

**NIST**

**National Institute of  
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**Special Publication 800-82**

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# **Guide to Industrial Control Systems (ICS) Security**

**Supervisory Control and Data Acquisition (SCADA) systems, Distributed Control Systems (DCS), and other control system configurations such as Programmable Logic Controllers (PLC)**

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## **Recommendations of the National Institute of Standards and Technology**

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Keith Stouffer  
Joe Falco  
Karen Scarfone

# Guide To Industrial Control Systems Ics Security

**Shon Harris, Fernando Maymi**



## **Guide To Industrial Control Systems Ics Security:**

**NIST Special Publication 800-82 Guide to Industrial Control Systems (ICS) Security** Nist,2012-02-29 The purpose of this document is to provide guidance for securing industrial control systems ICS including supervisory control and data acquisition SCADA systems distributed control systems DCS and other systems performing control functions The document provides an overview of ICS and typical system topologies identifies typical threats and vulnerabilities to these systems and provides recommended security countermeasures to mitigate the associated risks Because there are many different types of ICS with varying levels of potential risk and impact the document provides a list of many different methods and techniques for securing ICS The document should not be used purely as a checklist to secure a specific system Readers are encouraged to perform a risk based assessment on their systems and to tailor the recommended guidelines and solutions to meet their specific security business and operational requirements

**Guide to Industrial Control Systems (ICS) Security** U. S. Department Commerce,National Institute of Standards and Technology,2017-07-04 The Information Technology Laboratory ITL at the National Institute of Standards and Technology NIST promotes the U S economy and public welfare by providing technical leadership for the Nation s measurement and standards infrastructure ITL develops tests test methods reference data proof of concept implementations and technical analyses to advance the development and productive use of information technology ITL s responsibilities include the development of management administrative technical and physical standards and guidelines for the cost effective security and privacy of other than national security related information in federal information systems The Special Publication 800 series reports on ITL s research guidelines and outreach efforts in information system security and its collaborative activities with industry government and academic organizations This publication provides guidance on how to secure Industrial Control Systems ICS including Supervisory Control and Data Acquisition SCADA systems Distributed Control Systems DCS and other control system configurations such as Programmable Logic Controllers PLC while addressing their unique performance reliability and safety requirements The publication provides an overview of ICS and typical system topologies identifies typical threats and vulnerabilities to these systems and provides recommended security countermeasures to mitigate the associated risks

[Guide to Industrial Control Systems \(ICS\) Security](#) Keith Stouffer,Joe Falco,Karen Ann Kent,National Institute of Standards and Technology (U.S.). Engineering Laboratory, Information Technology Laboratory,2013

**Guide to Industrial Control Systems (ICS) Security** Keith Stouffer,Joe Falco,Karen Scarfone,2011-06-01 NIST Special Publication 800 82 This document provides guidance for establishing secure industrial control systems ICS These ICS which include supervisory control and data acquisition SCADA systems distributed control systems DCS and other control system configurations such as skid mounted Programmable Logic Controllers PLC are often found in the industrial control sectors ICS are typically used in industries such as electric water and wastewater oil and natural gas transportation chemical pharmaceutical pulp and paper food and

beverage and discrete manufacturing e g automotive aerospace and durable goods SCADA systems are generally used to control dispersed assets using centralized data acquisition and supervisory control DCS are generally used to control production systems within a local area such as a factory using supervisory and regulatory control PLCs are generally used for discrete control for specific applications and generally provide regulatory control These control systems are vital to the operation of the U S critical infrastructures that are often highly interconnected and mutually dependent systems It is important to note that approximately 90 percent of the nation s critical infrastructures are privately owned and operated Federal agencies also operate many of the ICS mentioned above other examples include air traffic control and materials handling e g Postal Service mail handling This document provides an overview of these ICS and typical system topologies identifies typical threats and vulnerabilities to these systems and provides recommended security countermeasures to mitigate the associated risks National Institute of Standards and Technology U S Department of Commerce *Guide to Industrial Control Systems (ICS) Security* National Institute of Standards and Technology,2011-06-30 This document provides guidance for establishing secure industrial control systems ICS These ICS which include supervisory control and data acquisition SCADA systems distributed control systems DCS and other control system configurations such as skid mounted Programmable Logic Controllers PLC are often found in the industrial control sectors ICS are typically used in industries such as electric water and wastewater oil and natural gas transportation chemical pharmaceutical pulp and paper food and beverage and discrete manufacturing e g automotive aerospace and durable goods SCADA systems are generally used to control dispersed assets using centralized data acquisition and supervisory control DCS are generally used to control production systems within a local area such as a factory using supervisory and regulatory control PLCs are generally used for discrete control for specific applications and generally provide regulatory control These control systems are vital to the operation of the U S critical infrastructures that are often highly interconnected and mutually dependent systems It is important to note that approximately 90 percent of the nation s critical infrastructures are privately owned and operated Federal agencies also operate many of the ICS mentioned above other examples include air traffic control and materials handling e g Postal Service mail handling This document provides an overview of these ICS and typical system topologies identifies typical threats and vulnerabilities to these systems and provides recommended security countermeasures to mitigate the associated risks Initially ICS had little resemblance to traditional information technology IT systems in that ICS were isolated systems running proprietary control protocols using specialized hardware and software Widely available low cost Internet Protocol IP devices are now replacing proprietary solutions which increases the possibility of cyber security vulnerabilities and incidents As ICS are adopting IT solutions to promote corporate business systems connectivity and remote access capabilities and are being designed and implemented using industry standard computers operating systems OS and network protocols they are starting to resemble IT systems This integration supports new IT capabilities but it provides

significantly less isolation for ICS from the outside world than predecessor systems creating a greater need to secure these systems While security solutions have been designed to deal with these security issues in typical IT systems special precautions must be taken when introducing these same solutions to ICS environments In some cases new security solutions are needed that are tailored to the ICS environment Although some characteristics are similar ICS also have characteristics that differ from traditional information processing systems Many of these differences stem from the fact that logic executing in ICS has a direct affect on the physical world Some of these characteristics include significant risk to the health and safety of human lives and serious damage to the environment as well as serious financial issues such as production losses negative impact to a nation s economy and compromise of proprietary information ICS have unique performance and reliability requirements and often use operating systems and applications that may be considered unconventional to typical IT personnel Furthermore the goals of safety and efficiency sometimes conflict with security in the design and operation of control systems

*Nist Special Publication 800-82 Guide to Industrial Control Systems Security* U.s. Department of Commerce,2014-10-09 This document provides guidance for establishing secure industrial control systems ICS These ICS which include supervisory control and data acquisition SCADA systems distributed control systems DCS and other control system configurations such as skid mounted Programmable Logic Controllers PLC are often found in the industrial control sectors ICS are typically used in industries such as electric water and wastewater oil and natural gas transportation chemical pharmaceutical pulp and paper food and beverage and discrete manufacturing e g automotive aerospace and durable goods SCADA systems are generally used to control dispersed assets using centralized data acquisition and supervisory control

*Nist Special Publication 800-82 Revision 1 Guide to Industrial Control Systems Security* U.s. Department of Commerce,2014-10-09 This document provides guidance on how to secure Industrial Control Systems ICS including Supervisory Control and Data Acquisition SCADA systems Distributed Control Systems DCS and other control system configurations such as Programmable Logic Controllers PLC while addressing their unique performance reliability and safety requirements The document provides an overview of ICS and typical system topologies identifies typical threats and vulnerabilities to these systems and provides recommended security countermeasures to mitigate the associated risks

**Nist Sp 800-82 Rev 2 - Guide to Industrial Control Systems (Ics) Security** National Institute National Institute of Standards,2015-05-29 NIST SP 800 82 Rev 2 Printed in COLOR ePub version also available for use on Kindle iPad Android tablet and iPhone If you like this book please leave positive review This document provides guidance on how to secure Industrial Control Systems ICS including Supervisory Control and Data Acquisition SCADA systems Distributed Control Systems DCS and other control system configurations such as Programmable Logic Controllers PLC while addressing their unique performance reliability and safety requirements The document provides an overview of ICS and typical system topologies identifies typical threats and vulnerabilities to these systems and provides recommended security

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**Industrial Control Systems Security and Resiliency** Craig Rieger,Indrajit Ray,Quanyan Zhu,Michael A. Haney,2019-08-29 This book provides a comprehensive overview of the key concerns as well as research challenges in designing secure and resilient Industrial Control Systems ICS It will discuss today s state of the art security architectures and couple it with near and long term research needs that compare to the baseline It will also establish all discussions to generic reference architecture for ICS that reflects and protects high consequence scenarios Significant strides have been made in making industrial control systems secure However increasing connectivity of ICS systems with commodity IT devices and significant human interaction of ICS systems during its operation regularly introduces newer threats to these systems resulting in ICS security defenses

always playing catch up There is an emerging consensus that it is very important for ICS missions to survive cyber attacks as well as failures and continue to maintain a certain level and quality of service Such resilient ICS design requires one to be proactive in understanding and reasoning about evolving threats to ICS components their potential effects on the ICS mission s survivability goals and identify ways to design secure resilient ICS systems This book targets primarily educators and researchers working in the area of ICS and Supervisory Control And Data Acquisition SCADA systems security and resiliency Practitioners responsible for security deployment management and governance in ICS and SCADA systems would also find this book useful Graduate students will find this book to be a good starting point for research in this area and a reference source

**Guide to Industrial Control Systems (ICS) Security** ,2013 [Guide to Industrial Control Systems \(ICS\) Security](#) ,2015 *Recent Developments on Industrial Control Systems Resilience* Emil Pricop,Jaouhar Fattahi,Nitul Dutta,Mariam Ibrahim,2019-10-05 This book provides profound insights into industrial control system resilience exploring fundamental and advanced topics and including practical examples and scenarios to support the theoretical approaches It examines issues related to the safe operation of control systems risk analysis and assessment use of attack graphs to evaluate the resiliency of control systems preventive maintenance and malware detection and analysis The book also discusses sensor networks and Internet of Things devices Moreover it covers timely responses to malicious attacks and hazardous situations helping readers select the best approaches to handle such unwanted situations The book is essential reading for engineers researchers and specialists addressing security and safety issues related to the implementation of modern industrial control systems It is also a valuable resource for students interested in this area

*Securing Your SCADA and Industrial Control Systems* Defense Dept., Technical Support Working Group (TSWG), Version 1 0 This guidebook provides information for enhancing the security of Supervisory Control and Data Acquisition Systems SCADA and Industrial Control Systems ICS The information is a comprehensive overview of industrial control system security including administrative controls architecture design and security technology This is a guide for enhancing security not a how to manual for building an ICS and its purpose is to teach ICS managers administrators operators engineers and other ICS staff what security concerns they should be taking into account Other related products National Response Framework 2008 is available here <https://bookstore.gpo.gov/products/sku/064-000-00044-6> National Strategy for Homeland Security October 2007 is available here <https://bookstore.gpo.gov/products/sku/041-001-00657-5> New Era of Responsibility Renewing America s Promise can be found here <https://bookstore.gpo.gov/products/sku/041-001-00660-5>

**Cyber-security of SCADA and Other Industrial Control Systems** Edward J. M. Colbert,Alexander Kott,2016-08-23 This book provides a comprehensive overview of the fundamental security of Industrial Control Systems ICSs including Supervisory Control and Data Acquisition SCADA systems and touching on cyber physical systems in general Careful attention is given to providing the reader with clear and comprehensive background and reference material for each topic pertinent to ICS security This book offers answers to such questions as Which specific

operating and security issues may lead to a loss of efficiency and operation What methods can be used to monitor and protect my system How can I design my system to reduce threats This book offers chapters on ICS cyber threats attacks metrics risk situational awareness intrusion detection and security testing providing an advantageous reference set for current system owners who wish to securely configure and operate their ICSs This book is appropriate for non specialists as well Tutorial information is provided in two initial chapters and in the beginnings of other chapters as needed The book concludes with advanced topics on ICS governance responses to attacks on ICS and future security of the Internet of Things

**Industrial Automation and Control System Security Principles** Ronald L. Krutz, 2016-11-30 Industrial Automation and Control System Security Principles Protecting the Critical Infrastructure 2nd Edition The use of cyber warfare as a prelude or substitute for conventional attacks has gone from conjecture to reality The obvious targets of such assaults are a nation s defense establishment critical infrastructure corporate intellectual property government databases and production capabilities This text develops a novel approach to securing industrial automation and control systems by generating protection principles through merging and adapting the best industrial and governmental standards and practices It Merges the fundamentals of information system security and the unique requirements of industrial automation and control systems Outlines highly effective structured defenses against real threats of cyberattack on critical infrastructure and essential manufacturing assets Presents a clear and implementable formula to defend crucial elements such as refineries chemical plants manufacturing operations power plants transportation systems and pipelines Examines the extant and emerging standards and guidelines including ANSI ISA IEC NIST and IEEE Addresses the unique requirements of industrial automation and control systems

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**Cyber Forensics** Albert J. Marcella,2021-09-13 Threat actors be they cyber criminals terrorists hacktivists or disgruntled employees are employing sophisticated attack techniques and anti forensics tools to cover their attacks and breach attempts As emerging and hybrid technologies continue to influence daily business decisions the proactive use of cyber forensics to better assess the risks that the exploitation of these technologies pose to enterprise wide operations is rapidly becoming a strategic business objective This book moves beyond the typical technical approach to discussing cyber forensics processes and procedures Instead the authors examine how cyber forensics can be applied to identifying collecting and examining evidential data from emerging and hybrid technologies while taking steps to proactively manage the influence and impact as well as the policy and governance aspects of these technologies and their effect on business operations A world class team of cyber forensics researchers investigators practitioners and law enforcement professionals have come together to provide the reader with insights and recommendations into the proactive application of cyber forensic methodologies and procedures to both protect data and to identify digital evidence related to the misuse of these data This book is an essential guide for both the technical and non technical executive manager attorney auditor and general practitioner who is seeking an authoritative source on how cyber forensics may be applied to both evidential data collection and to proactively managing today s and tomorrow s emerging and hybrid technologies The book will also serve as a primary or supplemental text in both under and post graduate academic programs addressing information operational and emerging technologies cyber forensics networks cloud computing and cybersecurity

**CISSP All-in-One Exam Guide, Eighth Edition** Shon Harris,Fernando Maymi,2018-10-26 A new edition of Shon Harris bestselling exam prep guide fully updated for the new CISSP 2018 Common Body of KnowledgeThis effective self study guide fully prepares you for the challenging CISSP exam and offers 100% coverage of all exam domains This edition has been thoroughly revised to cover the new CISSP 2018 Common Body of Knowledge hot spot and drag and drop question formats and more CISSP All in One Exam Guide Eighth Edition features hands on exercises as well as Notes Tips and Cautions that provide real world insight and call out potentially harmful situations Each chapter features learning objectives exam tips and practice questions with in depth answer

explanations Beyond exam prep the guide also serves as an ideal on the job reference for IT security professionals Fully updated to cover 2018 exam objectives and question formats Digital content includes access to the Total Tester test engine with 1500 practice questions and flashcards Serves as an essential on the job reference *CISSP All-in-One Exam Guide, Ninth Edition* Fernando Maymi, Shon Harris, 2021-11-12 A new edition of Shon Harris bestselling exam prep guide fully updated for the 2021 version of the CISSP exam Thoroughly updated for the latest release of the Certified Information Systems Security Professional exam this comprehensive resource covers all objectives in the 2021 CISSP exam developed by the International Information Systems Security Certification Consortium ISC 2 CISSP All in One Exam Guide Ninth Edition features learning objectives at the beginning of each chapter exam tips practice questions and in depth explanations Written by leading experts in information security certification and training this completely up to date self study system helps you pass the exam with ease and also serves as an essential on the job reference Covers all 8 CISSP domains Security and risk management Asset security Security architecture and engineering Communication and network security Identity and access management IAM Security assessment and testing Security operations Software development security Online content includes 1400 practice exam questions Graphical question quizzes Test engine that provides full length practice exams and customizable quizzes by chapter or exam domain Access to Flash cards *CISSP All-in-One Exam Guide, Seventh Edition* Shon Harris, Fernando Maymi, 2016-06-10 Completely revised and updated for the 2015 CISSP body of knowledge this new edition by Fernando Maym continues Shon Harris s bestselling legacy providing a comprehensive overhaul of the content that is the leading chosen resource for CISSP exam success and has made Harris the 1 name in IT security certification This bestselling self study guide fully prepares candidates for the challenging Certified Information Systems Security Professional exam and offers 100% coverage of all eight exam domains This edition has been thoroughly revised to cover the new CISSP 2015 Common Body of Knowledge including new hot spot and drag and drop question formats and more Each chapter features learning objectives exam tips practice questions and in depth explanations Beyond exam prep the guide also serves as an ideal on the job reference for IT security professionals CISSP All in One Exam Guide Seventh Edition provides real world insights and cautions that call out potentially harmful situations Fully updated to cover the 8 new domains in the 2015 CISSP body of knowledge Written by leading experts in IT security certification and training Features new hot spot and drag and drop question formats Electronic content includes 1400 updated practice exam questions

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