Minutes of the
Nuclear Corrosion Summer School – NuCoSS-19

1 Introduction

After the success of the first edition of the Nuclear Corrosion Summer School (NuCoSS-15, held in July 2015 in Slovenia), it was decided to organise a second one with support of the Horizon 2020 EU-project MEACTOS. One important task of the WP 4, as well as of the MEACTOS project is the education of young nuclear engineers and scientists in the field of nuclear corrosion. Also the knowledge transfer from the senior experts towards the next generation is supported by the WP and EU-project. Therefore a nuclear corrosion summer school (called "NuCoSS-19") has been organised in July 2019, in a beautiful alpine resort in Slovenia. The current report gives a brief overview on this successful event.

2 Summary of the event

2.1 Organisation and location

The Nuclear Corrosion Summer School (NuCoSS-19) took place from July 7 to 12, 2019, in Hotel Špik in Gozd Martuljek, Slovenia. It was a beautiful alpine resort with good meeting facilities and also offered plenty of sightseeing and social activities. The Slovenian National Building and Civil Engineering Institute, ZAG (B. Zajec, T. Kosec, A. Legat, N. Gartner, P. Močnik and M. Hren) acted as local host and main organiser, whereas the Paul Scherrer Institute, PSI (S. Ritter) has lead the scientific committee consisting of CEA (D. Féron and L. Martinelli) and The University of Manchester (F. Scenini, D. Engelberg and G. Burke). The event was co-organised by the MEACTOS project consortium (www.meactos.eu) and by the WP 4 'Nuclear Corrosion' (www.efcweb.org/WP4.html) of the European Federation of Corrosion (EFC) under the event no. 440.

Thanks to the MEACTOS project and a number of sponsors (see Figure 1), the attendance/registration fee could be kept at an extremely low level (student: 710.- €, non-student: 990.- €) and included attendance to the lectures, hand-outs on memory stick, coffee breaks, full cost accommodation for the whole week and one social event!

For this school the EFC has sponsored three student grants fully covering the accommodation and registration costs. Out of the numerous applications received, a review committee has awarded those grants to Mr. David Kumar (University of Bristol, UK), Ms. Kamila Wilczynska (CEA, France) and Ms. Lindsay Braithwaite (Western University, Canada), see Figure 2). Additionally, after the summer school, CEA donated a very interesting book on nuclear corrosion to each of the three winners.

Figure 1: NuCoSS-19 logo with organisers and sponsors.

Figure 2: Winners of the NuCoSS-19 student grant donated by the EFC. From left to right: Ms. Kamila Wilczynska (CEA, France), Mr. David Kumar (University of Bristol, UK) and Ms. Lindsay Braithwaite (Western University, Canada).

2.2 Attendance

The school was attended by 37 persons (25 students and 12 scientists or engineers) and 12 lecturers (some of the lecturers stayed several days or even the whole week) from 14 countries, even from outside Europe (see Tables 1 and 2). Hereby the school was completely sold out and can be regarded as a great success also from this point of view. Figure 3 shows a photograph of all attendees and some of the lecturers in front of the hotel.

Table 1: Distribution of the attendees by country and organisation.

Country	Organisation	No. of attendees
Belgium	SCK•CEN	1
Canada	Western University	1
Czech Republic	CVŘ	2
Finland	VTT	1
France	CEA	5
Germany	GRS gGmbH	1
Israel	NRCN	1
Romania	RATEN-ICN	1
South Korea	KAIST	2
South Korea	KEPCO E&C	1
Spain	CIEMAT	2
Sweden	KTH	1
Switzerland	NPP Leibstadt	1
Switzerland	PSI	3
UK	Lancaster University	2
UK	NNL	1
UK	The University Of Manchester	7
UK	University of Bristol	2
UK	University of Sheffield	1
USA	Missouri University of Science and Technology	1

Table 2: List of lecturers.

Name		Organisation	Country
Fabio	Scenini	The University Of Manchester	UK
Dirk	Engelberg	The University Of Manchester	UK
Damien	Féron	CEA	France
Hans-Peter	Seifert	PSI	Switzerland
Renate	Kilian	Framatome GmbH	Germany
Elodie	Gipon	EdF	France
Stefan	Ritter	PSI	Switzerland
Rik-Wouter	Bosch	SCK•CEN	Belgium
Pål	Efsing	Vattenfall	Sweden
Jamie	Noël	Western University	Canada
Laure	Martinelli	CEA	France
Peter	Schrems	IPS	Germany

Figure 3: Group photograph in front of the hotel.

2.3 Lecture programme

The daily schedule consisted of morning and evening lectures with approx. four hours free time in the afternoon. This afternoon break has proven to be an excellent way for recovering from the huge amount of information provided by the lecturers and also promotes networking, as well as an intense exchange between the students and the senior experts.

The programme started with an introduction to electrochemistry and corrosion and then continued with detailed insights into almost the whole “nuclear corrosion story”. The lectures coved a general overview on nuclear corrosion, corrosion in LWR plants (with an emphasis on environmentally-assisted cracking), corrosion in nuclear waste disposals and corrosion in future Gen-IV systems. Some lectures were made even more attractive by presenting relevant specimens or very simple experiments (see two examples in Figure 4). The whole programme can be found in the Annex.

Figure 4: Tube section shown by Renate Kilian (left) and simple stress corrosion cracking experiment provided by Hans-Peter Seifert (right).

The last day of the school was devoted to experimental work rather than theoretical lectures and attendees were given the opportunity to perform some electrochemical measurements with potentiostats and metal-electrolyte systems. For this purpose one of the sponsors (IPS) provided 14 small potentiostats along with accessories and ZAG prepared metal samples, various electrolytes and glassware. Ten groups were formed and despite certain initial obstacles these groups managed to perform several OCP vs. time and potentiodynamic measurements under the guidance of Peter Schrems and Jamie Noël (assisted by Bojan Zajec and Stefan Ritter). Already earlier that week a small workshop on “how to build your own low-budget reference electrode” was held after the lectures by Jamie Noël. Some impressions from the practical work can be seen in Figure 5.

Figure 5: Impressions from the experimental work during the summer school week.

2.4 Social activities

Several organised social activities were offered to all attendees and lecturers during the long afternoon breaks, such as: hike to Martuljek waterfalls; easy trip to Kranjska Gora by bicycle; e-bike trip to Peričnik waterfall and to Slovenian Alpine Musem; chairlift up to “Bedančev dom” hut above Kranjska Gora and hiking descent to lake Jasna; trip to Planica Nordic Centre and further hike to Tamar valley. On Wednesday afternoon all went on a bus tour to the source of the Soča river via the Vršič pass. All these amazing activities were very well attended and further contributed to the joyful spirit of the whole event. Figure 6 shows a few pictures from some of those activities.

Figure 6: Pictures from some of the social activities.

2.5 Other

Every year the EFC Working Party 4 ‘Nuclear Corrosion’ is awarding a prize for outstanding contributions to corrosion science and engineering in the nuclear field – the Henri Coriou Medal. During the summer school, being an official event of the EFC and because the 2019 winner was one of the lecturers, the medal has been handed over to the 2019 winner Hans-Peter Seifert (Paul Scherrer Institute, Switzerland). A picture of the prize ceremony can be seen in Figure 7.

Figure 7: 2019 Henri Coriou Award ceremony during NuCoSS-19; left to right: Stefan Ritter (WP 4 Chairman), Hans-Peter Seifert (winner), Damien Féron (WCO President).

3 Conclusions

It can be concluded that the current summer school was a great and successful event. The mixture of content/information, exercises, social activities and beautiful location has proven to be almost perfect. A short anonymous feedback questionnaire, handed over to the attendees and lecturers at the end of the week, confirmed those conclusions. Due to this success, it is anticipated to repeat this summer school in approx. four-years intervals.

4 Acknowledgement

The support by all persons and organisations involved in this school is gratefully acknowledged! Special thanks are expressed to the local host, the Slovenian National Building and Civil Engineering Institute (ZAG), and to the following supporting organisations: Belgian Nuclear Research Centre (SCK•CEN), Cormet Oy, European Federation of Corrosion (EFC), Electricité de France (EDF), Framatome GmbH, French Alternative Energies and Atomic Energy Commission (CEA), IPS Elektroniklabor GmbH & Co. KG, Paul Scherrer Institut (PSI), PowerPlant Chemistry (PPCHEM AG), The University of Manchester, Vattenfall, and Western University. This event received funding from the Euratom research and training programme 2014-2018 under grant agreement no. 755151.

5 Annex

Nuclear Corrosion Summer School 2019 (NuCoSS-19) - Programme

		Block	Lecture	Lecturer
Sun., 07 July 2019				
			Arrival at the hotel	
	16:30-17:00		Get together & coffee/tea break	
0	17:00-17:15		Welcome & school 'mechanics'	A. Legat & B. Zajec
1a	17:15-18:30	Electrochemistry & corrosion	Introduction to corrosion (I)	F. Scenini
	18:30-19:30		Dinner	
1b	19:30-21:00		Introduction to corrosion (II)	F. Scenini
Mon., 08 July 2019				
1c	09:00-10:30	Electrochemistry & corrosion	Introduction to corrosion (III)	F. Scenini
	10:30-11:00		Coffee break	
2	11:00-12:30		Advanced technologies to characterise corrosion	D. Engelberg
	12:30-13:30		Lunch	
	13:30-17:00		Free time (social activities)	
	~17:00-17:30		Get together & coffee/tea break	
3	17:30-19:00	General overview on nuclear corrosion	Corrosion in the nuclear cycle	D. Féron
	19:00-20:00		Dinner	
4	20:00-21:30	Corrosion in LWR plants	Principle of LWRs	D. Engelberg
Tue., 09 July 2019				
5a	09:00-10:30	Corrosion in LWR plants	Corrosion issues in LWRs - EAC (I)	H.-P. Seifert & R. Kilian
	10:30-11:00		Coffee break	
5b	11:00-12:30		Corrosion issues in LWRs - EAC (II)	H.-P. Seifert & R. Kilian
	12:30-13:30		Lunch	
	13:30-17:00		Free time (social activites)	
	~17:00-17:30		Get together & coffee/tea break	
5c	17:30-19:00		Corrosion issues in LWRs - EAC (III)	H.-P. Seifert & R. Kilian
	19:00-20:00		Dinner	
6	20:00-21:30		Corrosion issues in LWRs - MIC	R. Kilian
Wed., 10 July 2019				
7	09:00-10:30	Corrosion in LWR plants	Corrosion issues in LWRs - FAC	E. Gipon
	10:30-11:00		Coffee break	
8	11:00-12:00		Corrosion issues in LWRs - other phenomena	D. Féron
9	12:00-12:30		Corrosion/EAC mitigation in LWRs	S. Ritter
	12:30-13:30		Lunch	
	13:30-17:00		Common bus tour to Vršič pass (or free time)	
	~17:00-17:30		Get together & coffee/tea break	
10	17:30-19:00		Corrosion monitoring in LWR environments	R.-W. Bosch
	19:00-20:00		Dinner	
11	20:00-21:30		Corrosion in nuclear power systems – management, mechanisms and review of some field cases	P. Efsing
Thu., 11 July 2019				
12a	09:00-10:30	Corrosion in nuclear waste disposals	Nuclear waste disposal concepts	J. Noël
	10:30-11:00		Coffee break	
12b	11:00-12:30		Corrosion phenomena in nuclear waste disposal systems	J. Noël
	12:30-13:30		Lunch	
	13:30-17:00		Free time (social activities)	
	~17:00-17:30		Get together & coffee/tea break	
13a	17:30-19:00	Corrosion in Gen-IV systems	Introduction to Gen-IV systems & high-temperature corrosion	L. Martinelli
	19:00-20:00		Dinner	
13b	20:00-21:30		Corrosion phenomena in Gen-IV systems	L. Martinelli
Fri., 12 July 2019				
14a	09:00-10:30	Exercises	Exercises in small groups (simple electrochemical/ corrosion experiments) I	P. Schrems, B. Zajec & J. Noël
	10:30-11:00		Coffee break	
14b	11:00-12:30		Exercises in small groups (simple electrochemical/ corrosion experiments) II	P. Schrems, B. Zajec & J. Noël
	12:30-13:30		Lunch	
	13:30		End of NuCoSS-19	