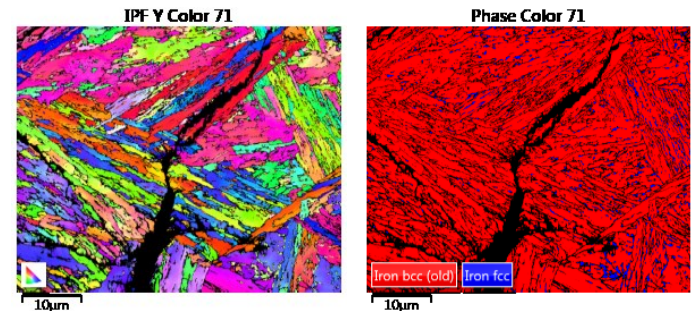


## EFC Working Party 5 Environment Sensitive Fracture

Chronological minutes from WP5 Business meetings since 2009 ... to 2017

**Krzysztof WOLSKI** appointed in 2009 as WP5 chairman  
Materials and Mechanical Engineering Center (Centre SMS)  
UMR CNRS 5307 LGF - Laboratoire Georges Friedel  
Mines Saint Etienne  
158, cours Fauriel 42023 Saint Etienne  
FRANCE

**Vigdis OLDEN** appointed in 2010 as vice-chairman  
SINTEF Materials and Chemistry  
R. Birkelands vei 2B 7465 Trondheim  
NORWAY



Understanding transgranular fracture path  
in a supermartensitic stainless steel  
under H<sub>2</sub>S environment

(C. Gayton, Mines St-Etienne, GE Thermodyn, 2017)



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EUROPÄISCHE FÖDERATION KORROSION  
EUROPEAN FEDERATION OF CORROSION  
FEDERATION EUROPEENNE DE LA CORROSION

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## Welcome

The EFC is a federation of over 30 societies with interests in corrosion based in twenty-five different countries within Europe and beyond. Taken together, its member societies represent the corrosion interests of more than 25,000 engineers and scientists.

Its aim is to advance the science of the corrosion and protection of materials by promoting cooperation in Europe and collaboration internationally. [[more...](#)]

### EFC Events

#### EUROCORR 2013

Corrosion Control for a Blue Sky

Estoril, Portugal

Sep 01, 2013 - Sep 05, 2013

#### 6th Kurt Schwabe Symposium

Surface analysis and material engineering in corrosion science and electrochemical technologies

Cracow, Poland

Sep 16, 2013 - Sep 19, 2013



### EUROCORR 2013

Estoril, Portugal, 1-5 September 2013

#### NEW:

- Plenary Lectures
- Graduate Course

EFC Newsletter No 21

September 2013

E-Newsletter April 2013

September 2012:

Lorenzo Fedrizzi elected as EFC President

## EFC WORKING PARTY 5: ENVIRONMENT SENSITIVE FRACTURE

WP5's overall objective is to bring together scientists and engineers encountering the problem of crack initiation and propagation in different application fields including nuclear, petrochemical and aeronautical industries. In such environments fracture often results from a simultaneous action of mechanical loading and aggressive environment which can be either water or hydrogen or reactive gases or even more specific like liquid metal. The common feature requested for accurate prediction of the remaining lifetime is the need to understand the mechanisms of crack initiation and crack propagation.

WP5 specific missions concern the fields of hydrogen induced cracking, stress corrosion cracking, fatigue-corrosion, high temperature corrosion and liquid metal embrittlement and are aimed at

- confronting physico-chemical and mechanical approaches in modelling environment sensitive fracture,
- promoting the use of advanced local investigation methods (AFM, EBSD, Auger/XPS, nanomechanical testing) for submicrometer range description of crack initiation sites and crack-tip characteristics and
- promoting the use of numerical simulations based on multiscale physical approach.
- contributing to the definition of recommendations through joint sessions with colleagues from different application fields.



**Chairman:**

Dr. Krzysztof WOLSKI  
Departement PMI  
Centre SMS - UMR CNRS 5146  
Ecole des Mines de Saint-Etienne  
158, cours Fauriel  
42023 Saint-Etienne Cedex 02  
France  
Tel: 0033-4-77 42 66 18  
Fax: 0033-4-77 42 01 57  
E-mail: [wolski@emse.fr](mailto:wolski@emse.fr)



Dr. Vigdis OLDEN  
SINTEF Materials and Chemistry  
R. Birkelands vei 2B  
7465 Trondheim  
Norway  
Tel: 0047- 98-230434  
E-mail: [Vigdis.Olden@sintef.no](mailto:Vigdis.Olden@sintef.no)

**If you wish become involved in the activities of the WP 5 on Environmental Sensitive Fracture please visit our homepage to register online under:**

**<http://www.efcweb.org/Working+Parties/WP+5>**

**If you wish get involved in the activities of the WP on Environmental Sensitive Fracture please click here to register!**



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## Service for members

The following pages are restricted to EFC Member Societies, members of the Board of Administrators (BoA) and members of the Science and Technology Advisory Committee (STAC), respectively.

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[Service for Member Societies](#)

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# EUROCORR 2009

**WP5: Environment Sensitive Fracture**

**Acting chairman Krzysztof Wolski ([wolski@emse.fr](mailto:wolski@emse.fr))**

**WP5 under its recently appointed acting chairman organized a session on Environment Sensitive Fracture at EUROCORR 2009. This included 10 oral presentations and 3 posters.**

**WP5's overall objective is to bring together scientists and engineers encountering the problem of crack initiation and propagation in different application fields including nuclear, petrochemical and aeronautical industries. In such environments fracture often results from a simultaneous action of mechanical loading and aggressive environment which can be either water or hydrogen or reactive gases or even more specific like liquid metal. The common feature requested for accurate prediction of the remaining lifetime is the need to understand the mechanisms of crack initiation and crack propagation.**



**Vigdis Olden appointed as co-chairman ([olden@sintef.no](mailto:olden@sintef.no))  
Organisation of WP5 session in Moscou with participation of  
approximately 50 persons, 10 oral presentations and 4 posters**

### **WP5 business meeting : 25 personnes**

**WP5 specific missions concern the fields of hydrogen induced cracking, stress corrosion cracking, fatigue-corrosion, high temperature corrosion and liquid metal embrittlement and are aimed at**

- confronting physico-chemical and mechanical approaches in modeling environment sensitive fracture,**
- promoting the use of advanced local investigation methods (AFM, EBSD, Auger/XPS, nanomechanical testing) for submicrometer range description of crack initiation sites and crack-tip characteristics and**
- promoting the use of numerical simulations based on multiscale physical approach.**
- contributing to the definition of recommendations through joint sessions with colleagues from different application fields.**



**2010 / 2011**

**Contribution to the book :  
“Nuclear corrosion science and engineering”**

**Chapter 5 “Environmentally Assisted Cracking”**

5.1 Introduction

5.2 Basic principles of EAC

5.3 Alloys and components exposed to EAC in nuclear industry

5.4 Models and mechanisms of EAC

5.5 Future trends : from experimental approach to numerical simulations

5.6 Sources of further information

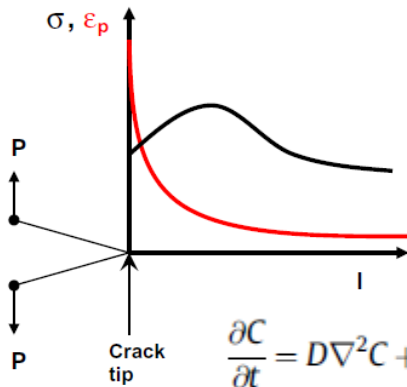
5.7 References

Editor: Dr Damien Féron, Commissariat à l’Energie Atomique, CEA Saclay,  
DPC/SCCME, France

**Published in 2012 by Woodhead Publishing**

# EUROCORR 2011

Organisation of WP5 session in Stockholm with participation of approximately 40 persons, 11 oral presentations and 5 posters



Cohesive zone simulation of cold cracking susceptibility in a hyperbaric weld of X70 structural steel

V. Olden et al., SINTEF Materials and Chemistry, Trondheim/N;

$$\frac{\partial C}{\partial t} = D \nabla^2 C + D \cdot \frac{V_H}{R \cdot (T - T^Z)} \nabla C \cdot \nabla p + D \cdot \frac{V_H}{R \cdot (T - T^Z)} C \nabla^2 p$$

Modeling environmentally assisted cracking : review of main ingredients as a function of temperature

Krzysztof Wolski  
Département Mécanique Physique et Interfaces (UMR CNRS 5146 PECCM)  
Centre SMS, Ecole Nationale Supérieure des Mines de Saint-Etienne  
158, cours Fauriel 42023 Saint-Etienne FRANCE

AIM  
To underline the importance of both metallurgical and environmental parameters in assessing Environmentally Sensitive Fracture  
To introduce the discussion during WP5 business meeting about the objectives of ESF session

PLAN  
Introduction  
1<sup>st</sup> Example of industrially relevant cracking (304H, 600°C)  
2<sup>nd</sup> Example of liquid metal induced embrittlement (Al-Bi)  
3<sup>rd</sup> From diffusion with trapping to Cohesive Zone Model  
4<sup>th</sup> Advanced experimental studies at a nanometer scale  
Conclusion

Eurocorr 2011, Stockholm, SWEDEN 4-8 September 2011

Modeling environmentally assisted cracking: review of main ingredients as a function of temperature

K. Wolski, École Nationale Supérieure des Mines de Saint-Etienne/F

WP5 business meeting : 15 personnes



# EUROCORR 2012

Organisation of WP5 session in Istanbul with participation of approximately 40 persons, 11 oral presentations and 5 posters

## Workshop on occurrence and mechanisms of Environmentally Assisted Cracking

First announcement



A common workshop during Eurocorr'2012, Istanbul, Turkey, 9-13/09/2012

co-organized by :

- WP 4 "Nuclear Corrosion"
- WP 5 "Environmentally sensitive fracture"
- WP 9 "Marine Corrosion"
- WP 13 "Corrosion in Oil & Gas"
- WP 15 "Corrosion in the Refining Industry"
- WP 17 "Automotive corrosion"

WP5 business meeting : 20

WS in environmentally assisted cracking

J. Kittel/K. Wolski

Keynote

T. Cassagne

U. Kivisäkk

V. Olden

C. Bosch

WS in environmentally assisted cracking

V. Olden/D. Feron

Keynote

P. Combrade

T. Couvant

J. Bouhattate

WS in environmentally assisted cracking

T. Couvent/C. Powell

R. Rebak

N. Lorho

S. Ritter

K. Wolski

# EUROCORR 2013

<http://eurocorr2013.org/>

**EUROCORR 2013**  
for a blue sky



**EUROPEAN CORROSION CONGRESS**  
The annual event of the European Federation of Corrosion



September 1 - 5, 2013 • Estoril Congress Center • Estoril, Portugal

**Conference Info**

- Introduction
- General Information
- About Estoril
- Committees
- Important Dates
- Congress Programme
- Plenary Lectures
- Scientific Sessions
- Meetings
- Instructions for Authors
- Full Manuscript Submission
- Registration
- Accommodation
- Official Airline Network
- Graduate Course
- NACE MR0175/ISO15156
- Exhibitors & Sponsors



Copyright Turismo Estoril

**Introduction**

EUROCORR is the most important event in Europe and a reference around the world on the subjects of corrosion and protection.

**Welcome to Estoril!!**

**Organisation of WP5 session in Estoril with participation of approx 30-50 persons, 17 oral presentations and 5 posters**  
**Keynote lecture by prof. Xavier Feaugas**

## Keywords

- Hydrogen diffusion and embrittlement
- Electrochemistry and Stress Corrosion Cracking
- From fundamental approach to industrial case studies

**WP5 business meeting : 8 persons**

Room 7-D1+D2 70
<b>Environment Sensitive Fracture</b>
<b>K. Wolski</b>
<b>1193 B. O. Hoch</b>
<b>1630 F. Vucko</b>
<b>1530 A. Oudriss</b>
<b>1243 J. Sobetzki</b>
<b>1152 A. Keserovic</b>
<b>Environment Sensitive Fracture</b>
<b>H. Hoffmeister</b>
<b>1230 K. Wolski</b>
<b>1080 K. Gao</b>
<b>1688 G. Mori</b>
<b>1280 R. B. Rebak</b>
<b>Environment Sensitive Fracture</b>
<b>J. Bouhattate / X. Feaugas</b>
<b>1037 S. Funani</b>
<b>1077 T. Haruna</b>
<b>1739 R. Rihan</b>
<b>1535 A. Girones</b>
<b>1520 Proverbio</b>
<b>1514 Blanc</b>

Room 7-D1+D2 70
<b>Environment Sensitive Fracture</b>
<b>K. Wolski / J. Bouhattate</b>
<b>1478 X. Feaugas</b>
<b>1478 X. Feaugas</b>
<b>1067 H. Hoffmeister</b>
<b>Business meet</b>
<b>Business meet</b>

# EUROCORR 2014

<http://eurocorr2014.org/>



Organisation of WP5 session in Estoril with participation of approximately 40 persons, 15 oral presentations

## Highlights

- Authors from 10 different countries
- No poster presentations

WP5 business meeting : 6 persons

Joint Session of EFC WP 5 Environmental Sensitive Fracture & WP 18 Tribocorrosion EUROCORR 2014, Pisa, Italy

Room 2
Environment Sensitive Fracture
<i>K. Wolski</i>
7490 C. Evans
7512 R. Pettersson
7210 C. Berne
7074 R. Bogdanov
break
Environment Sensitive Fracture
<i>C. Evans</i>
7271 W. Huang
7806 A. Atrens
7391 E.F. Turcu
7446 D. Bangsgaard
7586 C. Dellabiancia
lunch
Environment Sensitive Fracture
<i>A. Visser / C. Blanc</i>
7523D. Di Pietro
7688 I. Proriol Serre
7235 J. Sobetzki
7605 A. Visser
7829 L. Qiao
break
Environment Sensitive Fracture
<i>K. Wolski</i>
7151 K. Wolski
WP 5 business meeting

Room 4
JS I: Surface and Bulk Degradation
<i>M. Keddam / P. Ponthiaux</i>
7528 B. Normand
7532 N. Mary
7630 T. Kosec
7798 M. Keddam
break
JS I: Surface and Bulk Degradation
<i>M. Keddam / P. Ponthiaux</i>
7687 I. Proriol Serre
7772 F. Pagano

**EUROCORR 2014** <http://eurocorr2014.org/>

<http://efcweb.org/WP+Environment+Sensitive+Fracture.html>

**WP BUSINESS MEETINGS:**

**Next WP business meetings:**

The next meeting of the WP on Environmental Sensitive Fracture will be held in Montpellier, France during EUROCORR 2016

**Second announcement Joint Session WP13, WP9 and WP5 at EUROCORR 2015, Graz, Austria**

**WP Business Meeting during EUROCORR 2014, 11 September 2014, Pisa, Italy**

**Call for abstracts for Joint Session WP5&WP18 at EUROCORR 2014, 11 September 2014, Pisa, Italy**

**Announcement Workshop on Occurrence and Mechanisms of Environmentally Assisted Cracking at EUROCORR 2012, Istanbul, Turkey**

**WP meeting during EUROCORR 2010, 14 September 2010, Moscow, Russia**

**If you wish get involved in the activities of the WP on Environmental Sensitive Fracture please click here to register!**



# EUROCORR 2015

<http://eurocorr2015.org/>



ASMET, the Austrian Society for Metallurgy and Materials, is proud to host the European Corrosion Congress EUROCORR 2015. The conference will take place in Graz at the Stadthalle, from 6-10 September 2015.

**Organisation of WP5 session in Graz with participation of up to 50 persons, 14 oral presentations**

## Highlights

- Authors from 8 different countries
- Keynote lecture by prof. A. Atrens
- 2 poster presentations

Environment Sensitive Fracture
<i>K. Wolski</i>
86 Keynote A. Atrens
296 H.J. Kim
847 B. Zajec
Environment Sensitive Fracture
<i>A. Visser</i>
245 J. G. Sezgin
310 J. Bolivar
543 H. Mubarak
243 M. Borchert
Environment Sensitive Fracture
<i>A. Atrens</i>
1011 C. Gayton
652 A. Visser
499 C. Berne

Environment Sensitive Fracture
<i>M. Borchert</i>
226 H.S. Klapper
775 B. L'Hostis
807 A. Lanzutti
85 S. Funani
Environment Sensitive Fracture
WP5 Business Meeting

**WP5 business meeting : 4 persons**

# EUROCORR 2015

<http://eurocorr2015.org/>



ASMET, the Austrian Society for Metallurgy and Materials, is proud to host the European Corrosion Congress EUROCORR 2015. The conference will take place in Graz at the Stadthalle, from 6-10 September 2015.

**Organisation of a joint session in Graz with participation of up to 80 persons, 14 oral presentations**

## Highlights

- Authors from 8 different countries
- No poster presentations

**Joint Session among WP13, WP9 and WP5**  
**Corrosion in Oil and Gas Production,**  
**Marine Corrosion and Environmentally Sensitive Fracture**

Second announcement



Common session during Eurocorr'2015, Gratz, Austria, 06-10/09/2015

The aim of this common session is to bring together academics and industrials concerned with two issues that have recently become of outer importance:

- issues regarding HISC of duplex stainless steels such as easier qualification tests and design rules
- corrosion and cracking of Ni-based alloys in deep water oil&gas exploration

*Both issues are related to cathodic charging of materials in seawater that can result in hydrogen induced cracking. Recently it has been evident that hydrogen embrittlement of precipitation hardening Ni-base alloys can occur and contributions regarding this phenomenon including results from test programs and the mechanism are welcome. For HISC there have been guidelines rules present for several years which may be updated. Contributions can cover improved qualification test methods and design criterions as well as mechanistic work are invited.*

Hydrogen in Oil,  
Marine and ESF

S. Paterson/  
K.Wolski

915 U.H. Kivisakk

67 D. Bangsgaard

864 F. Bolzoni

841 X. Feaugas

769 C. Forot

Hydrogen in Oil,  
Marine and ESF

Kivisäkk

260 A. Smith

724 K. Kobayashi

814 J. Creus

837 A. Oudriss

83 Y. Huang

Hydrogen in Oil,  
Marine and ESF

Paterson

871 D.L. Sponseller

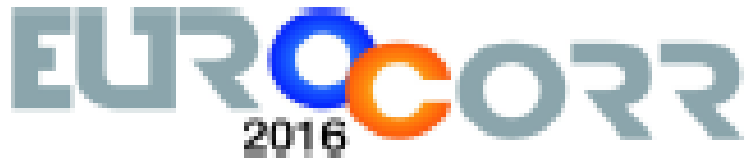
238 C. Holzer

518 D. Mizuno

925 E. Wallaert

# EUROCORR 2016

<http://eurocorr2016.org/>



Organisation of WP5 session in Montpellier with participation of up to 90 persons, 29 oral presentations

## Highlights

- Authors from 12 different countries
- 4 poster presentations
- In parallel with IHC at Jackson

WP5 business meeting : 4 persons

Environment Sensitive Fracture
<i>Wolski</i>
54392 Reccagni
67152 Mubarak
56427 Aubert
56907 Touzet Cortina
59777 Blanc
56937 Sezgin
Coffee Break
Environment Sensitive Fracture
<i>Wolski</i>
63657 Han
66667 Husby
70045 Liu
54572 Johnsen
57067 Mintz

Environment Sensitive Fracture
<i>Wolski</i>
57707 Gayton
56152 Aral
60262 Borchert
61242 Qian
51267 Haruna
Coffee Break
Environment Sensitive Fracture
<i>Wolski</i>
68570 Froome
60332 Hatami Monfared
62882 Zajec
61282 Proriot Gerre
Lunoh
Environment Sensitive Fracture
<i>Wolski</i>
67322 Mori
67752 El May
68490 Tada
58157 Leyser
65252 Blanc
Coffee Break
Environment Sensitive Fracture
<i>Wolski</i>
65227 Stenerud
51842 Conejero



# Business meeting in Montpellier



**Some other issues :**

- Forum for open informal discussions**
- WP5 members list to be updated**
- Possibility to organise EFC events**
- Any question / suggestion from delegates?**
  - Exceptionnal pictures of cracking paths**
  - Ideas in the field of ESF to be shared**

New EFC web page <http://www.efcweb.org/>



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## Welcome

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Founded in 1955, its aim is to advance the science of the corrosion and protection of materials by promoting cooperation in Europe and collaboration internationally. [ [more...](#) ]

The EFC accomplishes its most important activities through twenty active **working parties** devoted to various aspects of corrosion and its prevention.

**EUROCORR**, the EFC's annual conference is the flagship event of the European corrosion calendar. This year's event is the 36th in the series.

### EFC Events

#### EUROCORR 2017

held jointly with the 20th International Corrosion Congress-ICC and the Process Safety Congress 2017

Theme: Corrosion Control for Safer Living

Prague, Czech Republic

Sep 03, 2017 - Sep 07, 2017

#### 19th YUCORR International conference



**EUROCORR 2017**  
jointly with 20th International  
Corrosion Congress & Process  
Safety Congress 2017  
Prague, Czech Republic,  
3-7 September 2017

Courses in conjunction with  
EUROCORR 2017:

- Graduate Course  
"Corrosion Science"  
1-3 September 2017
- Tribocorrosion course  
3 September 2017
- **ACA concrete course**  
(supported by EFC)  
8-9 September 2017  
Registration deadline:  
7 August 2017

# Common ICC & EUROCORR 2017

<http://eurocorr2017.org/>, <http://www.prague-corrosion-2017.com/>



- Organisation of WP5 session in Prague with 21 oral presentations from 11 different countries
- Co-organisation of a common WP5 & WP13 session “Impact of H2 charging” with 12 oral presentations from 7 different countries
- Co-organisation of a common session with ICC “Techniques for SCC testing” with 2 presentations

## Highlights

- Co-organisation of WP5 with prof. T. Shoji
- Keynote lecture by prof A. Shipilov (Materials Science and Technology Division, Oak Ridge National Laboratory, Oak Ridge, USA): History of SCC Research: A Record of Progress

**WP5 business meeting proposed on 6/09 during the lunch**

<b>Environment Sensitive Fracture</b>
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<i>T. Shoji</i>
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99785 Shipilov Keynote
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75002 Proverbio
-----------------

96737 Gayton
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93852 Bolivar
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<i>K. Wolski</i>
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83071 Serrano
---------------

89786 Ornek
-------------

92381 Novikova
----------------

74887 Tohme
-------------

86121 Christien
-----------------

<i>C. Ornek</i>
-----------------

77311 Lanzutti
----------------

83961 Schonning
-----------------

79406 Ohla
------------

91901 Huang
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73516 Li
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94857 Di Gabriele
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WP 5 Meeting
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<i>H. Husby</i>
-----------------

88406 Blanc
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87736 Reccagni
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95287 Qiao
------------

89936 Raja
------------

77536 Klapper
---------------

90771 Tan
-----------

Impact of H2 charging
-----------------------

<i>Wilms/Wolski</i>
---------------------

93267 Paterson
----------------

90046 Hesketh
---------------

74797 Kittel
--------------

79331 Richou
--------------

<i>Wilms/Wolski</i>
---------------------

72497 Ishiguro
----------------

81636 Pourbaix
----------------

75547 Baba
------------

90961 Krieger
---------------

83411 Pushparasah
-------------------

<i>Wilms/Wolski</i>
---------------------

93682 Engelberg
-----------------

83771 Thomas
--------------

87316 Reuter
--------------

Techniques for SCC testing
----------------------------

<i>C. Blanc / K. Wolski</i>
-----------------------------

74972 Proverbio
-----------------

81901 Krawczyk
----------------