

# **Francis-99 Workshop 2: Transient Operation of Francis Turbines 2016**

Journal of Physics: Conference Series Volume 782

Lulea, Sweden  
14 – 15 December 2016

## **Editors:**

**Michel J. Cervantes  
Chirag Trivedi**

**O.G. Dahlhaug  
T. Nielsen**

ISBN: 978-1-5108-3533-7  
ISSN: 1742-6588

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2016) by the Institute of Physics  
All rights reserved. The material featured in this book is subject to  
IOP copyright protection, unless otherwise indicated.

Printed by Curran Associates, Inc. (2017)

For permission requests, please contact the Institute of Physics  
at the address below.

Institute of Physics  
Dirac House, Temple Back  
Bristol BS1 6BE UK

Phone: 44 1 17 929 7481  
Fax: 44 1 17 920 0979

[techtracking@iop.org](mailto:techtracking@iop.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# Table of contents

## Volume 782

**Francis-99 Workshop 2: transient operation of Francis turbines**  
14–15 December 2016, Lulea, Sweden

**Accepted papers received: 2 December 2016**  
**Published online: 16 January 2017**

### **Preface**

011001

OPEN ACCESS

[Francis-99 Workshop 2: transient operation of Francis turbines](#)

011002

OPEN ACCESS

[Peer review statement](#)

### **Papers**

012001

OPEN ACCESS

[Francis-99: Transient CFD simulation of load changes and turbine shutdown in a model sized high-head Francis turbine](#)

Peter Mössinger, Roland Jester-Zürker and Alexander Jung.....1

012002

OPEN ACCESS

[CFD simulations of transient load change on a high head Francis turbine](#)

Ken-Robert G. Jakobsen and Martin Aasved Holst.....13

012003

OPEN ACCESS

[Simulation of the Francis-99 Hydro Turbine During Steady and Transient Operation](#)

Yuvraj Dewan, Chad Custer and Artem Ivashchenko.....27

012004

OPEN ACCESS

[Numerical investigation of flow structure and pressure pulsation in the Francis-99 turbine during startup](#)

A Minakov, A Sentyabov and D Platonov.....42

012005

OPEN ACCESS

[Francis-99 turbine numerical flow simulation of steady state operation using RANS and RANS/LES turbulence model](#)

A Minakov, D Platonov, A Sentyabov and A Gavrilo.....55

012006

OPEN ACCESS

[Steady state operation simulation of the Francis-99 turbine by means of advanced turbulence models](#)

A Gavrilo, A Dekterev, A Minakov, D Platonov and A Sentyabov.....70

012007

OPEN ACCESS

[Performance prediction of the high head Francis-99 turbine for steady operation points](#)

E. Casartelli, L. Mangani, O. Ryan and A. Del Rio.....80

012008

OPEN ACCESS

[Efficiency limit factor analysis for the Francis-99 hydraulic turbine](#)

Y Zeng, L X Zhang, J P Guo, Y K Guo, Q L Pan and J Qian.....94

012009

OPEN ACCESS

[Frozen Rotor and Sliding Mesh Models Applied to the 3D Simulation of the Francis-99 Tokke Turbine with Code Saturne](#)

N Tonello, Y Eude, B de Laage de Meux and M Ferrand.....106

012010

OPEN ACCESS

[On the relation between friction losses and pressure pulsations caused by Rotor Stator interaction on the Francis-99 turbine](#)

Petter T.K. Østby, Jan Tore Billdal, Bjørn Haugen and Ole Gunnar Dahlhaug.....118