PIANC

The World Association for Waterborne Transport Infrastructure

PIANC InCom Work Group 192 | Status update May 2018

Developments in the automation and remote operation of locks and bridges

Contents

Introduction

The main objective of the new PIANC InCom Work Group 192 is to update the 2008 WG 96 report on 'Developments in the Automation and Remote Operation of Locks and Bridges' to reflect technological advancement and new considerations related to remote operation. Since the publication of WG 96 in 2008, significant technological advancements have been made at an increasingly rapid pace. Today, multiple ports and waterways have implemented remote operation technology or are planning this step in the nearby future. At the same time, events around the world have led to a much tighter security posture for marine and inland waterway transportation. This development has a significant impact on remote operation of locks and bridges.

The Work Group shall collect recent developments and case studies from different countries and will publish a comprehensive summary of lessons learnt and best practices that can be incorporated into the future design of remote operation of locks and bridges. Technical developments, organization of the chain of command, human factor engineering, traffic management, self-learning technology, simulation technology & certification of operators, security of the infrastructure and safety requirements will be some of the main topics, included in the final report.

The primary objective of this report is to assist companies, public organizations and operators who are approaching the upgrade of their security posture or want to implement remote operation of their structures. The report will provide them with the industry best practices so they can leverage the experience gained by other organizations.

This brochure is an intermediate status update and presents an overview of the topics covered in our Work Group and on best practices and technical developments concerning the latest developments in the field of automation and remote control relevant to their country. Further working activities, timeline and deliverables of WG 192 will be communicated through the PIANC websites, which are available for all PIANC members, port authorities, waterway organizations and technology partners.

As chairman of our WG 192, I look forward to the final deliverable of our work group to be available this autumn 2018. A last meeting will be hosted in Canada, where we also had our official kick-off in October 2016 in presence of Mr. Stephen Kwok, Vice-President Operations of St. Lawrence Seaway Management Corporation and sponsor of our Work Group.

I express my greatest appreciation for the personal commitment and the professional experience of all our work group members.

Lieven Dejonckheere
Chairman of PIANC InCom WG 192

Past & future meetings

The first meetings of PIANC WG 192 on 'Developments in the Automation and Remote Operation of Locks and Bridges' made clear that the work group is composed of members covering all expertise on the topic. The meetings at the St. Lawrence Seaway offices in Montreal (Canada), De Vlaamse Waterweg nv and Port of Antwerp (Belgium) and Lyon (France), already showed the recent developments and interesting case studies in these countries. These insights and developments were presented during the SMART Rivers Conference in Pittsburgh. Currently, the work group is working on finalizing the report.

The first three meetings included two days of discussions on all relevant topics of the report and visits to local remote control centres. Also, specific technical developments were presented to the Working Group. The Working Group was able to view the innovations at the lock in Montreal, where the St. Lawrence Seaway control centre is located. The locks of St. Lawrence Seaway are equipped with vessel self-spotting, self-positioning and hands-free moorings, to enhance safe and automated moorings. During the second meeting in Belgium, the Working Group made time to visit the construction site of the new lock in Harelbeke, as part of the European Seine-Scheldt project to improve and stimulate waterway traffic. Also, control centres of the Flemish waterway and the Port of Antwerp were visited. At our meeting in Lyon, visits were combined with report discussions, organised on a boat on the Rhone. A visit of the control centre of CGN, the simulator technology of CNR and a presentation of VNF's technical solution of user operation by the skipper, gave a very interesting idea of current technical developments. These visits, combined with the exchange of experiences and technical knowledge on developments in the automation and remote operation of locks and bridges, made our Working Group meetings very interesting.

The Working Group gave a preliminary insight on these experiences and gained knowledge on the PIANC SMART Rivers Conference in Pittsburgh, USA. The workgroup presented the activities and work done, giving an insight into recent developments and case studies from different countries covering automation and remote control of locks and movable bridges.

The first meetings of WG 192 focused on references and experiences in the field of automation and remote control of locks and bridges. During the meeting in Falkirk (UK) the Working Group members focused on writing down best practices and technical developments on all topics relevant to their country. The Working Group focused on the similarities and differences between all references. The best practices in this field were reviewed critically and recommended if and when appropriate as part of the final report. Important topics are, for example, the responsibilities of waterway managers, CE certification, differences in safety regulations and certifications (Europe vs USA/Canada), safety stops, remote control room design, instrumentation and automation systems, etc.

Past meetings

- Canada (Montreal): 26 October 2016 – 28 October 2016
- Belgium (Antwerp/Zemst/Harelbeke): 31 January 2017 – 01 February 2017
- France (Lyon): 18 May 2017 – 19 May 2017
- USA (Pittsburgh): 18 September 2017 – 22 September 2017
- UK (Falkirk): 02 March 2018 – 04 March 2018

Future meetings

- Panama: 07 May 2018 - 12 May 2018
- Germany: May/June 2018

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1. St. Lawrence Seaway Management Corporation, Montreal (Canada), October 2016
2. Centrale de Gestion de la Navigation, Rhône River, France, May 2017
3. Meeting in Falkirk, UK, March 2018

General overview members & countries

Canada

Leonard Swift

The St. Lawrence Seaway Management Corporation

United Kingdom

Jason Hudson

Royal HaskoningDHV
Enhancing Society Together

United States of America

Albert Barnes

TETRA TECH

Kathy Griffin

US Army Corps of Engineers.

France

Laurent Luchez

Cerema

Cyrille Chaussat

CNR

The Netherlands

Leon Uijttewaal

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

Ad Kloppenburg

Witteveen+Bos

Germany

Rainer Strenge

WSV.de
Wasserstraßen- und Schifffahrtsverwaltung des Bundes

Walif Achim Schneider

WSV.de
Wasserstraßen- und Schifffahrtsverwaltung des Bundes

Belgium

Lieven Dejonckheere

Flanders
State of the art

Michiel Coopman

De Vlaamse Waterweg nv

Wim Van Santvoort

Port of Antwerp

Kim Geylen

TRACTEBEL ENGIE

Presentation of individual members

Belgium

Michiel Coopman

Project Leader at De Vlaamse Waterweg nv

Michiel Coopman is a multidisciplinary skilled elektromechanical engineer with education in international economy and governement management. He joined De Vlaamse Waterweg nv in 2012 and since then was project leader in most major remote control engineering projects, such as the state-of-art control room in Zemst, where the Seacanal Brussels-Scheldt is operated. He is currently leading the development of a test and training simulator for remote control of locks and bridges, which will be placed in a new training centre. He specialises in control room and HMI design aswell as the impact of remote control on other aspects of the organisation, such as technical management, procurement strategy, training, bussiness processes and intra-organisational alignement.

De Vlaamse Waterweg nv works towards a dynamic management of the waterways in Flanders, Belgium, including the areas along it. De Vlaamse Waterweg nv stimulates the use of these waterways and this land, while taking into account the interests of all stakeholders involved and paying attention to sustainable growth, flood protection and integrated water management.

Wim Van Santvoort

Senior Program Manager at Port of Antwerp

Wim Van Santvoort started his career as engineer for locks and bridges at Port of Antwerp in 1988. Throughout his career, he was involved in several projects concerning the automatization of locks and bridges. Furthermore, Wim was an active member of PIANC INCOM WG N° 96 from 2005 -2008, where he followed and discussed the latest developments in the automation and remote operation of locks and bridges. Wim is since 2013 the senior program manager for the ARGUS project, where he is responsible for two sub-projects concerning remote control and automatization. In the first project, he is responsible for the development of a full scale Proof of Concept for the remote control of locks and bridges in the Port of Antwerp. The second sub-project concerns the development of a proof of concept concerning full automatic surveillance of lock doors and movable bridges before and during opening or closing.

*The 1,650 employees of the **Antwerp Port Authority** play an important role in the day-to-day operation of the port. They make sure the port is able to function and work on a sustainable future for the Port of Antwerp to ensure it can continue playing a leading role as an international seaport. The positions and responsibilities within the Port Authority are very diverse. The Port Authority manages and maintains the docks, bridges, locks, quay walls and land. It is also responsible for the efficient passage and safety of the shipping traffic in the Antwerp port area. It provides tugs, carries out dredging work and promotes the port in Belgium and abroad.*

Kim Geylen

Project Engineer at Tractebel

Kim Geylen works as project engineer at Tractebel in the department Ports & Waterways. She is specialised in the automation and remote control of port and waterway infrastructure, such as locks, movable bridges and pumping stations. In these projects, safety is one of the important parts, both the controlling of the compliance of the design with the Machinery Directive as the safety objectives specific for each project. Kim has developed a specific experience in the field of machine safety and the principles of risk assessment and risk reduction for port and waterway infrastructure. Kim has a key role in several automation and remote control projects for Belgian waterway and port authorities. She is involved in projects of full automatic bridge and lock operation (Port of Antwerp), remote control strategy of locks and bridges (Flanders waterway authorities), work load analysis of remote control rooms for inland navigation and optimal design and camera plan of the human machine interface (operator desk) for waterway infrastructure.

***Tractebel** is a multidisciplinary engineering and consultancy company. Tractebel supports their customers in both the private and public sectors in defining their strategic choices and master plans, advising them on how to create policy and feasibility studies, and in performing detailed engineering and project management. They offer these services in a variety of areas: regional and urban development, buildings, marine ports and waterway projects and transport infrastructure. Contemporary topics like climate change, energy efficiency and infrastructure intelligence are spearhead products. Waterways are an essential component in any sustainable transport system. Tractebel carries out feasibility studies, and does conceptual and detailed design for waterways and port (sea and inland) projects. Tractebel assists the authorities from master plan level down to tender specifications and detailed design (civil, electro-mechanical and E&I engineering). They have experts in the fields of locks and (movable) bridges, quay walls and barrages, dikes and bank protection, hydroelectric power stations, etc. To optimize the efficiency in waterway management, Tractebel offers consultancy in corridor management, automation and remote control of locks, movable bridges and pumping stations with attention to safety, reliability, availability, work load analysis, risk analysis, technical requirements and standardisation. Centralized control and further steps in automation will lead to a more efficient way of operation, a better control of the navigation on the waterways and a more efficient water management on rivers and canals.*

Lieven Dejonckheere

Advisor on inland navigation, waterways and transport logistics
Flemish Minister for Mobility, Public Works, Vlaamse Rand, Tourism and Animal Welfare
Government of Flanders

Lieven Dejonckheere has 20 years of experience in managing technology projects at the University of Ghent, in the aviation industry and in both the maritime and inland shipping sectors. He was responsible for remote operation of locks & bridges and for vessel traffic management on the inland waterways in Flanders at De Vlaamse Waterweg nv. Currently he is appointed as advisor to the Flemish Minister for Mobility, Public Works, Vlaamse Rand, Tourism and Animal Welfare within the Government of Flanders. As member of the cabinet of the Minister, he is responsible for inland navigation, inland waterways and transport logistics.

Government of Flanders, www.flanders.be

Canada

Leonard Swift

Manager at St. Lawrence Seaway Management Corporation

Leonard Swift has thirty-four (34) years of hands-on Electrical Engineering experience in designing, developing and implementing remote operation, automation and operator interface systems. Bailey Controls and ABB are where Leonard gained the skills and experience leading automation projects and managing engineering teams. Leonard came to the St. Lawrence Seaway Management Corporation (SLSMC) in early 2004 as the Senior Engineer and then Manager of the Operating Technology Department. During this period, Leonard was involved in the design and implementation of systems for the remotely operated bridges. In 2013, Leonard was asked to develop and promote a corporate technology roadmap describing the steps required to remotely operate the lock structures and a plan for future automation. Since 2014, Leonard has led the corporate design team responsible for the implementation and commissioning of the robotic vessel mooring systems and for the control system changes required to facilitate remote operation.

*The **St. Lawrence Seaway Management Corporation** is a not-for-profit corporation responsible for the safe and efficient movement of marine traffic through the Canadian Seaway facilities, which consists of 13 of the 15 locks between Montreal and Lake Erie. The Corporation plays a pivotal role in ensuring that the waterway remains a safe and well-managed system, which it shares with its American counterpart, the Saint Lawrence Seaway Development Corporation. The Corporation's mandate promotes efficiency and responsiveness to the needs of shipping interests, ports, marine agencies, and provincial and state jurisdictions.*

France

Laurent Luchez

Project Manager at Cerema

Laurent Luchez is a 25 year experienced civil engineer in the field of inland waterways. He is an expert in the automation and remote control of locks and bridges, in the water level management (including hydraulics and dam management), and is also a specialist of the geotechnical works issues (riverbands, canal dikes and reservoirs). He has been working at the "Water, Sea and Waterways" direction of the Cerema, in Compiègne, since 1991.

__Cerema__ (Centre for Studies and Expertise on Risks, Mobility, Land Planning and the Environment) is an interdisciplinary scientific and technical resources center, placed under supervision of the ministries in charge of sustainable development, town planning and transportation. In addition, representatives of local authorities sit on Cerema's board of directors. Thanks to its strong regional footing, Cerema is able to connect the needs and policies of central government, government's decentralized offices, local authorities and of all those who contribute to implementing public policies. Cerema supports the energy transition in France.

Cyrille Chaussat

Chief of the Rhone Traffic Management Centre

Cyrille joined CNR in 2007, where he started as Chief Safety Officer. Since july 2015 he is the chief of the Rhone Traffic Management Centre, which remotely controls 14 large gauge locks on the Rhône. In this role, he is responsible for a team of 40 employees and the correct implementation of the rules, procedures and instructions relative to the exploitation , safety and security of the center. Furthermore, Cyrille is in charge of the further improvement of the navigation process and is in close contact with both the French authorities (Voies navigables de France) as well as customers (excursion boats, commercial vessels,..). Concerning automatization and remote control, Cyrille has extensive expertise in the navigation process, especially in the areas of regulation, customer contact and IT systems (control, video, audio and IP network systems).

The __Compagnie Nationale du Rhône (CNR)__ designed and now operates the Rhône Traffic Management Centre in Châteauneuf du Rhône. Since 2012 the Centre remotely controls 14 wide gauge locks on the Lower Rhone on a 24/7 basis. This innovative system, the only one of its kind in France, satisfies three main challenges: guaranteeing maximum safety on the Rhône through increased monitoring of the installations, improving information for the users of the Rhône by providing full information on traffic in real-time and improving the service available for skippers by optimizing lock passages (less than 20 min). With a monitoring system that operates 24/7 (video, VHF, telephone), the Navigation Management Centre provides permanent surveillance along the navigable section of the Rhône and increases the safety of lock operations

Germany

Rainer Strenge

Head of Traffic Technologies Centre at the German Federal Waterways and Shipping Administration

Rainer Strenge is heading the Traffic Technologies Centre (TTC). After receiving a university degree in electrical engineering he joined the Administration in 1990. His professional career started at the regional office Cuxhaven where he was in charge of the Elbe VTS renewal and gained experiences in leading technical projects. Since he moved to Koblenz TTC he has been involved in various remote operation projects and in the development of standards for remote systems and operation centers. He has also expertise in the implementation of River Information Services (RIS) on German inland waterways.

Walif Achim Schneider

Project engineer at the German Federal Waterways and Shipping Administration

Walif Schneider is project engineer in the Traffic Technologies Centre which is part of the German Waterways and Shipping Administration. His expertise is in automation of locks and weirs. He supports the German Ministry of Traffic and Local Offices in in the wide field around automation, simulation of technical plants, test of PLC-software and EU Directive on Machinery respectively risk assessment. He is also involved in the work of several national working groups for the development of standards for automation and remote control concepts and systems. He is currently head of working group "Machine Safety" in charge to update the national guideline with regard to safety issues considering locks and weirs.

*The Traffic Technologies Centre (TTC) is an engineering and consultant office of the **German Federal Waterways and Shipping Administration**. TTC, located in Koblenz next to the two international waterways Rhine and Moselle River, was established to support all sections of the German Federal Waterways and Shipping Administration. TTC is also an advisor for the Ministry of Transport and Digital Infrastructure (BMVI). The various fields of competencies include electrical and mechanical engineering for locks, weirs, ship lifts etc. Further activities comprise all kind of aids to navigations and also systems with regard to the implementation of River Information Services (RIS).*

The Netherlands

Leon Uijttewaal

Lead Architect at Rijkswaterstaat

Leon Uijttewaal is working for 10 year at Rijkswaterstaat in the function of Lead architect for the development of "building blocks" for operating and control systems in the infrastructure. Infrastructure such as, locks, movable bridges, surge barriers, tunnels and Trafficcenters. He is also specialized and TuV certified Machinery Safety Expert for the machinery in the infrastructure. Previous employers are Frames Energy Systems (Oil & Gas), Province Zuid Holland (infrastructure) and Strypes Netherlands (Consultancy).

***Rijkswaterstaat** is part of the Dutch Ministry of Infrastructure and the Environment and responsible for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands. This includes the main road network, the main waterway network and the main waterways.*

Ad Kloppenburg

Electrical Engineer at Witteveen+Bos

Ad Kloppenburg is since 1988 employed at Witteveen+Bos. He is now a senior consultant for electrical installations in inland water transport related structures such as movable bridges, navigation locks, tunnels under rivers and canals. He was involved in several major projects such as the inspection and preparation of a tender for the Djerdap navigation locks overhaul in Serbia and the design and cost calculation of the 18 km long immersed Fehmarnbelt tunnel between Germany and Denmark. As a member of a big international team in 2013 he carried out a conceptual design and validation of the electrical and mechanical installations of the Sharq crossing Doha, Qatar. He was also active in remote control related projects, such as the supervision, review of contractor documents, testing and commissioning of a remote command control center for 5 bridges and 10 navigation locks in Lelystad. Ad also carried out several feasibility studies including conceptual design and cost estimate for the remote control of 11 movable bridges from one command and control center in the province Fryslân in the Netherlands.

***Witteveen+Bos** is a company based in the Netherlands that provides consultancy and engineering services worldwide in the fields of infrastructure, water, the environment, spatial development and construction. Their multidisciplinary approach to projects is the distinctive feature of the way they work. Their clients are governmental, commercial and industrial organisations, including various types of joint ventures and public-private partnerships. Witteveen+Bos serves their clients from six offices in the Netherlands and ten international offices. The company has a workforce of more than 1000 specialists. They take pride in delivering quality. Partnership is their keyword – partnership with clients and with Witteveen+Bos. Personal development and acquiring new expertise are key drivers because the work constantly demands new knowledge and responsibilities. Employees feel at home at Witteveen+Bos because it is a company firmly committed to delivering quality and making an extra effort for the clients and personnel.*

United Kingdom

Jason Hudson

Principal Electrical Engineer at RoyalHaskoningDHV

Jason is a Chartered Electrical Engineer with 25 years' experience working within a wide range of industries in the UK and overseas, with a particular focus on large moving structures. Prior to joining Royal HaskoningDHV, he was employed by the Canal & River Trust (formerly British Waterways) where he was responsible for the safe automation of their canal and navigation locks and bridges. His experience includes feasibility studies, design, specification preparation, and commissioning and inspection work associated with link spans, water control equipment (valves, gates and penstocks), moving bridges, dock and lock gates, port and dockyard moving machinery and associated systems. His particular interest is in the design of control systems used in safety applications. He is apprentice trained and a Member of the Institute of Electrical Engineers and has European Engineer Status through Membership of FEANI. Jason is keen to promote good practice and share his knowledge by representing the UK on the PIANC WG192 - Developments in the Automation and Remote Operation of Locks and Bridges.

***Royal HaskoningDHV** has been making a world of difference in people's lives since 1881. As an independent international engineering and project management consultancy, they have been working with clients to successfully deliver projects which contribute to improving living circumstances around the world for 135 years. The 6,000 colleagues, spread over 150 countries are committed to the promise to enhance society together.*

United States of America

Albert Barnes

Senior Electrical Engineer at Tetra Tech

Albert Barnes is a senior electrical engineer for Tetra Tech. He has 24 years of experience in the design and commissioning of electrical and controls systems for heavy industrial projects. He has spent the last 8 years at Tetra Tech working on a variety of projects involving lock, dam, pump station, and floodgate electrical and control systems including the new locks for the Panama Canal and hurricane flood risk reduction for New Orleans.

__Tetra Tech__ is a full-service consulting and engineering firm with offices and operational infrastructure throughout the United States, Canada, and abroad. With 16,000 associates in 400 offices in more than 110 countries on six continents, Tetra Tech's technical knowledge and hands-on site work is broad and deep. Tetra Tech's innovative, sustainable solutions help our clients reach their goals for water, environment, energy, infrastructure, and resource management projects. Tetra Tech has been ranked #1 in Water for 14 consecutive years by Engineering News-Record. The Global Infrastructure Design group within Tetra Tech specializes in innovative planning, engineering, and design solutions for inland navigation, waterfront, ports, dams, and levees, hydropower, and flood control.

Kathy Griffin

Deputy Chief Operations and Regulatory Divison at US Army Corps of Engineers, Pittsburgh District

Kathy Griffin is an experienced technical leader with the U.S. Army Corps of Engineers. She joined the Buffalo District as an intern with the Regulatory program and currently serves as the Pittsburgh District Deputy Chief, Operations and Regulatory Division. Kathy combined her education in Biology and Regional Planning with diverse work experience in the Corps to develop skills in organizational leadership, strategic thinking, program management, collaborative problem solving, and continuous improvement.

Her experience in the Corps Regulatory program established a strong commitment to public service and ability to serve as the "honest broker" balancing the value of economic development and water resource protection. Additional experience managing the operation and maintenance of navigation infrastructure on both the Great Lakes and Inland Marine Transportation System, provided Kathy with unique skill sets that enable her to lead an enterprise approach to asset management. A key leader on the Great Lakes Navigation Team, Kathy introduced and led the implementation of numerous initiatives and business practices that enabled the Corps Great Lakes Districts and navigation stakeholders to manage individual Great Lakes harbors as a system.

Her leadership has been key to increased Federal investment on both these systems. With experience in Operations and Maintenance, Regulatory, Emergency Management, Engineering, Construction, Programs, and Project Management, Kathy has a broad knowledge of the Corps Civil Works Programs. In addition to completing two developmental assignments at the Corps Headquarters Office in Washington, D.C., she deployed to Afghanistan in 2011 where she served as the Afghan National Security Forces Program Manager.

As the U.S. Representative for The World Association for Waterborne Transport Infrastructure (PIANC) remote and automated lock operation working group, Kathy continues to lead continuous improvement of the nation's waterborne transportation system.

The United States Army Corps of Engineers *is a U.S. federal agency under the Department of Defense and a major Army command consisting of 37,000 civilian and military personnel. The corps' mission is to "Deliver vital public and military engineering services; partnering in peace and war to strengthen our Nation's security, energize the economy and reduce risks from disasters." The most visible missions include:*

- *Planning, designing, building, and operating locks and dams. Other civil engineering projects include flood control, beach nourishment, and dredging for waterway navigation.*
- *Design and construction of flood protection systems through various federal mandates.*
- *Design and construction management of military facilities for the Army, Air Force, Army Reserve and Air Force Reserve and other Defense and Federal agencies.*
- *Environmental regulation and ecosystem restoration.*

InCOM

InCOM is one of the 4 international technical commissions of PIANC (Permanent International Association of Navigation Congresses) concerned with inland waterways and ports and focusses on:

- Inland navigation
- Inland waterways
- River and port infrastructures
- Inland waterway transport and logistics
- …

InCOM commission comprises many different working groups including:

Name	Status
WG 207 - Innovations in ShipLift Navigation Concepts	First Stage
WG 206 - Update the Final Report of the International Commission for the Study of Locks	First Stage
WG 203 - Sustainable Inland Waterways A Guide for Waterways Managers on Social and Environmental Impacts	First Stage
WG 201 - Development of a Proposal of Inland Waterway Classification for South America	First Stage
WG 199 - Health Monitoring for Port and Waterway Structures	First Stage
WG 198 - Saltwater Intrusion Mitigations and Technologies for Inland Waterways	First Stage
WG 197 - Small Hydropower plant in Waterways	First Stage
WG 192 - Automation and remote operation of locks and bridges	**In Progress**
WG 191 - Composites for Hydraulic Structures	First Stage
WG 190 - Corrosion Protection of Lock Equipment	First Stage
WG 189 - Fatigue of Hydraulic Steel Structures	In Progress
WG 179 - New Ships in the CEMT 92 Classification	Final stage
WG 173 - Movable Bridges and Rolling Gates	Published
WG 166 - Inflatable Structures in Hydraulic Engineering	Final stage
WG 156 - E-navigation for Inland Waterways	Published
WG 155 - Ship behaviour in locks and lock approaches	Published
WG 154 - Mitre Gate Design and Operation	Published
WG 151 - Impacts of seismic loads and ship impact on lock gates	Published
WG 141 - Design Guidelines for Inland Waterways	Final stage
WG 140 - Semi-probabilistic design concept for inland hydraulic structures	Published
WG 139 - Values of Inland Waterways	Published
WG 137 - Resilience - Flood Defense Systems (2014)	Published
WG 128 - Alternative Technical-Biological Bank Protection Methods for Inland Waterways	In Progress
WG 125 - River Information Services	In Progress
WG 106 - Innovations in Navigation Lock Design (2009)	Published
WG 101 - Movable Weirs and flood Barriers (2006)	Published

More information on InCOM and the working groups can be found on: http://incomnews.org/

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Table of content of the WG192 Report

Work group 192 will deliver a final report in 2018, covering the following topics.

Business case development for remote control
- Value of investment vs benefit
- Traffic management
- User references

Organisational implementation
- Changes within the organisation
- Service model to customers
- Interaction with the public

Operational implementation
- Process definition
- Procedures
- Operator skills
- Control room design

Technical implementation
- Rules & Regulations
- System architecture
- Technical developments

Safety
- Reliability
- Operational safety
- Technical safety requirements
- Technical safety solutions

Security
- Perimeter protection
- Cyber security
- Traffic monitoring

Business continuity
- Redundancy
- Failure modes & support model

Traffic management

Information management
- (Big) data analysis
- Reporting and statistics

Recurring issues regarding remote control and automation

Reference projects

PIANC Work Group 192 relies on the wide, varied and in-depth experience of its members.

On the following pages, a selection of reference projects, that were realized by the individual members, are listed. These examples are an illustration of the rich and diverse expertise of the members of the work group. In case of questions or if additional information is required concerning the reference projects, feel free to reach out to the relevant members of the working group by means of the contact information at the end of this brochure.

Belgium | De Vlaamse Waterweg nv

Automation of Waterways: Training and Reference Centre (AWATAR)

Name project AWATAR (Automation of Waterways: Training and Reference Centre)
Location Gentbrugge, Belgium
Duration Building the training center: 6 months of design, 1 year of construction. Designing and building the simulator: 6 months of design, 1 year of construction.

Goal of the project

Developing technical, functional and operational standards for remote operation of bridges and locks, integrating them into a training simulator and setting up a training course for operators.

Project summary

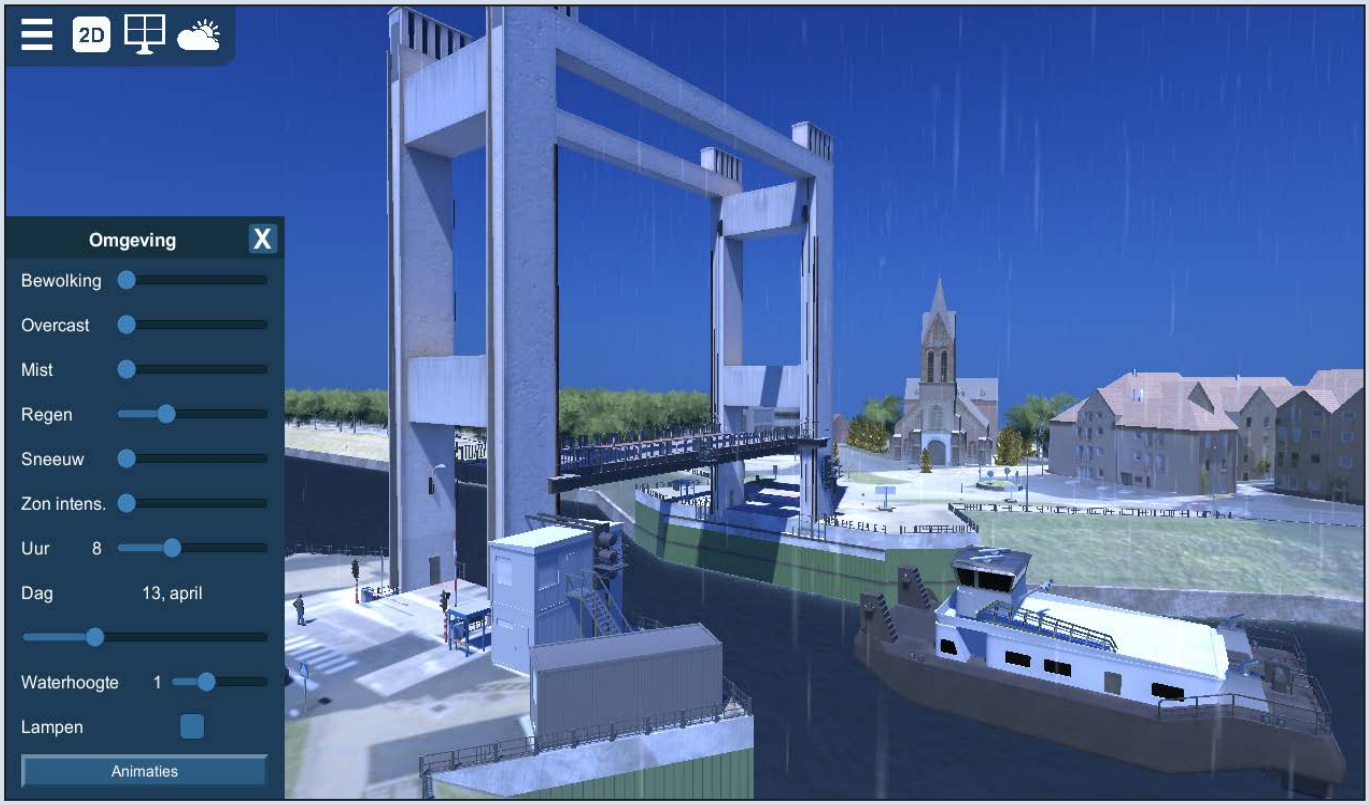
De Vlaamse Waterweg nv is currently working on the development and implementation of a simulator for the remote control of locks and bridges. The simulator will be built in a special designated AWATAR-center. A virtual world of waterways with different types of locks and bridges is created within the simulator. These virtual locks and bridges can be operated from a reference control room, serving as a realistic representation of a real control room. The purpose of the AWATAR-project is to streamline and standardize the way in which infrastructure is automated as well as operated remotely, by creating reference designs as well as standardized operating procedures.

More specifically, the simulator serves as an aid for:

- co-creating a user-centered and standardized human-machine interface in cooperation with experienced operators;
- evaluating and fine-tuning of operating procedures and functional specifications;
- drawing up the functional and technical standards for remote control operation;
- training new and experienced operators on how to operate installations remotely, in both normal as exceptional circumstances;
- creating buy-in for all personal involved in the transition process;
- facilitate and speed-up the technical conversion projects from manual/local control to remote/central control by virtually prototyping and testing items such as camera viewing-angles, specific HMI's, functional safety.

Realized advantages and benefits

- Within De Vlaamse Waterweg nv there are many geographical differences in the technical realization of remote control. Thanks to the AWATAR-project, the approach on how to implement remote control is streamlined and made simpler. Specific attention is paid to sharing best practices, ensuring the use of economies of scale and an efficient roll-out of remote control.
- The use of detailed, uniform and standardized technical and operational specifications increases safety and at the same time increases the flexible deployment of personnel across installations and control rooms.
- Furthermore, new work stations and procedures are tested beforehand which enables savings in terms of time and money in realizing remote control projects.
- The AWATAR simulator also serves as a tool to provide training and instructions for the operators with the goal to build trust and cooperation. This is of vital importance to mitigate reluctance to this new form of remote/central operation.



Lessons learned

- The simulator must closely resemble the existing technical installations, so modifications and improvements can be tested first on the simulator. Furthermore, AWATAR is designed in a multifunctional and modular way, so it allows for fast and easy adaption to new ideas and technological evolutions.
- The use of contractors with firsthand experience in automation and remote control of bridges was found crucial.
- In the design of the simulator, various co-creation workshops were organized together with the operators. The results of these workshops contributed in composing the detailed design of the AWATAR simulator and are crucial for future remote control projects. During these workshops, several modern techniques such as 3D modeling, VR glasses and eye-tracking glasses were utilized
- The use of these techniques was found very helpful as they facilitate and deepen discussions and allow testing and evaluating.
- This trajectory of co-creation takes time but really improves the quality and usefulness of the project.

Belgium | De Vlaamse Waterweg nv

Traffic Centre Zemst

Name project Traffic Centre Zemst
Location Zemst, Belgium
Duration In te vullen

Goal of the project
The automatization and remote control of multiple movable bridges, locks and waterbound infrastructure in a traffic center.

Project summary
To create added value for logistics service providers and transport by inland navigation, De Vlaamse Waterweg nv invests in automation, remote control of locks and bridges in intense collaboration with waterway users and port companies. A resilient infrastructure and reliable locks and bridges make it possible to shift towards remote control centers with active vessel traffic services and optimized operation times for the waterway users. This corresponds to the principles of efficient corridor and shipping traffic management on the Flemish waterways. Moreover, it contributes to the optimization of the connection with international waterways.

The Zemst traffic center operates the movable bridges, within the VTS-area, along the Brussels–Scheldt Maritime Canal. The center, which came into use in 2016, is now regarded as the reference for remote operation control centers within De Vlaamse Waterweg nv. Thanks to innovative and state-of-the-art technologies all locks and bridges are being operated with high redundancy and efficient control. In the construction of the center a lot of attention was given to the design of the remote control rooms. Furthermore, the work load of operators, ergonomic factors, communication, camera images, SCADA and desk setups were taken into account. These topics were the subject of several workshops with the operators, in order to give them a voice in the design and lay-out of the traffic center.

Decisive for the success of the remote control center is the function of the VTS-operator, who is responsible for the functioning of the traffic center and its operational management. The VTS-operator monitors and regulates traffic flows and is responsible for collecting, recording and disclosing information to ensure safe shipping traffic. This person is also responsible for the communication and planning between different traffic centers and hence other VTS-operators.

Realized advantages and benefits
By organizing the operation of locks and bridges on a corridor level from a central remote control center, the following benefits were achieved:

- Improved traffic flow thanks to better coordination between different locks and bridges in the corridor allowing faster, more efficient and safer shipping.
- Expansion of operating times since remote control centers enable operators to control locks and bridges 24/7.
- Coordinated approach towards operational shipping assistance and water management. In the event of calamities coordinated actions can be organized in a quicker and more efficient way.
- A higher level of safety and protection for shipping, operating personnel and third parties.
- Overall improvement of service provision thanks to a more efficient and uniform method of operation. This leads to more a reliable and qualitative service with fewer failures.

Lessons learned

- Remote control centers require different approaches and work methods compared to the operation of local infrastructures since operators are faced with highly complex traffic situations and tasks compared to a locally operated bridge or lock.
- Hence, specific attention and time need to be dedicated to the transition from local operation to remote control operation. The employees need to be prepared, but also given a voice in this process in order to gain acceptance and commitment.
- Finally, there is also the need to invest in the training of remote control center staff and VTS-operators since they constitute the base for good and timely operation and efficient shipping traffic management.

Remote control in the Port of Antwerp

Name project ARGUS – subproject remote control
Location Antwerp, Belgium
Duration 2013 Q1 - 2018 Q1

Goal of the project

1. Investigating whether there are reasons why a centralized control of the Antwerp locks and movable bridges would prove impossible.
2. Building a simulator.
3. Design and build a prototype control room desk and implement the necessary changes and extensions to the technical installations of the Noordkasteel bridges and of the Boudewijn- & Van Cauwelaert lock complexes.
4. Try different organization alternatives and gather experience in how to run a remote control center.
5. Learn as much as possible in order to be thoroughly prepared for the technical roll out.

Project summary

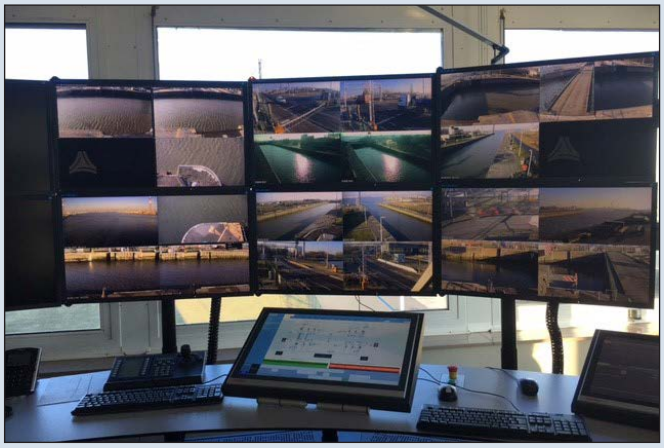
The Argus project analyses the different technical possibilities for productivity improvement of the movable locks and bridges in the Port of Antwerp. To study remote control, a proof of concept, reflecting realistic circumstances on real-scale, was designed in order to study how the control room of the future should look like. This proof of concept consisted out of different parts:

- Design and build of 5 prototype control room desks.
- Developing standards for the design, lay out and use of an elaborate CCTV installation.
- Adapting and/or extending the on site installations of a bridge and lock complexes that are representative for the rest of the locks and bridges in the port concerning aspects like size, density and complexity of traffic (both land and water bound), technical complexity.
- Design and build a performant redundant fiber optic WAN, using dark fibers of the existing network of the PoA. This network is solely dedicated for the remote control of the locks and bridges.
- Perform load tests while simulating the simultaneous load of all installations.

To evaluate the new way of working and the design of the operator desks, a simulator was build. This was designed to have the same look and feel as a real operator desk. The simulator was used to provide a development environment that mimics the real life installation in great detail for automation and CCTV. It is also used as a collaboration tool between operators, automation engineers and ergonomics engineers.

Realized advantages and benefits

- Consensus among operational departments that there are no counter-indications that indicate that remote control of locks and movable bridges is impossible in the port of Antwerp.
- New standards developed and tested for the layout of control desks, CCTV-topology, WAN, SCADA and local installations.
- Simulator for training of operators and development and testing of PLC and SCADA software.



Lessons learned

- Stimulate close operation between Operations and Automation departments.
- Invest time in open communication with internal stakeholders.
- Human machine interface is a matter of great importance.
- Modern technology offers ample opportunities.
- Technical problems are almost always solvable but change management is difficult.

Belgium | Port of Antwerp & Tractebel

Full automatic surveillance for Port of Antwerp

Name project Full automatic surveillance of movable bridges and locks
Location Antwerp (Belgium)
Duration PoC 2.0 will be executed in 2018

Goal of the project

Design of a full automatic control system for all movable bridges and locks in the port of Antwerp.

Project summary

To anticipate the development of maritime logistics, the Antwerp Port Authority has started the 'ARGUS project'. This project is a quest for technical opportunities for an improvement in productivity of the operation of movable bridges and locks.

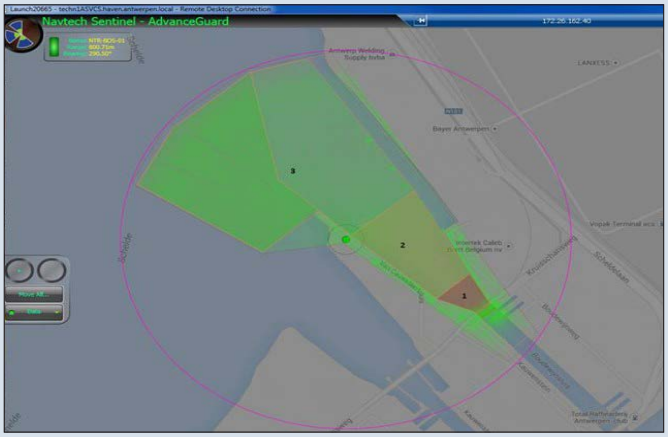
The goal of the ARGUS project is a full automatic control of all movable bridges (ca. 30) and locks (7) in the port of Antwerp. Engineering consultancy company Tractebel Engie was assigned to design an automated control system for all movable bridges and locks of the Port of Antwerp. This system should ensure a safe supervision of different areas of movable bridges and lock gates, where pedestrians, vehicles and vessels may be at risk before, during and after the movement to open or close the bridge / lock gate. This supervisory task is currently done by a local operator relying on cameras. The goal is to automate this task by means of equipment which can reliably detect objects, people, vehicles and ships in the areas at risk.

In a first project phase, the possibility was studied to design a type of automatic control system which can screen, control and operate the full automatic operation of locks and bridges. By advancing insights, the original objectives have been adjusted and the Proof of Concept installation was designed to compare and evaluate different types of detection systems, measurement principles and technologies, and comparable technologies from different suppliers.

The difficulty of this feasibility study and search for applicable detection systems is to verify if new technologies on the market can be successfully combined into a new system which complies with the constraints of the port regarding reliability, the safety regulations and the European machinery directive.

Realized advantages and benefits

By testing different detection technologies in a proof of concept installation, the Port of Antwerp and Tractebel are in continuous contact with multiple suppliers. These important contacts give the advantage of hands-on information on possible new developments. This proof of concept installation can be the start for certain suppliers to invest and (re)develop their instruments according to the safety regulations for machinery in outdoor conditions like movable bridges and locks.



Lessons learned

- The proof of concept has resulted in a first selection of possible applicable detection systems. E.g. the tested LIDAR Laser Scanners, microwave barriers and radar scanners were evaluated to be very accurate. Technologies based on Video Content Analysis were more focussed on security applications and are therefore not (yet) applicable for safety solutions. But even for the more accurate detection technologies, currently, there is no product fully applicable. For the use in a full automatic control system, the detection systems need further development for this specific combination of safety SIL certification and reliability in the specific, outdoor environment.
- The proof of concept installation will be updated according to the test results in combination with new technologies, e.g. high-frequency radar technology and electrostatic sensors. These technologies will be further tested as PoC 2.0 in 2018.
- During this PoC 2.0, not only detection technologies will be tested and compared, also the environmental requirements will be taken into account. The sensor performance will be analysed for different environmental conditions, rain, snow, fog, etc.

Canada | St. Lawrence Seaway Management Corporation

Hands Free Mooring System

Name project Hands Free Mooring System
Client Canadian Government (Transport Canada)
Location Canada
Duration April 2012 - March 2018

Goal of the project

The Remote Operation project currently undertaken by the St. Lawrence Seaway Management Corporation intends to add remote operation of lock structures to the existing Operation Control Centers.

Project summary

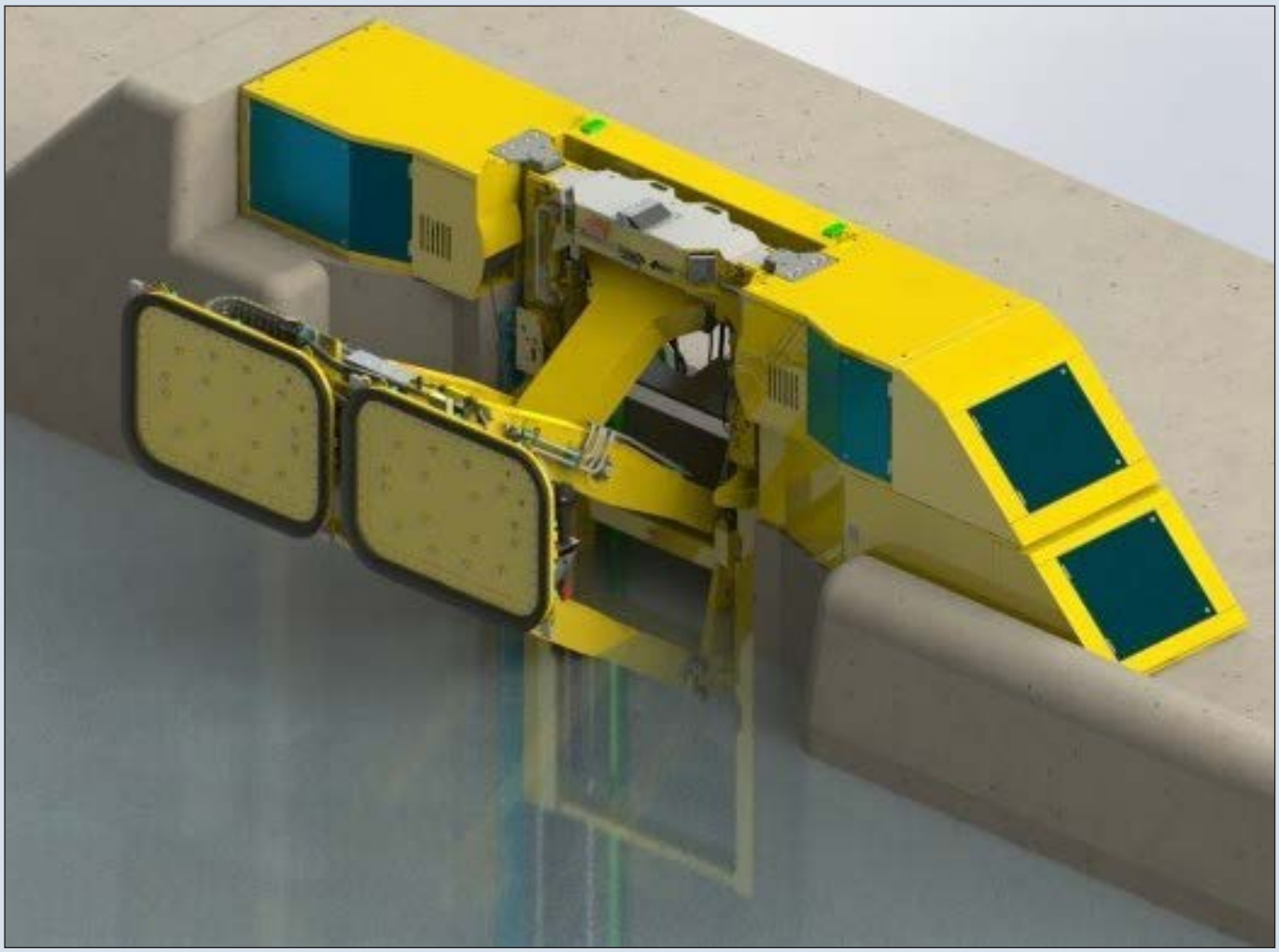
As part of the Remote Operation project, different modernization programs are considered key in the achievement of the corporate business plan. One of the main modernization program projects is the installation of a Hands Free Mooring System. The mooring system was designed to replace the steel cables used to moor vessels during the lockage process for many decades. Primary to the design were the safety aspects of protecting workers and users from the danger of cable breaks. Additionally, the physical effort required to handle the steel cables was an increasing source of injury to the staff. Lastly, the elimination of the requirement for vessels to be outfitted with steel cables allows a greater percentage of the world fleet to successfully transit the system.

The Hands Free Mooring System is comprised of automated mooring robots which employ vacuum pads to hold the vessel in position during the lockage process. The system was designed to provide 20 tons of holding force per suction pad and there are three double pad systems installed at each lock. Two mooring machines (four pads) were deemed to be sufficient to replace the steel cables previously required to moor full size vessels. A third mooring machine was added to provide spare capacity for maintenance cycles and to accommodate vessels with hulls that make it difficult to achieve a proper vacuum seal.

The automated mooring system is being integrated into the lock automation system to make it more effective. Data from the Traffic Management System will automatically be sent to the mooring system as the vessel approaches the lock. This data will indicate how many vacuum pads are required to achieve the minimum system capacity to safely process this specific vessel. Also, the data will include the initial vacuum pad position (height above the water) where the mooring system can have the best chance to successfully attach to the vessel.

Realized advantages and benefits

- The elimination of the use of steel mooring wires has increased the number of vessels in the world fleet that can now transit the St. Lawrence Seaway system. It is estimated that the number of potential vessel calls has now expanded from 800 vessels to more than 8000 vessels.



- Not using steel wires has eliminated a significant health and safety risk to which customers and employees were exposed every day.
- The elimination of wire lines has allowed the vessels to reduce the number of crew members required on deck during a canal transit. They have not only realized this as a direct cost savings, but also reduced the need for "safety rest".
- The installation of the Hands Free Mooring systems has facilitated the move of the lock operators from each lock into the control center. The St. Lawrence Seaway has remotely managed vessel traffic and operated large movable bridges from the control center for ten years. Moving the lock operators into the control center has improved working conditions, collaboration and communication between operations staff. The move has also facilitated the reduction of operations staff from three employees per lock to a single employee (operating either locally or remotely).

Lessons learned

The Hands Free Mooring system was developed and enhanced over a nine year period and five major design prototypes. The initial designs proved the concept of using a vacuum pad to moor a vessel. Also, each design iteration provided valuable insights into the mechanical energy exerted by large vessels. Subsequent changes to lock fill and dump sequences allowed the processing of a vessel to be similar time duration to that of using steel wires. Designing a mechanical rail system which allows the vacuum pads to travel approximately 14 meters, the height of a deep lock, was challenging. Integrating this rail system into the lock wall structurally was also a challenge.

Remote terminal for the small locks operation

Name project Remote terminal for the small locks operation
Client Voies navigables de France (VNF)
Location French waterways
Duration To be completed

Goal of the project

The main goals are :

- to be compatible with the old systems for a progressive deployment,
- to implement a certified safety stop,
- to be easily adaptable to other uses (operating moveable bridges, provide information for big data, give traffic information, perform tourism information,...),
- to use standards, and when it's not possible, to be the property of the network manager, both hardware and software.

Project summary

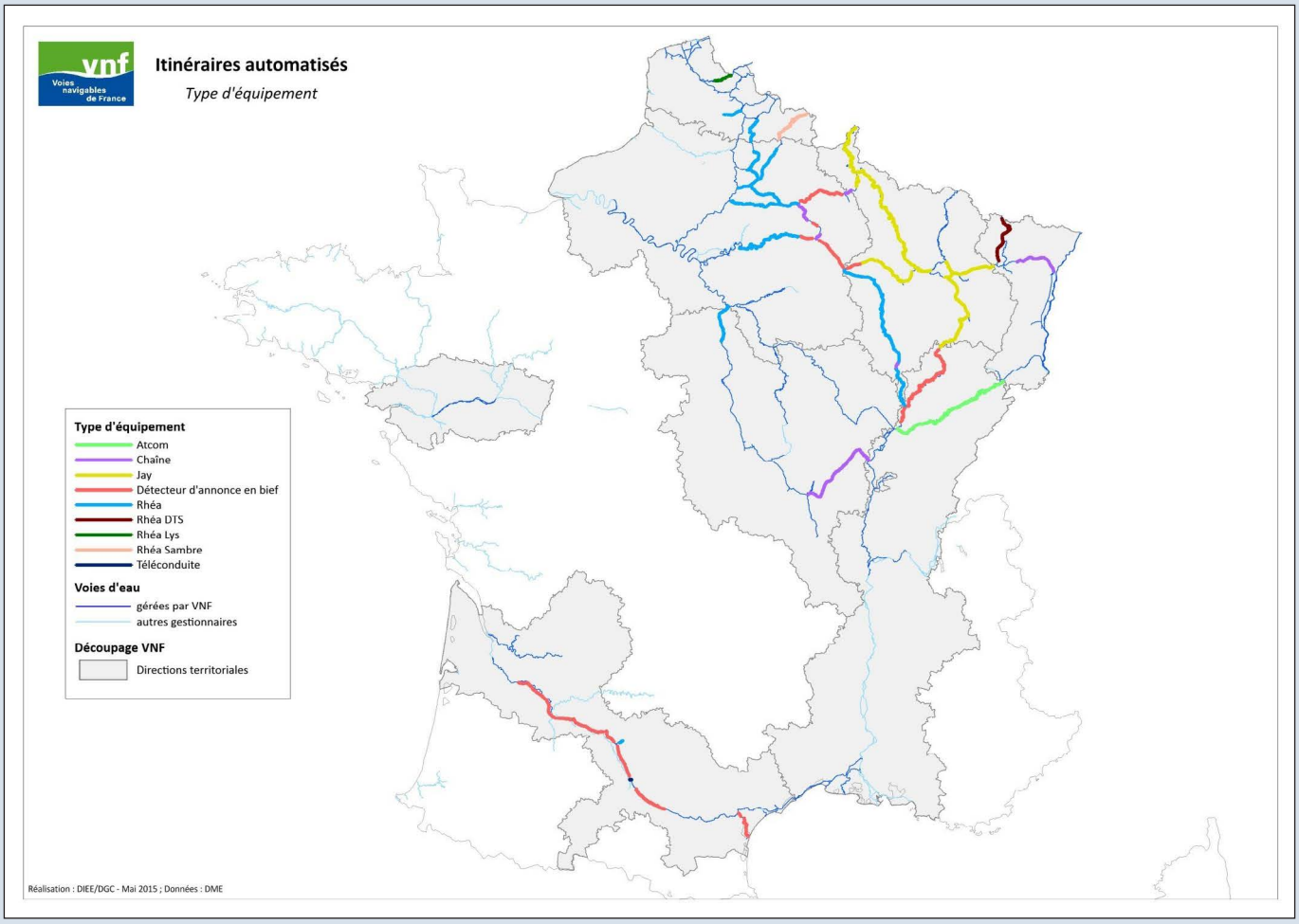
The French waterway network is 8500 km long. More than three quarters of this network was built during the 18th century. The (approximately 1500) locks of these canals are 40 meter-long and 5 meter-wide, and are mostly used by leisure navigation. The locks are automated, to keep a good amplitude of operating hours, even in winter when only few boats are on the canals. The users are generally equipped with a remote terminal to ask for lockage.

Different remote terminals have been built since the end of the 1900's, and Cerema and VNF decided to design a new 'smart' remote terminal. The remote terminal is called SCUO – (Communication System between the User and the Infrastructures), and is a concentrate of technology; 433 MHz and 866 MHz radio systems, GPS, GSM, safety buttons, submersion detection, updating software,..

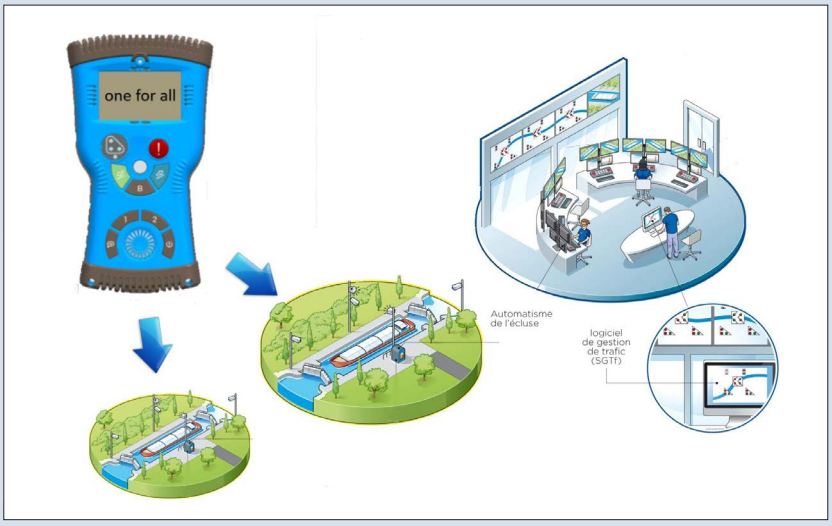
The terminal was designed under the control of a national expert group, led by VNF and Cerema. After two iterations and many tests, the design of a final compact version is in progress.

Realized advantages and benefits

Concerning the terminal, the benefits are classical benefits of standardization: compatibility, maintenance, development costs. Concerning the system, the connection to RIS is a big step to know the user and systems behavior and to define the future operation mode choices.



Above: Bold lines represent the automated sections of french canals (Freycinet size – 350 tons). Different colors mean different PLC's. The SCUO's terminal can operate every lock of this network.
Right: The SCUO principle: remote terminal - PLC - communication system - control room - RIS.



Lessons learned

- SCUO v2 was modular designed in order to find more easily the origin of potential malfonctions. Gathering fonctions in a single equipment (one of SCUO v3 aims) will reduce costs and needed space for electrical cabinet.
- SCUO v2 was very comprehensive for navigation regulation, with a complex algorithm to give priority to one or another user. In fact, the rules are well applied by the users themselves, and a simple and resilient software is easier to implement and better for safety validation.

France | Rhône Traffic Center

Design and construction of the Rhône Traffic Management Centre

Name project Design and construction of the Rhône Traffic Management Centre
Client Compagnie Nationale du Rhône (CNR)
Location Châteauneuf-du-Rhône, France
Duration /

Goal of the project

Remote control for gauge locks from one central location in Châteauneuf-du-Rhône.

Project summary

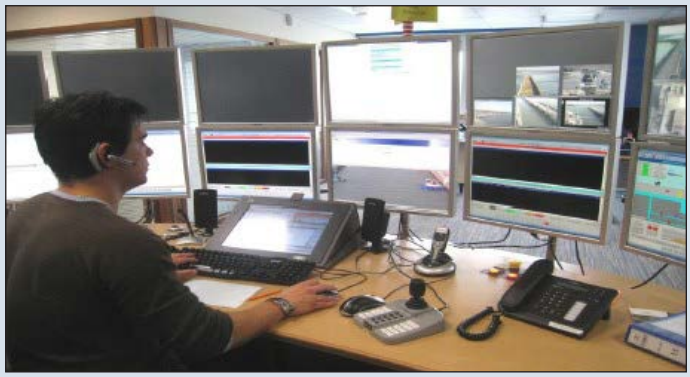
The Compagnie Nationale du Rhône has designed the Rhône Traffic Management Centre, which allows them to operate and remotely control 14 wide gauge locks from one central location in Châteauneuf-du-Rhône. Furthermore, CNR put in place an AIS (Automatic Identificiation System) on the Rhône. This system is based on an automatic geolocation system allowing boats fitted with it to find out the identity, status, position and route of the units in the navigation zone, by automatic exchanges of VHF radio messages. The AIS system is composed of three main parts, namely

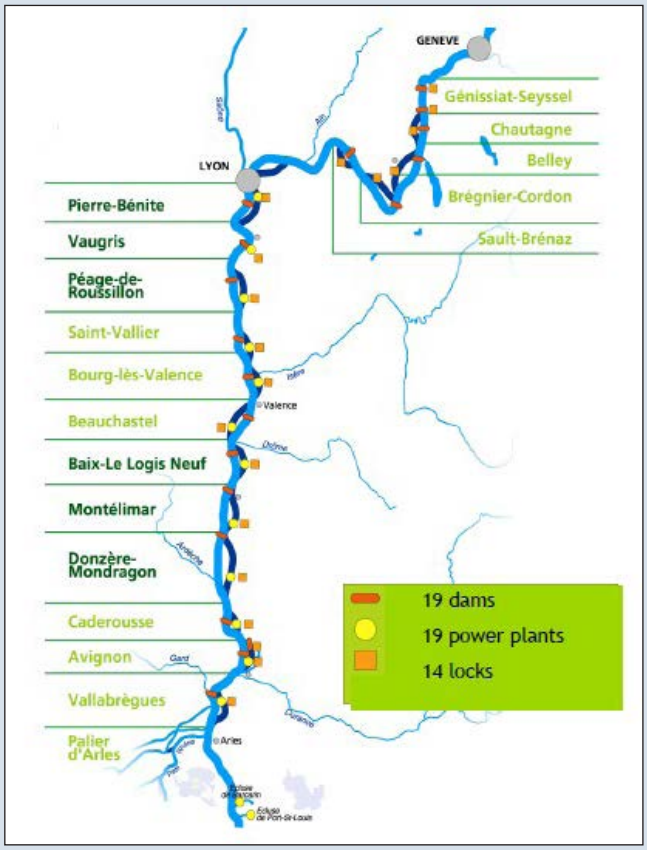
- VHF antennas over the length of the waterway
- VHF transponder + GPS equipment on board of the boats
- IT platform for collecting and managing data

To implement AIS, CNR placed the appropriate reception equipment in all 14 locks along the Rhône. The transmitted AIS data is used in the Rhône traffic management application (GTR) and allows the Management Centre to have the exact positioning of the traffic on the Rhône and estimated arrival of boats at the locks. Hence, CNR is able to improve the navigation management thanks to AIS by a perfect knowledge of the traffic on the Rhône.

Realized advantages and benefits

- Thanks to the Rhone Traffic Management Centre and implementation of AIS, CNR was able to improve the services towards the skippers, for example by extending the operating hours from 5am-9pm to a 24/7 service.
- This enables CNR to provide a permanent surveillance and monitoring along the navigable section of the Rhône and hence increase the safety of lock operators.
- The Traffic Management Centre makes it possible for CNR to quickly respond to crises (accidents, floods,…) and manage them in the appropriate way.
- Furthermore, CNR is able to give better information to the users of the Rhône by providing full information on traffic in real-time and optimizing the lock passages (less than 20 min).

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Sault-Brénaz
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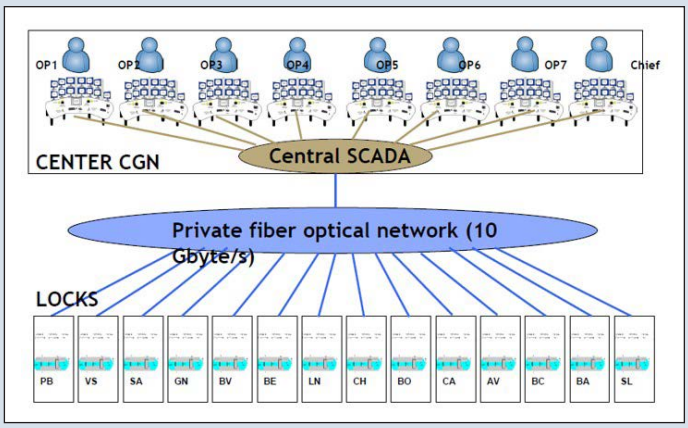
Pierre-Bénite
Vaugris
Péage-de-Roussillon
Saint-Vallier
Bourg-lès-Valence
Valence
Beauchastel
Baix-Le Logis Neuf
Montélimar
Donzère-Mondragon
Caderousse
Avignon
Vallabrègues
Palier d'Arles
Arles
19 dams
19 power plants
14 locks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Central SCADA
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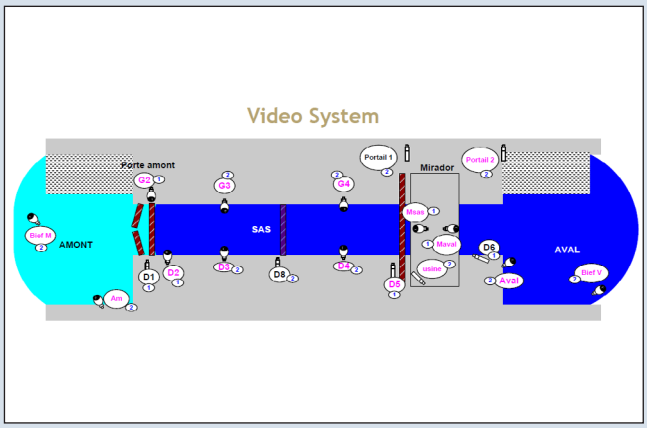
Video System
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Germany | German Federal Waterways and Shipping Administration

New Hannover lock operation centre (LOC)

Name project New Hannover lock operation centre (LOC)
Location Hannover City, Germany
Duration 2013-2019 Q4

Goal of the project

Designing and building of a new LOC that ensures safe and reliable operation of the connected locks by bundling of services and optimized personnel deployment.

Project summary

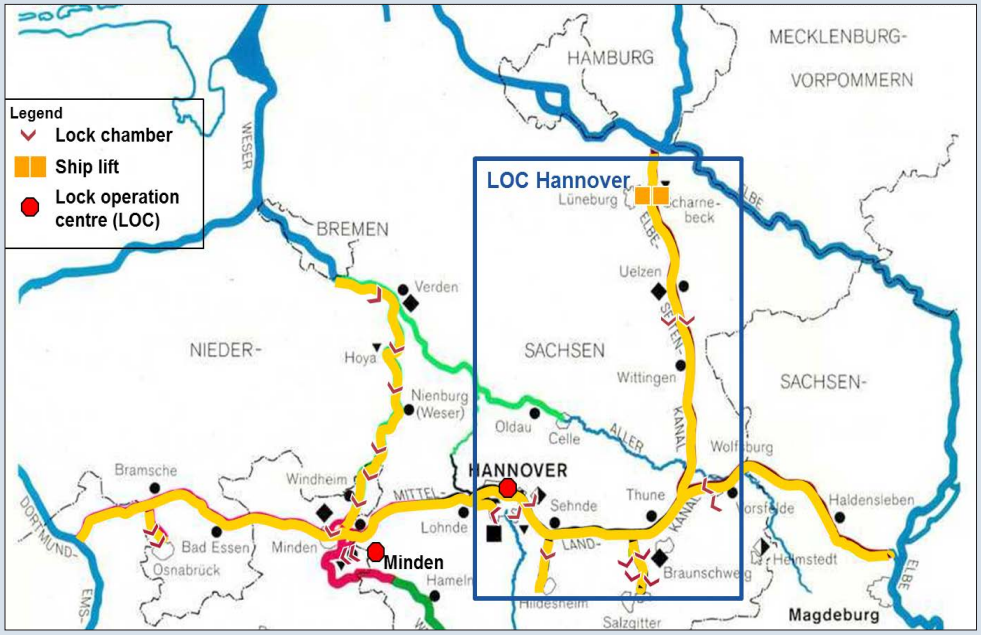
The new Hannover LOC will replace two operation centers that are currently located at two separate local lock control rooms. The technical equipment has been in operation since 2003, spare parts are no longer available. Under these two conditions, high availability of the locks operations can no longer be guaranteed. In addition the fulfillment of ergonomic standards such as space, workplaces, accessibility etc. can only be achieved with a new building. The project will also allow additional locks and pumping stations to be connected to the new center. The new building was preceded by an extensive preliminary investigation with the development of an automation concept including comprehensive redundancy considerations. The duration of failure shall not exceed 1 hour per year.

Major operational and technical elements of the project are:

- The new LOC will mainly serve 7 locks; however, in periods with light traffic e.g. night shifts, additional locks of neighbor Minden LOC will be operated by Hannover.
- Remote operation of Scharnebeck twin ship lift (Elbe Seiten canal) is prepared as an option in terms of technology and space required.
- 8 work stations with 16 standard operating desks will be used for lock operation, training and maintenance, 2 additional work desks are allocated for water management; reserve work desk for future extensions.
- Full redundancy due to two independent technical rooms in two fire compartments that will enable maintenance without restriction to operation.
- High available power supply with redundant UPS and generator ensure reliable operation.
- Energy-efficient cooling of the technology is provided by cold aisle containment.
- Reduced number of hardware components by realizing the concept of virtualization for major applications.
- The locks are connected with the LOC via a high available communication ring network using glass fiber optic cables. The communication network is operated by the Federal Waterways and Shipping Administration.

Realized advantages and benefits

It is anticipated that Hannover LOC will ensure safe and reliable remote operation of the connected structures.



Lessons learned

- During the design phase, it is necessary to consider the technology that exists or is to be implemented at the LOC, as well as the technology of the locks to be connected to the center.
- It helps and makes the system less complex if the hardware and software of the various structures is on a consistent level.
- It is also helpful to introduce a comprehensive IP address concept.
- Additionally, qualifying maintenance personnel at an early project stage will ensure reliable operation.

Germany | German Federal Waterways and Shipping Administration

Lock management service trials

Name project Lock management service trials
Location Danube River in the south of Germany, close to the Austrian border
Duration /

Goal of the project

Optimizing occupancy of locks and reduce waiting times for ships by the introduction of lock management service.

Project summary

At the Danube River lock management service tests are currently carried out to optimize the occupation of locks that are remote operated by Regensburg lock operation center and to reduce waiting times for ships. AIS data transmitted by on-board devices, e.g. position, speed, size and type are the basis for the optimization process. A lock management application is processing the current configuration and condition for every lock, ship and convoy in the lock chain to the optimization application. The optimization algorithm, based on a heuristic method, calculates the locking times for all convoys and ships, focusing on the determination of the best overall voyage time. Several additional conditions are considered, e.g. to avoid an accumulation of waiting times for a single convoy or ship. The calculation of traffic data result in a RTA (Requested Time of Arrival) that can be transmitted to the skippers via VHF radio communication or by an AIS specific messages. The figure gives an example for organized and unorganized traffic. Personnel of the lock operation center have been involved in the development of the requirements.

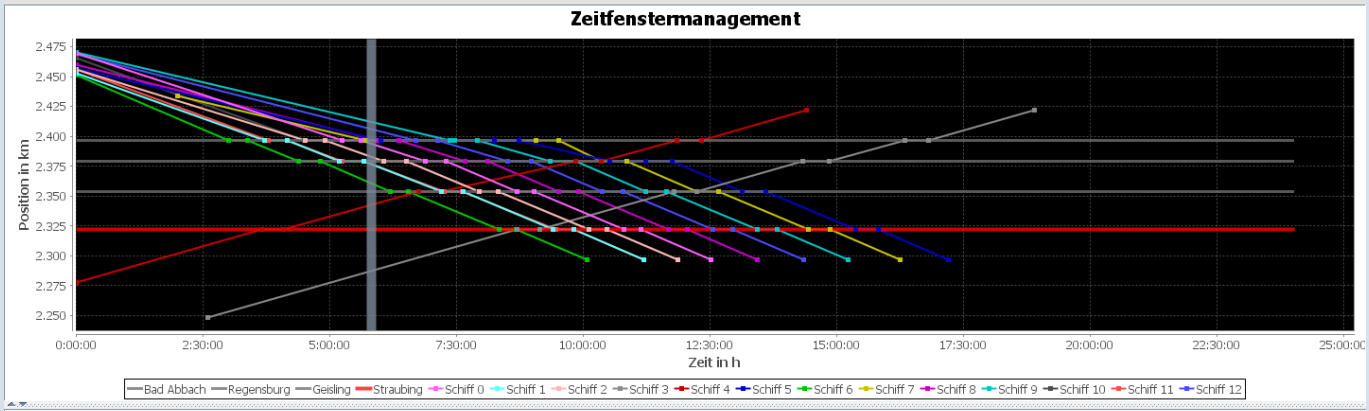
Realized advantages and benefits

- It is anticipated that successful lock management means both optimum occupancy of locks and reduction of waiting times for ships. It helps to make shipping and operation of locks more efficient.
- The integration of Inland AIS data facilitates realistic traffic information, for the lock operator as well as for the electronic lock diary and the planning software.

Lessons learned

- For a reliable lock planning in a lock chain the early information on the upcoming journey is required, e. g. next destination, any stop-overs and breaks.
- For use at different waterways the lock management service has to be adapted to special requirements of these waterways and their locks, e. g. waterways with branch junctions and confluences, locks with a separable lock chamber (middle gate) etc.
- On waterways with high traffic load, deviation from the “first come-first served”-principle may be required. Work is needed to convince shipping in order to get acceptance.

Datei Simulation Einfügen



Übersicht | Ansicht Schichtleiter | Ansicht Kapitän | Ergebnis Optimierung

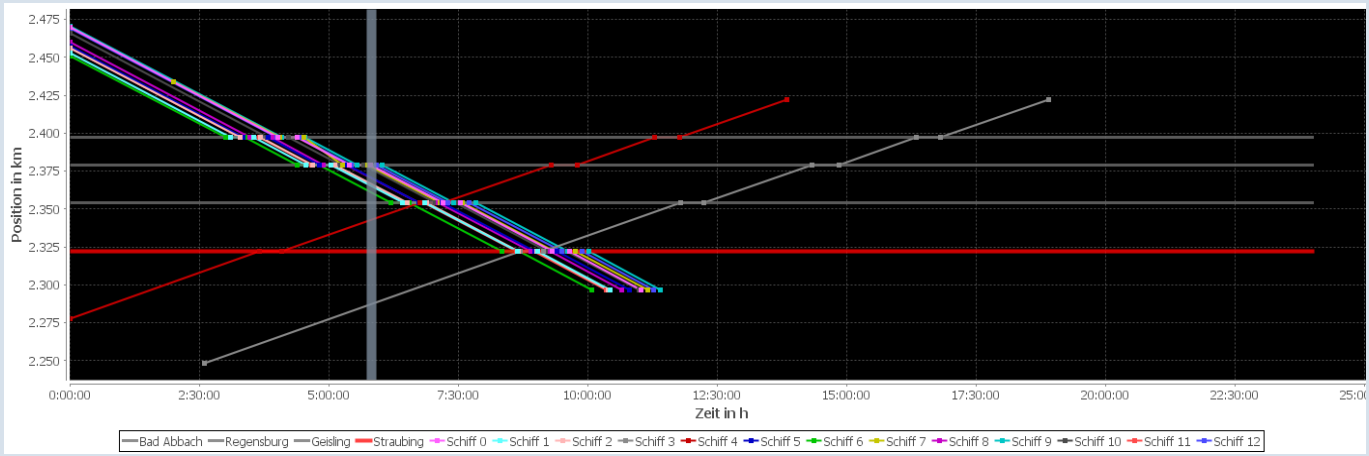
Schiffe

Name	Startsituation	Länge (m)	Rüstzeit (min)	Wartezeit (h)	Reisezeit (h)	Wartezeit Op...	Reisezeit Opt ...	Veränderung (h)
Schiff 0	Fahrt	180	0:02:17	0:00:00	11:02:28	0:00:00	12:31:57	+1:29:29
Schiff 1	Fahrt	82	0:07:05	0:00:00	10:26:07	0:00:00	11:12:22	+0:46:15
Schiff 2	Fahrt	98	0:03:51	0:00:00	10:24:22	0:00:00	11:52:07	+1:27:45
Schiff 3	Fahrt	85	0:08:23	0:00:00	18:54:23	0:00:00	18:54:23	+- 0
Schiff 4	Fahrt	97	0:08:16	0:00:00	13:51:23	0:00:00	14:25:01	+0:33:37
Schiff 5	Fahrt	138	0:08:59	0:00:00	10:48:25	2:55:31	17:12:35	+6:24:10
Schiff 6	Fahrt	95	0:03:10	0:00:00	10:04:33	0:00:00	10:04:33	+- 0
Schiff 7	Fahrt	132	0:07:13	0:00:00	11:09:22	3:21:24	16:15:24	+5:06:02
Schiff 8	Fahrt	144	0:04:43	0:00:00	10:39:43	0:00:00	13:26:32	+2:46:48
Schiff 9	Fahrt	139	0:06:44	0:00:00	11:24:30	0:05:58	15:13:37	+3:49:07
Schiff 10	Fahrt	89	0:04:48	0:00:00	10:59:34	0:00:00	11:52:10	+0:52:35
Schiff 11	Fahrt	93	0:03:06	0:00:00	10:21:10	0:00:00	11:12:19	+0:51:08
Schiff 12	Fahrt	134	0:06:19	0:00:00	11:16:52	0:00:00	14:21:03	+3:04:11

Wartezeit Durchschnitt (h)	Reisezeit Durchschnitt (h)	Wartezeit Opt Durchschnitt (h)	Reisezeit Opt Durchschnitt (h)
0:00:00	11:38:41	0:29:27	13:44:09

Schleussen

Name	Position (km)	Schleussdau...	Länge (m)
Bad Abbach	2397	0:20:00	190
Regensburg	2379	0:22:30	190
Geisling	2354	0:18:20	230
Straubing	2322	0:17:30	230



Germany | German Federal Waterways and Shipping Administration

Automation Concept for the New Ship Lift Niederfinow

Name project Automation Concept for the New Ship Lift Niederfinow
Location Niederfinow, Germany
Duration 2006 - 2020 (estimated)

Goal of the project

The project aims to ensure safe and reliable operation of the new ship lift of all automated components by using a virtual planning model (VR model) for the development and testing of the automation concept that includes the PLC (Programmable Logical Control) application software and the surface of the SCADA system (visualization).

Project summary

The new ship lift in Niederfinow will replace the existing one, which was in operation for more than 70 years. Due to the large number of safety-relevant elements to be monitored and controlled, new modern tools and methods have been used for developing and testing of the technical automation concept. State of the art PLC controllers, sensors and actuator systems connected by a safety bus system have to ensure reliable operation. The complex requirements make it necessary not only to test the PLC application software itself but also the interfaces between the different devices and the complete automation process of the ship lift. A virtual planning model (VR model) was implemented for developing and testing the automation software in order to reduce the risk of malfunctions.

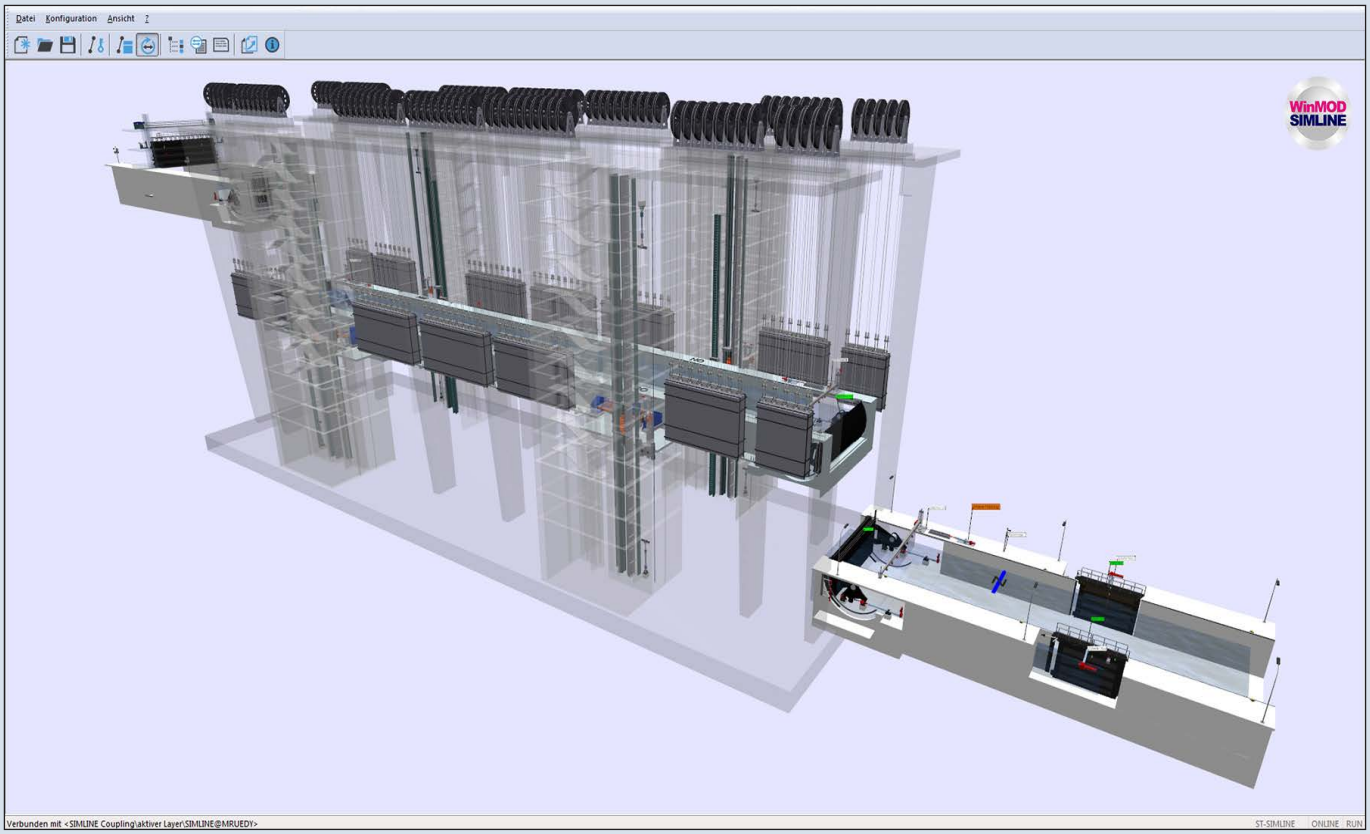
Starting in 2006 the project includes the following steps:

- the virtual reality planning model (VR model)
- the PLC control structure and bus system
- the necessary safety functions (e.g. safety stop)
- the functionality of the PLC application software
- the needed control operating levels
- the design of the standard surface of the SCADA system

The results were later adopted to the created tender documents for the implementation by different contractors. Currently, parts of the PLC software are tested and simulated in the VR model, reviewing not only the regular processes. During this software test phase it is also important to test the behavior and the response of the PLC software or the PLC itself on malfunctions of different origins like sensor or actuator errors.

Realized advantages and benefits

- While testing the PLC application software in the VR model, software errors are identified and fixed without any impact on the real ship lift.
- An additional advantage of the VR model is that the operators can be trained before working in the operation center of the real ship lift to reduce incorrect operations.



Lessons learned

- During the test phase of the PLC application software in the VR model the software was improved as well.
- It is also considered that in the future the whole PLC-structure of the ship lift will be duplicated in the remaining test environment to optimize the control process without interfering ongoing real operation.
- In case a future PLC generation will occur, the VR model can be used for testing before running on the real ship lift.

3B
Building block

Name project 3B Building block
Location The Netherlands
Duration /

Goal of the project
Rijkswaterstaat will start working with standard systems when operating (Bedienen), managing (Besturen) and monitoring (Bewaken) bridges. This 3B Building block will be used to operate, manage and monitor bridges in a uniform manner.

Project summary
The development of the 3B Building block stems from a refinement of the I-Strategy of Rijkswaterstaat which mainly focusses on the standardisation of information services and the standardisation of industrial automation as well as implementing this in a sustainable way in the organisation and processes. The first step in standardizing the operation, management and monitoring of bridges is defining building blocks which encompass the entire chain, ranging from operating moveable components to the signaling of locks and bridges. The development of the 3B Building block must result in a standardized system, consisting of different modules. As a result the Building block becomes exchangeable and configurable and thus applicable for the complete Rijkswaterstaat.

A first pilot program will be established for the renovation of the Wantijbrug (Dordrecht) and Van Brienenoordbrug (Rotterdam). If it turns out the Building block is reusable, it will be applied for the remaining bridges of Rijkswaterstaat.

Realized advantages and benefits
The 3B Building block presents numerous advantages to Rijkswaterstaat such as:
- Cost-saving measures on Industrial Automation- design, realization and testing processes;
- Efficient approach towards generic problems in projects;
- Cost-saving measures on management and maintenance;
- Less disturbance for waterway users;
- Increased agility of Rijkswaterstaat in implementing changes in the future.

Lessons learned
- Before rolling out the standardized Building blocks to the entire firm, it is advisable to test it thoroughly in real-world applications to see if the Building blocks work as designed.
- The entire process should be documented. This documentation is what will be used for the roll-out strategy and could serve as a basis for training manuals.
- More lessons learned to come after finalization of the project.

Operation centre for movable bridges and navigation locks in Lelystad

Name project Operation Center for movable bridges and navigation locks
Client Rijkswaterstaat
Location Lelystad, Flevoland (The Netherlands)
Duration March 2013 - May 2014

Goal of the project

Realization of a marine traffic center in Lelystad and implement remote control of existing bridges and navigation locks in the province Flevoland.

Project summary

Witteveen+Bos carried out a project where an operation center was installed in the Flevoland province office building. From this operation center, five bridges and ten locks in Flevoland are remotely controlled. There are eight operator desks available, but the number of operators depends on the season and number of expected ships.

From one desk two random objects can be selected and remotely controlled. A software interlocking system prevents operating of two objects on the same time. When an object is selected the emergency stop buttons on the desk are connected to the selected object and the software of a safety PLC guards the proper emergency stop functionality. The connections for data and CCTV images between the operation center, bridges and navigation lock is performed by dark fibers, hired from a service provider. The remote control system is connected to existing local control and command systems without carrying out major changes in the existing installations. On all bridges and navigation locks , CCTV camera's are added to provide images for safe operation. The contractor designed a clear and uniform interface between the remote control system and the existing control system by using a safety PLC's.
Part of the contract was also a automated operational marine traffic management system. Ships are announcing their arrival by phone, local push button or radio. All requests are collected in an ordered list presented on the operator screen. The operator can select the bridge or navigation lock to operate.

Realized advantages and benefits

- Reduced the number of operators.
- Enhanced service through extended opening times.
- Enhanced working conditions operators especially during the quiet winter period.

Lessons learned

- Perform local onsite sight measurements to determine the exact position of cameras, perform 3D-moddeling of the design (new designs) and consult operators in a early stage of the project.
- Pan-Tilt-Zoom camera's are used to obtain maximum flexibility and redundancy, however the privacy of the nearby residents should be taken into account. This point can be resolved by installing (expensive) cameras with built-in privacy masking software and to involve residents during commissioning of the cameras. Therefore, use of PTZ cameras should be minimized and fixed camera's are preferred.
- To obtain a reliable and safe operation performed by different operators a uniform easy to understand interface is necessary.
- Existing command and control systems must be tested on safety issues and adjusted accordingly before connecting to a remote control system.
- More attention should be paid to the social aspects of the operators in order to facilitate the transition of working alone to working as part of a team.
- The contractor should be held responsible for all necessary changes on the existing installation related to remote control and CE-marking. Available health and safety reports and risk assessments can help to define the scope of work in the contract.

Overhaul and implementation of remote control Vlaardingerdriesluis

Name project Overhaul and implementation of remote control Vlaardingerdriesluis
Client Rijkswaterstaat
Location Vlaardingen (The Netherlands)
Duration August 2015 - April 2016

Goal of the project

Realization of a reliable and safe remote controlled navigation lock.

Project summary

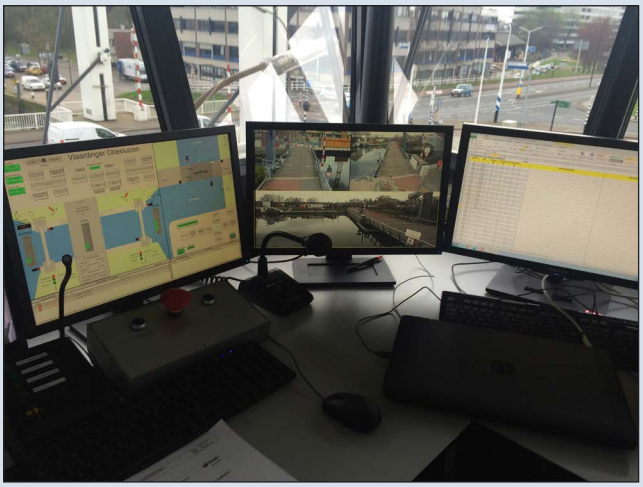
The present Vlaardinger Driesluis navigation lock was built in 1960 and has a monumental status. From the year 1639 water management constructions on this location are known. In 1999 the electrical installation of the navigation lock has been renewed and equipped with a fully automated control system for self-service operation. Ship detection was performed by laser scanners. During the years of operation the laser scanners, emergency stop system and the self-service appeared to be sensitive for operational failures resulting in unreliable operation. During time safety regulations changed and the level of safety was not acceptable anymore. To obtain a reliable and safe operation the navigation lock has been mechanically overhauled and electrically renewed including the automation system. Self-operation is changed into remote operation with CCTV observation from an existing control room of a nearby navigation lock and movable bridge (about 1 km distance). To comply with the EU machinery directive a ISO 12100 risk assessment has been carried out and a functional safety plan according IEC-62061 has been made to identify safety functions.

Realized advantages and benefits

- Less operational failures
- High safety level
- Higher level of reliability and availability
- CCTV camera's for remote control reduces vandalism

Lessons learned

- Health and safety reports of the existing installation should be part of the contract.
- The contractor should be held responsible for all necessary changes on the existing installation related to remote control and CE-marking. Available health and safety reports and risk assessments can help to define the scope of work in the contract.



Remote operation of mechanised bridges

Name project	Remote operation of mechanised bridges
Client/developer	Canal & River Trust
Location	Gloucester & Sharpness canal (United Kingdom)
Duration	October 2015 - present

Goal of the project
Improvements to customer service and reduced staffing costs.

Project summary
The Trust currently has 14 mechanised bridges on the Gloucester & Sharpness canal that are operated by staff for the use of boaters. Manning of these bridges is not only costly but has a number of negative impacts on customer service. This project has looked at new technologies that will improve both customer experience alongside reducing costs to the Trust.

A solution has been developed that will transform the navigation experience through an innovative design which offers a primary method of 'Self Service' remote operation to boaters. As a boater approaches a bridge, a previously downloaded software app on their smart device will automatically detect where they are within a Trust 'Self Service Zone' for a particular bridge. The app will ask if they wish to operate the structure ahead. A simple one touch request on their 'smart device' will operate the structure giving updates on the sequence of operation and instructions to wait and proceed as appropriate.

There will be no requirement for the boaters to leave their boat. The app will be secure and boaters will need to register with specified details before downloading it. A number of strategically installed lasers on the bridge deck and canal within the bridge operating zone together with existing safety systems and interlocks will ensure safe and reliable operation.

A bridge control room will have oversight of all bridge status and activity through SCADA (Supervisory Control & Data Acquisition) and CCTV systems. The control room will also act as a single point of contact for boaters and bridge users.

Realized advantages and benefits
- Significant cost savings of up to £500,000 which can be spent on improvements to the canals.
- Re-deployment and upskilling of current bridge operating staff
- Extended navigation hours will boost canal businesses and the local economy
- Improved road safety and traffic control
- Control center provides a new single point of contact for highways, emergency services, road and canal users
- Improved safety (less responsibility on untrained operators)
- Faster bridge openings
- Instant detection and diagnosis of most faults
- Increases surveillance and security around bridges and roads (CCTV records 24/7)
- Restricts boat licence evasion (only licence-holders can use the app)

Lessons learned

- When the operating strategy is changed, it is essential to consider a thorough consultation period with all stakeholders, such as local businesses and authorities, boat and road users and emergency services.
- Additional road layout improvements and restricted bridge opening times around peak road traffic hours have resulted in reductions in traffic congestion. To overcome the road users concerns detailed operating protocols were developed to define the operating strategies. Once the road users understood the operational protocols their opposition lessened.
- Significant investigation, risk assessments and extensive trails were undertaken to evaluate best practices in the UK and Europe and to evaluate if the designed reliability had been achieved.

Houma Navigation Canal Lock Complex

Name project Houma Navigation Canal Lock Complex
Location Houma, Louisiana (United States of America)
Duration January 2016 - December 2021

Goal of the project

To provide hurricane protection for Houma and the surrounding area, to reduce salinity in Houma Navigation Channel, and to distribute freshwater in the Terrebonne Basin.

Project summary

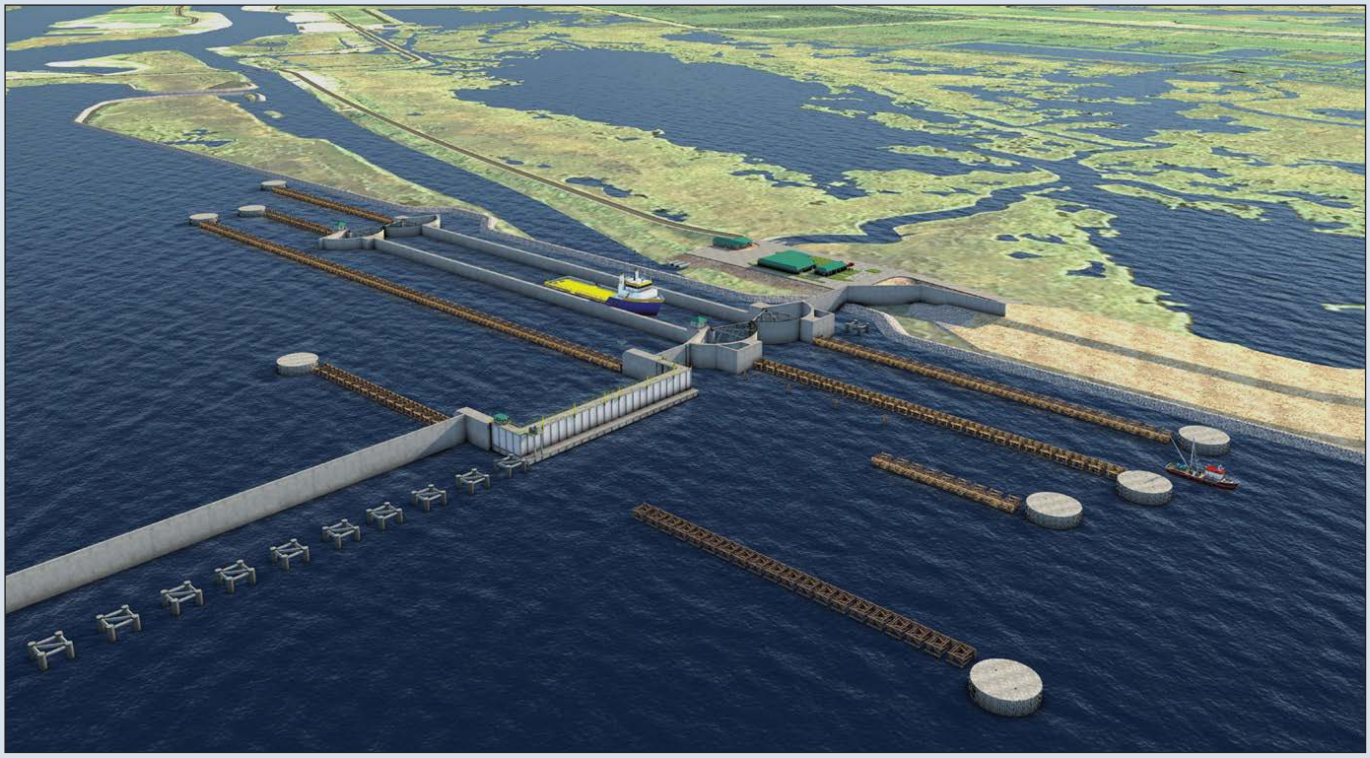
The Houma Navigation Canal (HNC) Lock Project is a large-scale, long term protection and restoration feature recommended for implementation in Louisiana's Comprehensive Mater Plan for a Sustainable Coast approved by the Louisiana Stat Legislature. The project includes a new 110-foot wide by 800-foot long lock, either a refurbished or replacement 250-foot wide barge gate, and adjacent floodwalls that will tie into the existing levees. Project features will be constructed to a 100-year annual exceedance probability elevation and design life and will adhere to the Hurricane and Storm Damage Risk Reduction System (HSDRRS) design standards.

The new lock will be operated remotely from the control building with a PLC system connected via a ring topology Ethernet communication system. The barge gate will be operated locally. All lock and barge data (lock gates and barge gate positions, lock gate hydraulic pressure units (HPU's) operations, barge gate pumping operations, etc.) will be monitored from the control building. There will also be lock environmental data such as water levels, temperature, and speed and direction sent back to the levee offices located approximately 15 km away. The site will include a closed circuited television (CCTV) and DVR systems for video monitoring and recording. Data storage will be available over a one month cycled period. Fire detection and protection includes a fire detection systems and fire pumps located at the lock.

Control room design will be similar as done in other countries with remote voice and data communications, remote video monitoring, remote environment condition monitoring, and remote fire detection monitoring. Remote ship traffic will not be monitored.

Realized advantages and benefits

- Future benefits include hurricane protection for Houma and the surrounding area,
- Reduced salinity in Houma Navigation Channel,
- Additional freshwater in the Terrebonne Basin.



Grays Landing Remote Operations of Locks Demonstration

Name project Grays Landing Remote Operations of Locks Demonstration
Client US Army Corps of Engineers
Location Fayette County, Commonwealth of Pennsylvania (United States of America)
Duration January 2017 - January 2020

Goal of the project

The project aims to demonstrate the viability of remote lock operations on a large scale commercial waterway within the inland navigation system.

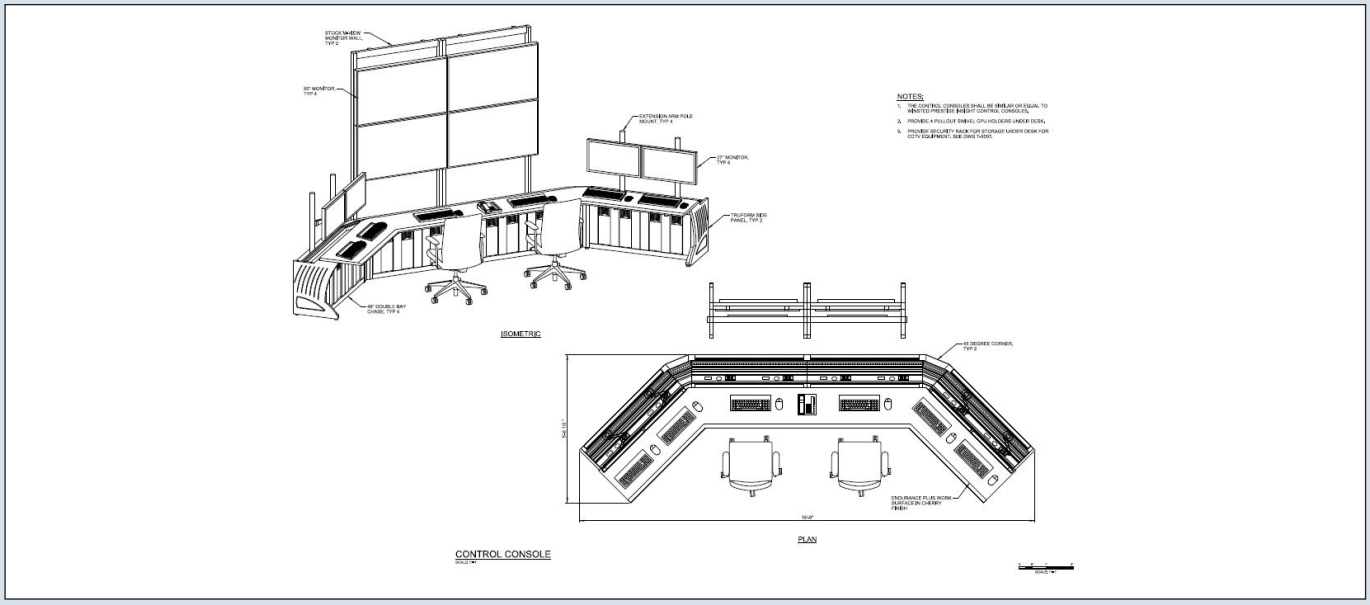
Project summary

The Grays Landing Remote Operation of Locks Demonstration Project consists of the design and implementation of a remote operations system installed on Grays Landing Lock and Dam on the upper Monongahela River. This project is an initiative by the U.S. Army Corps of Engineers to automate lock operations. This demonstration project will be the first remotely operated lock in the United States, and is intended to be a proof of concept of remote operations which could then be adopted on waterways across the nation.

The remote operation and control of Gray's Landing Lock will be accomplished in two sequential phases. Phase 1 will consist of remotely controlling the lock from a location onsite that is out of view from the lock. During the initial demonstration phase and proof of concept, operational adjustments will be performed to enhance the operating experience for an operator. Phase 2 will consist of remotely controlling the lock from an offsite location such as Point Marion Lock and Dam located 9 miles upstream of the project location. Additionally, structural health monitoring technology will be leveraged to ensure that sensors applied to remote operations dual purpose to improve routine and non-routine maintenance planning by continually reading and analyzing the performance of the structure. This structural health monitoring is a collaborative effort between the Pittsburgh district, the Engineer Research and Design Center (ERDC), Construction Engineering Research laboratory (CERL), and the Inland Navigation Design Center (INDC).

Realized advantages and benefits

- Automating and remotely operating locks will allow one set of operators in a central location to operate multiple facilities, this should be true wherever a lock isn't being used to capacity. Thus, base operations costs can be reduced without negatively affecting industry's ability to efficiently transit the inland navigation system.
- Reduced operation costs allow more funding flexibility for capital reinvestment and maintenance.
- Consolidated staffing also allows for extended operating hours at lower use facilities that were previously closed during times of low demand, a positive net benefit for industry and recreation users. This economy of scale continues to become more important as operations costs increase and river traffic decreases.



Lessons learned

- Due to the large number of sensors associated with remote operations, this project leveraged those sensors for dual purposes and is also piloting a project to utilize the collected data for analysis of the structural health of the system while operating in a remote capacity. This effort has the potential to allow lock personnel to conduct targeted maintenance in advance of failures.
- Remotely operated locks have higher lifecycle maintenance costs associated with software and electrical components compared to traditional lock operating machinery. The intent of remote operations is to save in personnel costs, however the lifecycle maintenance costs are a concern.

Notes

Notes

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