeting, apologies for absences and approval of the agenda
2. Approval of the minutes of the Istanbul fall meeting
3. EFC WP4 internal matters
 - Short presentation of the EFC WP4
 - Members and "friends"
 - WP4 awards
4. EFC WP4 Publications
 - Books & special issues already published
 - Future publications
5. EFC WP4 past events
6. EFC WP4 future events
 - Summer school on "nuclear corrosion"
 - Workshop "LongTermCorr 2016"
 - Others
7. EFC WP4 website
8. EUROCORR's
9. Missing items
10. Closure

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Enclosure 2:

- ✓ Annex 2 Best Oral and Poster Presentation Awards



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Enclosure 3:

- ✓ Annex 3 Rules for the WP4 Oral and Poster Presentation Awards

**RULES for the ORAL PRIZE of
the WORKING PARTY on NUCLEAR CORROSION of the EFC (EFC WP4)**

AWARD

The Working Party on Nuclear Corrosion of the European Federation of Corrosion (EFC WP4) establishes a new award for the best oral communication presented in the nuclear corrosion session and in the workshops supported by the EFC WP4 at each EUROCORR Conference. The aim of the new award is to encourage the submission of more communications of high quality and the submission of the associated paper in the EUROCORR proceedings by corrosion scientists and engineers, including PhD students, post-doctoral researchers, etc.

The Prize, consisting of a certificate, will be awarded each year to the scientist or the engineer who, in the opinion of the Jury, has made the most worthy presentation on nuclear corrosion during the nuclear corrosion session(s) or the workshop(s) supported by the EFC WP4 at EUROCORR.

SELECTION OF THE AWARD WINNER

The Jury for the award will be composed of **the Chairman or Vice-Chairman** of the EFC WP4 (or a designed representative) and the chair(s) of the nuclear corrosion session(s) and of the workshop(s) supported by the EFC WP4.

The eligible authors should have the full paper of their presentation included in the EUROCORR proceedings and should present themselves the oral communication.

The criteria to be used in selecting the winner will include:

- 1) The scientific/technical contribution to the field of corrosion covered by the work presented in the paper and in the oral presentation;
- 2) The clarity with which important concepts are conveyed orally during the presentation;
- 3) The quality of the verbal presentation and of the answers to the questions by the presenter.

PRESENTATION OF THE AWARD

The presentation of the Award will take place at the end of the nuclear corrosion session(s) or workshop(s) supported by the EFC WP4.

FORMER RECIPIENTS OF THE EFC WP4 ORAL PRIZE

The first winner will be selected during EUROCORR 2014 in Pisa.

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**RULES FOR the POSTER PRIZE of
the WORKING PARTY on NUCLEAR CORROSION of the EFC (EFC WP4)**

AWARD

The Working Party on Nuclear Corrosion of the European Federation of Corrosion (EFC WP4) establishes a new award for the best Poster presented in the nuclear corrosion session and in the workshops supported by the EFC WP4 at each EUROCORR Conference. The aim of the new award is to encourage the submission of more posters of high quality and the submission of the associated paper in the EUROCORR proceedings by corrosion scientists and engineers, including PhD students, post-doctoral researchers, etc.

The Prize, consisting of a certificate, will be awarded each year to the scientist or engineer who, in the opinion of the Jury, has made the most worthy presentation during the poster sessions at EUROCORR.

SELECTION OF THE AWARD WINNER

The Jury for the award will be composed of three persons including **the Chairman or the Vice-Chairman** of the EFC WP4 (or a designed representative) and two other members chosen during the meeting of the EFC WP4 that immediately precedes the conference or by an Email ballot prior the Eurocorr and organized by the Vice-Chairman.

The eligible authors should have the full paper of their presentation included in the EUROCORR proceedings and should be present by their posters during the relevant poster session.

The criteria to be used in selecting the winner will include:

- 1) The scientific/technical contribution to the field of corrosion covered by the work presented in the paper and in the poster;
- 2) The clarity with which important concepts are conveyed visually by the poster;
- 3) The quality of the verbal presentation by the author during the poster session.

PRESENTATION OF THE AWARD

The presentation of the Award will take place at the start of the EFC WP4 Session or supported workshop on the morning following the final poster session.

FORMER RECIPIENTS OF THE EFC WP4 POSTER PRIZE

The first winner will be selected during EUROCORR 2012 in Istanbul.

2012 - Decision of the Jury: no award

2013 - Mônica Maria A. M. Schwartzman (*Effects of Chloride and Sulphate Ions on the Corrosion of Alloy 800 Steam Generator Tube*, Fábio A. Mansur, Mônica Maria A. M. Schwartzman, Pedro Henrique B. O. Nogueira and Marco Antônio Dutra Quinan, CDTN, Brazil)

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Enclosure 4:

- ✓ Annex 4 LongTermCorr 2013 in "Matériaux & Techniques"

Nouvelles scientifiques, techniques et industrielles

Événement/Event

LongTermCorr 2013

An event of the European Federation of Corrosion in Japan

By Damien Féron¹

The 5th international workshop on long-term prediction of corrosion damage in nuclear waste repository (LongTermCorr, EFC event 360) took place at Asahikawa (Hokkaido), Japan (6 – 10 October 2013). The goal of the event was to compare the approaches that are being developed worldwide for predicting long-term corrosion phenomena, including corrosion strategies for interim storage and geological disposal.

Among the options considering how to deal with radioactive wastes, geological disposal is the one recommended at the international understanding. Observing the degradation process and predicting the lifetime of the metallic barrier in a robust and reliable manner represents one of the greatest scientific and technical challenges for the manmade structures, since the required period for their integrity largely exceeds that of any industrial application. This issue was already explored during four previous successful workshops: Cadarache (France, 2001 – EFC event 2656), Nice, (France, 2004 – in conjunction with Eurocorr 2004), Pennsylvania State University (USA, 2007 – EFC event 301) and Bruges (Belgium, 2010 – EFC event 329).

The 5th international workshop on long-term prediction of corrosion damage in nuclear waste repository (LongTermCorr 2013 or LTC2013 in short, EFC event 360) took place at Asahikawa (Hokkaido), Japan, from October 6 to October 10, 2013. It was organized by the Japan Society of Corrosion Engineering and it was the first time than an EFC event was organized in Japan. The local organizing committee, chaired by Professor Kazuhisa Azumi (Hokkaido University) with



▲ Figure 1. Attendance of the 5th international workshop on long-term prediction of corrosion damage in nuclear waste repository (LTC 2013 in short).

Hidekazu Asano (RWMC) as Secretary General, succeeded to gather 64 participants from 12 different countries for this workshop where 30 oral presentations have been given and 28 posters have been shown. The one-day technical tour to JAEA's Horonobe Underground Research Center was a part of the official workshop program. The visit of Horonobe Underground Research Facility at –250 m underground by groups of 10 attendees was very impressive. At the same location, the visit of a full-scale demonstration facility for engineering barrier systems (EBS) was also very instructive. During the bus trip, the landscape of the northern territory of Hokkaido with wildlife of fox, deer and bear has been appreciated by all the participants.

The main objective of these workshops is to get together scientists and engineers from various countries that are developing high-level nuclear waste disposal technologies, with the goal of promoting scientific and technical exchanges concerning long term behavior of metallic containment materials and engineered barrier systems. In particular, the workshops compare the approaches that are being developed worldwide for predicting long-term corrosion phenomena, including corrosion strategies for interim storage and geological disposal. The 2013 edition was divided into 11 oral sessions and one poster session which addressed the major following items:

- an overview of national programs (Japan, UK, France...) with emphasis on similarities, common challenges and different approaches, legal issues, retrievability...

¹Chairman of the Working Party on Nuclear corrosion (EFC WP4), Commissariat à l'Énergie Atomique et aux Énergies Alternatives, CEA - Centre de Saclay, Bâtiment 458 - PC 50, 91191 Gif-sur-Yvette Cedex, France

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Nouvelles scientifiques, techniques et industrielles

Événement/Event

- the experimentation of candidate materials (copper and carbon steel mainly) including laboratory tests, full-scale demonstration, in-situ testing, methodology,
- the modeling and long-term prediction with the determination of mechanisms, the fundamental of prediction, numerical analysis and simulation,
- the archeological artifact and natural analogues and their use for long-term prediction.

Geological storage

After an overview of the situation of nuclear energy in Japan following Fukushima (all reactors of the arrested, important security works on many nuclear sites,...) Kenichi Kaku (NUMO, Nuclear Waste Management Organization of Japan) focused on the ongoing developments relating to geological storage with two underground laboratories in operation: one in granitic site (Tono Mizunami URL) and the other in sedimentary site (Horonobe URL).

Underground storage – Chinese program

Kewei Gao (University of Science and Technology Beijing, China) described the current program in China for underground storage of nuclear wastes, with three main periods (i) 2006/20: selection of one or more sites, (ii) 2021/40: underground laboratory tests and (iii) 2041/50: in-situ tests & construction of underground storage. She presented the advantages of the Beishan site, located in the Gobi desert, to build a geological storage. The first tests of corrosion in laboratory are made with carbon steel in aqueous medium at temperatures up to 90 °C.

Biocorrosion

Several talks focused on the phenomena of biocorrosion which have been the subject of many discussions either

at the end of presentations (and it has been needed several times to interrupt the discussions to not overflow on schedules) or during breaks. In this sense, the presentation of the French approach of biocorrosion phenomena stood closer to the concerns. Generally, biocorrosion phenomena are observed in the areas where bacteria can develop (empty volumes):

In his presentation, N. Smart (AMEC, UK) presented the results obtained on a steel mini-container exposed for 5 years at 450 m underground in Aspö in clay. There is a set of evidence of corrosion rates on steel reached up to 500 µm/year and localized corrosion of the mini-container (or canister) copper more than one millimeter in depth. These degradations are attributed to sulphate-reducing bacteria that have developed in an empty space where the corrosion specimens and the monitoring electrodes were exposed.

M. Flachet (INSTN, France) presented the first results after 1 month of exposure of coupons in steel exposed in Tournemire type aqueous solution where it is clearly highlighted the formation of biofilm. In addition L. Urios (Université de Pau, France) presented the results obtained after 10 years of exposure of coupons in contact with Tournemire argillite. Generalized corrosion rates of 50 µm to 300 µm were observed and the bacterial biodiversity has been characterized.

Corrosion rate measurements

Another issue has been widely debated. It concerned corrosion rate measurements: corrosion rates on carbon steel in underground representative environments are rarely less than 1 µm/year when they are measured by mass loss or electrochemistry. But they reach lower values when measured by hydrogen evolution. It is difficult to compare these measurements because exposure conditions are not exactly the same. Nevertheless, the trapping



▲ Figure 2. Allocation of Prof. K. Azumi during the workshop banquet.

of the cathodic hydrogen (by corrosion products, metal itself or other elements present in the system) has been evocated as possible reasons of the differences.

Stress corrosion cracking of steel

In opposition to the previous editions of the workshop, little works on the stress corrosion cracking of steel were presented: a single oral communication (B. Kursten, SCK - CEN, Belgium) and two posters (Mr. Kobayashi, RWMC, Japan and H. Inoue, Osaka University, Japan). However the question of heat treatment of the welds of the steel overpacks has returned several times to discussion in the poster session.

Generalized corrosion and localized corrosion

Several lectures were given in relation to the mechanisms and the models of generalized corrosion and localized corrosion (pits) and showed large progress in the understanding and in the simulation of corrosion phenomena.

The attendees thanked their Japanese colleagues for the perfect organization of the workshop and its outstanding scientific and technical content. The exchanges will be useful to scientists and engineers who are developing appropriate technologies for high level nuclear waste isolation and valuable to operating nuclear waste authorities and regulators who evaluate solutions to nuclear waste disposal issues.

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 - ✓ Annex 5 Slides presented by D. Féron*

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